International Experiences with Public Finance for Renewable Energy

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1 Barriers to RE

The barriers to the penetration of renewable energy sources consist of cost disadvantages, uncertainties related to the properties of RE-resources, power system interface issues and newcomer disadvantages.

The *financial cost per MWh of output* of most RE-technologies is higher than the cost of conventional sources of energy supply. The exceptions are mature technologies at resource rich locations near centers of demand, e.g. small hydropower with high capacity factors at sites located near distribution grids, and RE-technologies for specific, local applications such as bagasse based power plants at sugar factories, solar PV for telecommunications or for off-grid electricity supply to isolated households. The incremental financial of RE-systems cost makes the penetration of RE-systems dependent on support schemes and thus, on political preferences that can change.

The preparation of utility scale RE-power involves *high costs of transactions* and long lead times. Securing land rights, resource rights, construction permits, environmental permits, etc. can be a very time consuming process, giving RE project-preparation the reputation of "lasting forever". A small hydropower project may need to secure 40 to 60 permits from different public authorities and agencies.

Price distortions on the bulk power market caused by *subsidized prices for fossil fuel* consumption of thermal power plants - fuels consumed at power plants are typically priced below their net-back value as export product in fossil fuel-exporting developing countries - and by *import duties & VAT on RE-components* – whereas components and fuels for thermal power production are exonerated from import duty and VAT - introduce artificial cost bias against RE.

The *capital intensity* of RE-systems makes the implementation of new projects dependent on efficient national financial markets and vulnerable to high costs of finance. Weak capital markets introduce a bias on the free market in favor of investments in fossil fuel based technologies. Because RETs are more capital intensive than conventional power technologies, high interest rates- high nominal interest rates in inflation prone economies deter investments even if real interest rates at the time of project preparation are low - short maturities and low gearing ratios[1] shift the financial price per kWh of RE upwards relative to conventional power. Absolute dearth of loan or equity capital may prevent potential RE-projects from even trying to reach financial closure.

Resource dependency leads to substantial variations in annual output from windfarms and hydropower plants that need to be taken into account in financial planning and structuring. Security of fuel supply poses an absolute risk for dendro-power plants during the operating phase. Developers of geothermal power projects must invest considerable financial resources upfront in substantiating the existence of resources of a size making it feasible for a plant to be developed. Yet, even during operation unexpected drops in the flow rate can take place.

RE-power projects can face two different types of *off-take risks*. The credit-worthiness of a RE-plant with a long-term PPA is not higher than the credit worthiness of the off-taker, which can be undermined by a regulatory regime, which fails to protect the financial viability of the utilities. A generous feed-in tariff can be subject to downward retroactive changes in its level.

The *intermittency of RE-power supply*, in particular from wind energy, adds incremental costs to the power system in the form of back-up power, spinning reserves and control systems that lead system operators to resist the penetration of RE-generation. In addition, intermittency makes system operators and regulators

[1] In many developing countries, banks ask for a 50% equity co-finance

reluctant to recognize the capacity contribution of intermittent renewable technologies such as wind and solar in heir planning process; and thus to attribute any financial value to intermittent capacity.

The *interface between transmission and distribution grid planning* on the one side *and RE-project preparation and implementation* on the other side is problematic in several countries. Wind farms stand idle because the connection line to be build by a utility has not been constructed yet or incur low capacity factors because of grid downtimes as required investments in grid reinforcement were not carried out.[2] Disputes over the calculation of the total cost of connection (including 'deep connection costs' for system reinforcement) and the allocation of payments for these costs between project developers and grid owners and operators need to be settled by the national regulator. Yet, it is a subject where regulatory economics do not provide clear cut answers as to the right methodologies and payment principles.

In some countries, *power market rules* are designed to secure new capacity on short to medium contracts and do not enable long-term supply contracts; no premium is given to contracts offering long-term price certainty. Thus, the portfolio value of including RE-supply in the power mix is not taken into account.

In countries involved in the incipient stages of RE-development, RE-projects face multiple *newcomer handicaps:* new RE- technologies lack an established track record, shortages in specialized skills as an efficient national supply chain for RE-technology has not yet been build up, standardised financial products specific for the RE&EE industry are not being offered by finance institutions, and there is uncertainty about how new promotion laws and market regulations will be interpreted in practice. This increases investors' risk perception of RE-projects, and thus, their cost of capital. In a country with a small potential market size for a specific technology these handicaps impose a very high cost penalty per future MWh of generated energy.

Yet, RE has strong credentials as well. In the long run RE-based energy supply is the most important CO_2-mitigation tool. From a strictly national energy policy point of view, the benefits of RE-energy supply relate to the portfolio advantage of more diversified energy supply, reduced reliance on imported fuels and industrial policy benefits in the form of productive employment creation.

[2] China in July 2011 set provincial quotas for wind energy generation in an effort to ease pressure on the power grids. As of the end of March 2011, the amount of inactive power from wind in the country totaled almost 25% of total installed capacity. Source: Bloomberg Energy Finance. Week in Review, July 26, 2011

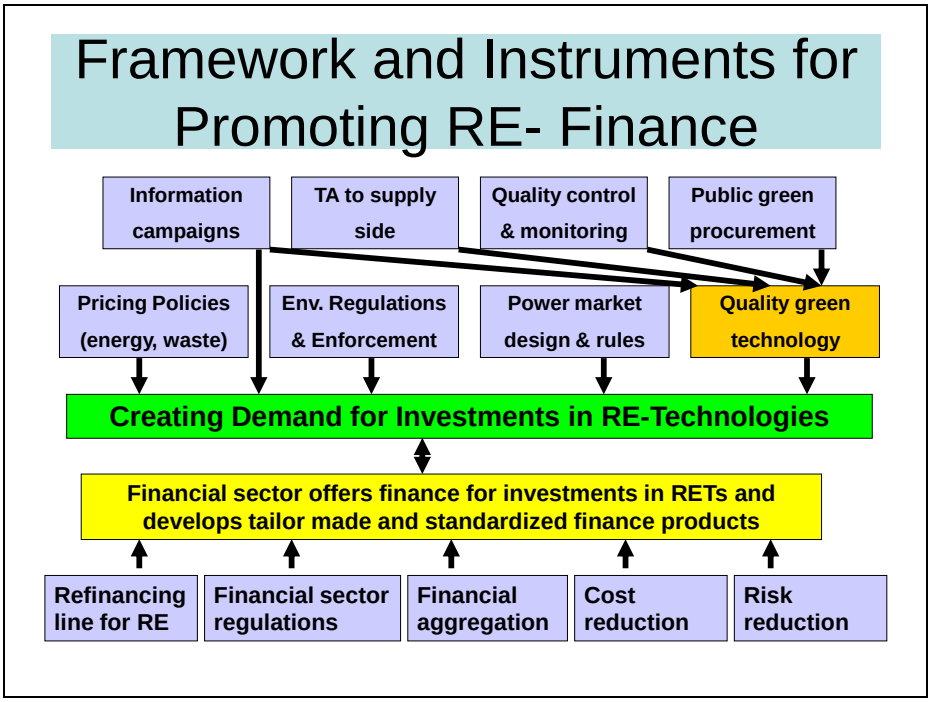
2 Government's role in promoting RE

2.1 Generic Framework for RE

A supporting framework for RE is composed of two inter-linked pillars:

1. *RE-policy instruments* composed of *(i) incremental cost covering* subsidies that bridge the gap between economic and financial viability of promoted RE-technologies, thereby making otherwise financially unviable energy investments commercially attractive; and (ii) *a market expanding regulatory framework*, which reduces risks, keeps down the costs of projects transactions, and gives supply from RE priority access to the power market and (ii).
2. *Public finance instruments* that enable RE-projects to access commercial finance - equity and long-term debt finance - in sufficient quantities and at market-competitive terms and prices.

Due to the interlocked nature of the obstacles to market development, effective frameworks to promote environment finance are complex, consisting of packages of complementary and mutually reinforcing instruments. Although framework conditions vary from one country to another, the contours of a policy framework for promoting RE-finance can be established, which is generally applicable. The Chart below groups government interventions by three major categories of instruments: "demand pull", "technology supply" and "finance push" instruments.[3] Al three are needed for RE-promotion to succeed.



Source: authors

The '*demand pull'* instruments include incremental cost finance instruments - support schemes that enable RE-technologies to become financially viable on the national energy markets - power market rules that facilitate the entry of RE and environmental regulations and enforcement that increase the cost of fossil fuel based energy.

[3] The framework is applicable for clean energy in general, that is, also for the promotion of EE.

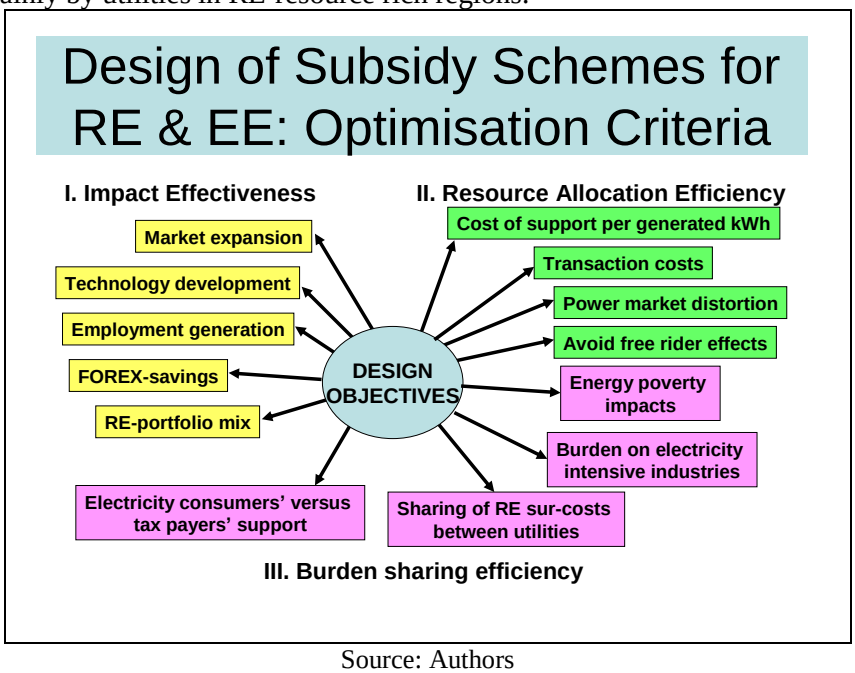
The objective of the '*technology supply'* instruments is to improve the economic-financial competitiveness of RE by reducing the cost and improving the quality of the RE-supply chain. Instruments include information campaigns to create consumer awareness[4], TA to actors in the supply chain, monitoring and quality control of supply, public procurement policies for clean energy technologies and, in countries with 'green industrial growth' ambitions, RE-supply chain development and cluster policies.

Whether commercially viable RE-investments succeed in attracting finance is a separate issue, calling for public intervention during the initial market build-up phases in the form of '*finance push instruments'*. Their aim is to increase the supply of private finance by providing liquidity for RE-finance and reducing investor risks and bank transaction costs. Instruments comprise refinancing lines, financial sector regulations that facilitate RE-finance, assistance in establishing non-conventional financing channels, public co-financing of project preparation and due diligence costs and sharing of lending risks.

2.2 Optimisation criteria for incremental cost support

Incremental cost support is a subsidy. Subsidy schemes must fulfill several policy objectives. The relevant design criteria for a subsidy scheme, detailed in the chart below, are:

- *Impact effectiveness*: the scheme must lead to a significant expansion of the market, to cost reductions in RE, provide portfolio benefits in terms of risk reduction and generate employment and foreign exchange earnings/savings.
- *Finance efficiency*: planners do not want to over-compensate investors, create big distortions on the market (e.g. by giving RE-generators too many exemptions from the general rules of the power market) or set up a system that imposes high administrative costs on recipients and on the public administrator of the scheme.
- *Burden sharing efficiency*: the schemes should not impose a heavy burden on low-income households or on energy intensive industries that are subject to fierce foreign competition nor lead to unwanted redistribution of income between firms and social groups, nor should the incremental cost be born mainly by utilities in RE-resource rich regions.



Source: Authors

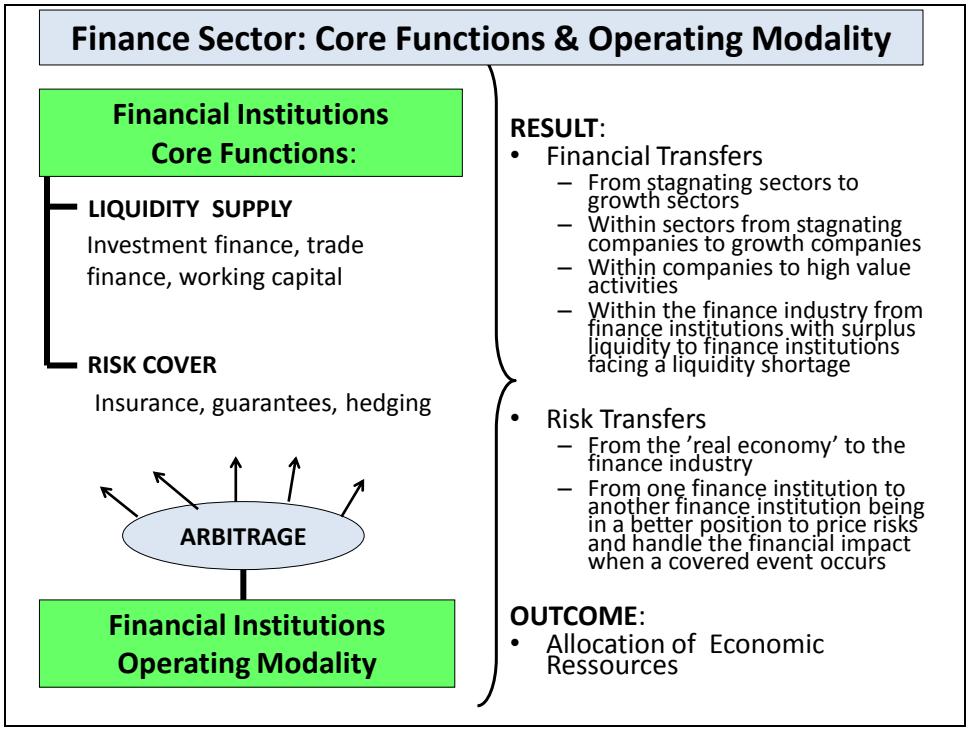
[4] The aim of some measures is to give consumers confidence in the products and advisory services, overcoming the problem of asymmetric information between suppliers and consumers of clean technology. These are partly demand pull, partly technology supply instruments.

2.3 Instruments for leveraging private finance

Public finance instruments in the context of green energy finance refer to instruments that seek to eliminate barriers in the finance sector that prevent commercially viable RE-projects from accessing private equity and debt finance in sufficient quantities and on acceptable terms.

2.3.1 Basic functions of the finance industry: liquidity and risk cover

Public interventions to attract private investment finance to the RE sector seek to affect the direction of existing flows of private finance. What this entails can be explained with the help of the chart below.



Source: Author

The chart provides a basic model of the finance industry stripped of non-essentials. The financial sector has two core functions: to satisfy investor demands for liquidity and for risk cover. It does so by exploiting arbitrage opportunities: transferring finance from people with money to invest to people wanting to invest, providing insurance cover from institutions having the financial strength to do so to investors incapable of surviving financially if a catastrophe occurs, etc. In an efficient finance and economic system, the transfer of financial resources through the finance industry leads to an optimal allocation of economic resources in an economy.

The objective of public finance interventions, to direct flows of private finance towards the RE-sector can thus be promoted in two ways. One is to through *instruments providing liquidity*: debt and equity capital in forms and on terms not sufficiently available on the market. The other is through *risk sharing instruments* that improve the risk-return profile of RE-loans and equity investments as seen by the finance providers; and therefore, the risk-weighted profitability of providing finance to a RE-project. Such finance facilities may be supported by grant financed technical support to participating finance institutions and by grant funds for project preparation and due diligence reviews.

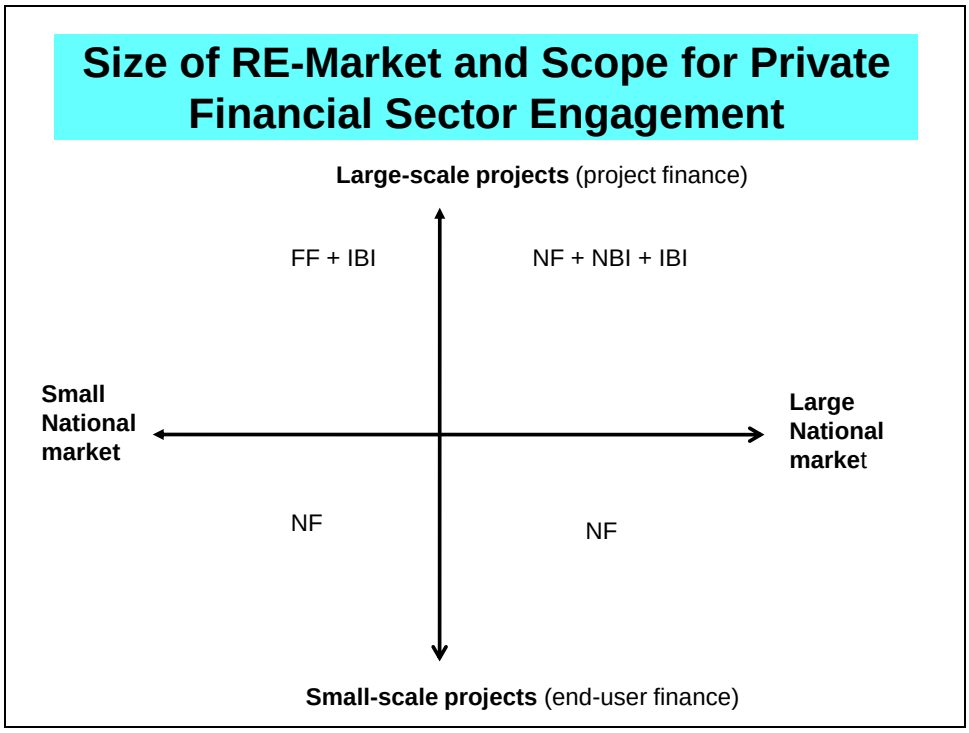
The use of a public finance instrument is subject to two caveats: (i) that it *does not replace private capital*, out-competing private finance that otherwise would have been made available and (ii) that the intervention

supports the transformative goal of enabling the private investor and finance community to undertake RE-finance on its own, without continued support from public finance instruments. The challenge is to use the public finance instruments in a way that triggers the greatest amount of private funding for the smallest amount of public funds, whilst still attaining the politically defined RE-penetration targets.

2.3.2 Size of RE-market and scope for financial sector engagement

The scope for financial sector transformation depends on the potential size of the RE-market: the finance sector must be able to see a large potential market to be motivated to engage resources in the development of finance products specifically for RE-investments. Large potential market size, also gets more local entrepreneurs to engage in RE-project development and in creating a technical-commercial supply chain for RE. The chart below illustrates that the sources of private capital that are targeted by public finance programs depend on two parameters: the size of the national market and the size of the individual RE-projects.

- The implementation of a large project - say a 200 MW windfarm/geothermal plant - in a country with a small potential market for follow-up investment projects will be too large for the local finance sector and local entrepreneurs to handle. The aim of public finance instruments is in this case to attract foreign investment capital: foreign developer equity, commercial bank loans. The transformative impact is limited to building local know-how in the operation and maintenance of the supported technology.
- The largest transformational impact can be achieved in countries with a large potential market for RE. China is the ultimate success story for obvious reasons: large RE market potential, strong national finance capacity and an internationally competitive RE supply chain combined to turn China into the leading "green growth economy". The initial role of foreign public finance was to kick-start this 'nationalization process': to overcome the newcomer disadvantage of initial low investment volumes and lack of familiarity in the business and developer community with technology and RE-market conditions.



FF: Foreign finance. NF: National Finance. IBI: International Bond Issue. NBI: National Bond Issue

In countries with large established RE-markets, the role of public finance instruments disappears or is reduced to niche applications: e.g. as tools to safeguard a continuity of investment efforts or to increase the speed of financial close in priority investments.

3 RE Policy Instruments for financing Incremental Costs

3.1 Finance Sources and Finance Targets

3.1.1 Matrix showing the portfolio of support instruments

The portfolio of financial support instruments to increase the market share of RE-generated electricity is summarized in the matrix below. The rows identifies *four potential financing sources* for subsidies to RE: (i) subsidies financed by the public budget, (ii) subsidies raised through electricity invoices, (iii) subsidized export credits for RETs and soft loans from development banks, (iv) payments for greenhouse gas reductions from use of RE. The columns point out *three potential subsidy targets*: (i) subsidies to investments, (ii) subsidies to output, (iii) subsidies to the cost of operation.

FINANCING SOURCES	SUBSIDY TARGETS		
	Cost of Investment	Price of Output	Operating Costs
Public Budget Finance Instruments (tax payer financed)	Investment grants Soft loans for investments VAT exemption Import duty exemption Accelerated depreciation Tax holidays on income Subsidies to exporters of RET-equipment Subsidies to R&D&D	Topping-up premiums to producers Production tax credit Topping-up premiums to consumers VAT/excise duty exemptions Public green electricity purchases	Subsidies to the marketing of green electricity
Electricity invoice financed instruments (rate payer financed)	Grid reinforcement (deep connection costs) paid by utilities Part of (shallow) connection costs paid by utilities R&D&D of power utilities on interfaces between windfarms and regional/national power system	Premium feed-in-tariffs for RET-electricity Renewable portfolio standards with or without RECs Tenders for a limited number of RE-technology specific long-term PPAs with regulated utilities Net/reverse metering Voluntary green consumer premium tariffs Eco-taxes on alternative fuels	Wheeling tariff below the true cost Balancing costs charged to consumers not to generators Use-of-system charges fixed below cost Subsidized administration of green invoicing
Greenhouse gas payments		CO2-certificates CER-/JI revenue/kWh	
Export credits to RETs	Soft loans for RE-investments Grants for project preparation		

Source: Authors

The ideal subsidy package depends on its political expediency and on the scope and the scale of potential RE-supply in the country. For different stages of the technology introduction cycle, a different package of subsidy instruments is needed.

- A 'tax payer pays' based strategy is useful in the short term to get a development process started for a specific, new RE-technology. They are used in end-user finance to promote stand-alone systems (eg solar home systems or solar water heaters) and to promote grid-connected RE in the R&D&D (research, development, demonstration) stages.
- The 'electricity consumer pays' strategy is the solution for the large scale commercialisation phase of a grid-based RE-technology.

Countries with ambitious RE-programs employ 'tax payer' as well as 'energy consumer pays' instruments Because RE-technologies are at different levels of innovation and commercial market maturity, countries. *Combinations of 'tax payer pays' and 'energy consumer pays' instruments* for RE-investments can also be used to serve special interests. The standard of living of low-income households is negatively affected by consumer-paid schemes; therefore, cofinancing of RE-support from the public budget can be used to relieve problems of energy poverty: households with limited ability to pay the monthly utility bills. Some Spanish Provinces added a premium to the feed-in-tariff if a certain percentage of total investment was locale sourced. In Navarra, Spain, wind power investors could deduct up to 15% of their earnings from wind power before handing in their tax returns, if they located a windfarm in the Province. In Denmark, a wind turbine owner does not have to pay taxes on the level of production, which equals his annual power consumption; this instrument was introduced to secure public backing for on-land windturbine investments by spreading their ownership base.

3.1.2 Shifting from investment subsidy to tariff support through mandated markets

For a grid-based RE-technology the typical evolution over time in its financial support is: (i) a shift from tax-paid to electricity consumer paid support; (ii) replacement of capital investment subsidy by support to the output of kWh; (iii) strong focus on the elimination of "over-compensation" and (iv) support which is more compatible with general power market rules, inter alia by charging RE-generators the full-cost of auxiliary services which RE-supply imposes on system operators.

A mandated market has three general features: (i) an obligation on transmission and distribution companies to connect RE-generation, (ii) an adequate tariff level with long-term power purchase agreement, and a right for commercial power suppliers to recover legally-imposed surplus RET-costs from consumers; and (iii) a national (or state) policy target for the penetration of RE on the market. Mandated market schemes for RE-systems fall into three main categories:

1. Feed-in tariffs.
2. Tendering mechanism: Bidding for long-term PPAs with the system operator / national transmission company or for the level of required feed-in-premium to be paid on top of the power market price.
3. Renewable Portfolio Standard: Tradable green certificates schemes, where electricity suppliers are obliged to supply a certain quota of renewable energy by investing in RE-generation or by buying RE-certificates from RE-generators.

In the feed-in-tariff schemes, policy makers fix the price, the market the resulting quantity of new RE power supply.

In tender schemes and tradable green certificate schemes, policy makers fix the desired quantity of new RE-power supply, the market establishes the price for the desired quantity.

The following sections will review first international experiences with investment grants and then review the experiences with the three types of mandated markets.

3.2 Investment subsidy

3.2.1 Support for the R&D&D stages of RE technology

Concerning financial support to the R&D&D stages of a RE-technology, expert and political opinion is divided between the relative merits of

- grants for specific technologies *versus*
- tax deductions for a more broadly defined range of technologies.

Proponents for the *technology specific grant approach* underline two merits. One is the ability to focus on technologies that reflect the ambitions in national RE-policy. The other is that the approach can target the creation of regional-national know-how clusters.

Proponents for *tax deductions* for more broadly defined technologies argue that they leave it to private entrepreneurs and creativity to identify the most promising technologies to focus on, whereas grant based programs for specified technologies entrust the capability to pick winners to public administrators.

3.2.2 Upfront investment grants and interest rate subsidies

The upfront investment subsidy is used mainly for two cases: (i) to support the initial development of a market for a new RE-technology; (ii) to support employment during the recession phases of a business cycle; and (iii) to the cover the incremental costs of renewable energy to demonstrate the potential RE technologies and set cost benchmarks, in the absent of mandated market policies

An example of the former is the *Australia's Photovoltaic Rebate Programme (PRVP)*.[5] The PRVP, which started in 2000, makes cash rebates available to householders, owners of community use buildings, display home builders and housing estate developers who install grid-connected or stand-alone photovoltaic systems. In 2007, PRVP provided a 'rebate' of AUD 8 per watt for solar PV systems with a maximum of AUD 8,000. That year's federal budget allocated AUD 300 million for PRVP.[6] The support was allocated on a first come basis. This type of scheme is of potential interest for emerging economies who want to take a step into the development of distributed generation without run-away costs for the public budget. However, the same result can be achieved also by a very stingy feed-in-tariff.

An example of the latter is the Chinese Government's *"Golden Sun Demonstration Project*" launched in July 2009 by the Ministry of Finance, Ministry of Science and the National Energy Board. . In 2009, the financial crisis caused a significant decline in the export market for PV products; the scheme provided a lifeline market outlet for small PV-manufacturers.[7] The scheme paid 50% of the investment for qualifying solar-power plants and transmission and distribution projects; for projects in remote regions not connected to the grid, the subsidy was 70%. However, in the midst of the "first come, first served" boom, businesses engaged in false bidding, and used low-quality products. A relatively high proportion of businesses – in order to boost the subsidies they received from government – declared their material costs to be higher than they actually were. That type of fraud risk is inherent in schemes that provide subsidies as a percent of the cost of

[5] Another example is the Chinese Government's Solar Roofs Plan, under which the standard subsidy from the Ministry of Finance was 20 yuan per watt.
[6] The budget was used also for a targeted scheme to support the design and installation of solar systems on commercial, industrial and iconic buildings; and to fund the training and accreditation of solar panel installers to meet the skills needs of the expanded program.
[7] Larger manufacturers participate as well for demonstration effect reasons.

investment. Enterprises contracted under the Golden Sun project did their utmost to keep prices down, and suppliers did not hesitate to take a loss in order to obtain orders. However, some suppliers allowed second-class components and defective stock to be absorbed within Golden Sun projects. The use of low-quality products meant that the conditions for receiving the subsidy were not being met.[8]

An investment subsidy can also be provided in the form of a *concessional loan*. A concessional loan is a hybrid between an incremental cost cover instrument (the NPV of the interest rate subsidy could have been given upfront as an investment grant through a deduction in loan principle[9]) and a public finance instrument (enabling financial close). The instruments is seen mainly in export-credits and in loans to stimulate end-consumer purchases of RE-technologies.

3.3 Investment tax credit vs production tax credit

3.3.1 Investment tax incentives

Investment tax incentives provide income tax deductions or credits for some portion of the capital investment made in a RE-project. Income *tax deductions* reduce taxable income, *tax credits* directly offset taxes due.

In particular two countries have relied heavily on tax-code based investment support for grid-connected RE: India and the USA.

During the 1990s, almost all windfarm investments in India were undertaken by private corporations who were attracted by two complementary instruments. One was accelerated depreciation, the ability to write off 50%/100% (depending on the date of putting in place the first foundations at the site) of their investment against their taxable profits of the period during which they make the investment. The other was 'wheeling' of power at a fixed low rate through the transmission and distribution grid from the site of generation to the site of power consumption at company owned plants.

Tax deductions and tax credits are economically attractive only to corporations with a sufficiently large taxable income. Yet, they have proven to be powerful instruments with regard to attracting and getting RE-capacity installed. Their record in terms of the real policy objective: electricity generation from RE, is less convincing. Because investment tax incentives reward the installation of renewable energy facilities, but not the production of electricity from those facilities, in California during the 1980s and in India during the 1990s, companies rushed to install wind turbines to capture the associated investment tax incentives, with little regard for choosing the best wind locations and the most efficient turbines. A significant fraction of installed windfarm capacity from those two periods represented mis-investment.

Several countries experimented with *income tax incentives* for customer-sited RE-systems, giving investors the right to tax deductions or to tax credits for a percentage of the cost of the RE-investment.

Property tax reductions can eliminate up to 100 percent of the property taxes on land and fixed assets used for RE-production facilities.

3.3.2 Production tax credits

In the USA the federal 10-year, production tax credit of 1.5 cents/kWh given to windfarms (geothermal energy and solar PV get similar tax credits) is similar to a feed-in-tariff premium in the sense that it is paid

[8] Source: Yuan Ying article March 2011, at **www.chinadialogue.net**

[9] In fact, although not seen by the eye of the loan taker, this mechanism is used in the structuring of socalled mixed credits, where a third party pays a commercial bank upfront the NPV of an interest rate reduction on a loan given to a RE-project.

separately from the price for power received by a RE-generator. But unlike RE-generators receiving a feed-in-premium, the RE-generator receiving a production tax credit need not sell the power output at market prices. Normally, the generator will be paid a favorable RE-tariff under a long-term PPA with a utility which needs to fulfill a RE-quota. The production tax credit can be characterized as an investment grant which is paid upfront over a ten-year period, but with the advantage that it encourages efficient production. It lowers the levelized life cycle cost of wind power by about 25 percent. The production tax credit is a means to share the incremental cost of green power (i) between tax payers and the power consumers and (ii) between the US population as a whole and the state population where the off-taking utility is located. But the volatility of the US production tax credit policies has negative impacts of sustainability growth of RE industries (when the congress approves PTC, RE grows; when congress disapprove PTC, RE growth stops). Continuity of the policy is essential for sustainable and healthy growth of RE industry.

3.3.3 Comparison of investment and production tax credit

Output-based incentives (production tax credit) are preferable to investment-based incentives (investment tax credit), as output incentives per kWh of power produced directly promote the desired outcome, which is to generate electricity from RE. The production tax credit focuses the mind of investors on maximizing output, the production tax credit on getting the investment implemented. In India, the policy during the 190s led to a series of investments in wind farms with very low capacity factors either because the wind resource quality had not been properly verified or because the local grid quality had not been checked before the investment in the wind farm.

3.4 Feed-in-tariffs

3.4.1 Feed-in-tariffs: design challenges and lessons learned

The term feed-in-tariff (FiT) is reserved for mandated market schemes where the level of the tariff for new RE-capacity is fixed by political decision. The tariff is assumed to reflect the full cost of the technology for private investors, including the market rate of return on investments with comparable risk profiles. Due to this, feed-in-tariffs are technology specific.

The *strong point* of the FiT as policy instrument are: (i) Its market penetration impact: Because technology specific feed-in-tariffs are fixed at a level that reflects the full cost of the technology for private investors, all potential project sites with generation costs equal to the feed-in-tariff could, in theory, be initiated in the year when the tariff comes into force. The market development potential of feed-in-tariffs is, therefore, very strong.. (ii) If properly designed, it is also very subsidy cost effective in terms of triggering RE-supply per dollar of incremental cost subsidy.

The *weak point* of the FiT is (i) the risk of run-away support costs because of stronger than expected market development, inter alia, caused of (ii) economic rents that are generated by declines in the market prices of RE-technologies that were not expected by policy makers when they fixed the FiT-levels.

The design of a feed-in-tariff poses a number of challenges:

- Which reference prices to use as benchmark for fixing the levels of the FiTs?
- How to keep demand expansion and associated support costs within manageable bounds?
- How to take ‘learning curve’ cost reductions into account to avoid over-compensation?
- How to reduce resource rents from the best sites to a minimum, whilst allowing a broad range of sites to be developed?
- How to make the FiT scheme as compatible with general power market rules as possible?
- How to handle the fuel element in FiTs for biomass power?

Reference prices for setting the level of a FiT. Three different reference prices are used as benchmark for setting the level of a FiT: (i) the estimated cost of generation per kWh of the supported RE-technology at a site with a typical RE-resource profile; (ii) the estimated avoided costs in conventional power supply per kWh of supplied RE-power; (iii) the cost per kWh of the average retail tariff.

Table 1: Reference Price and Cost Benchmarks for setting the level of a FiT

	Cost-of-RE-Technology based	**Avoided-cost based**	**Retail-tariff based**
Annual tariff/ revenue impacted by power market price during year	(Feed-in-premium)	Variable, power system cost dependent	Tariff expressed in percent of retail tariff Reverse metering
Fixed tariff throughout FiT payment period	Fixed FiT (but may have inflation adjustment of individual components, e.g. biomass fuel cost)	Fixed FiT, derived from hypothetical LRMC of power supply	FiT fixed with reference to retail tariff in base year multiplied by RE-technology specific factor

As reflected in the table, the benchmark price can be used either to fix the FiT for the FIT-period of a project (also here there are differences: some countries pay the FiT for a specified number of years, other for a specified quantity of GWh per installed MW capacity) or to fix the FiT, which is received during a specific year of the FiT period. The overall lessons of the FiT is that the chosen method must be as cost-reflective as possible. The approach applied in the Ukraine of fixing technology FiTs with reference to the retail tariffs in the base year when the FiT is fixed and multiplying it with some technology-specific factors (e.g. with 0.8 for one RET, and with 2.2 for another RET) it going to be very expensive for consumers! The US PURPA scheme of the late 1980s, which fixed the RE-tariffs according to a LRMC estimate of avoided costs of conventional power based on an assumption of fuel prices increases each year in real terms, proved to be far off the price path of the conventional fuels.

Risk of excessive market expansion. The strength of the FIT – its ability to expand the market faster than any alternative – is also its highest risk: the market expanding ability risks pushing up the annual support bill very fast and to levels beyond what politicians expected and what the public budget or consumers can afford. A fast expansion of RE power supply strains the adjustment capacity of the power system. Intermittent power increases the cost of system management, while distributed generation calls for investments in the reinforcement of distribution grids. The mounting bill for incremental cost support is a particularly serious issue for solar PV due to its high cost of generation per kWh[10] and the absence of a natural limit on demand expansion: PV systems can be installed on roof-tops and on open land and be installed without resource investigations soon after the decision to invest has been taken. The introduction of relatively generous (expected to give an 8% rate of return on investment) solar feed-in-tariffs in Germany led to such a massive expansion of demand that some 60% of new solar PV capacity world-wide was installed in Germany during the 2004-2006 period. The massive upward shift in world demand reversed the trend of steadily falling prices: PV-prices increased from 2004 to 2006 due to bottlenecks in supply. From 2007 to 2011, due to a massive expansion in supply capacity, in particular coming from China, the prices of installed PV-systems dropped about 60 per cent. As the downward adjustments in solar feed-in-tariffs did not match the

Tax-financed feed-in-tariffs. In Sri Lanka, an open-ended feed-in-tariff regime with technology specific tariffs was introduced in 2009. Two funds managed by the Sri Lanka Sustainable Energy Authority (SLSEA) are foreseen to finance the support needed to attract the private investments required for the realization of the national renewable energy and energy efficiency policy: the Sri Lanka Sustainable Energy Fund (SLSEF) and the Sustainable Energy Guarantee Fund (SEGF). A tax on oil imports is to be the main source of funding for the SLSEF. The SLSEF intended to finance the difference between the cost of the feed-in-tariffs received by RE-plants and the value of the financial savings from avoided thermal power costs by the national power utility CEB via transfers from the SLSEF to CEB. This was not a feasible arrangement: the stability of annual funding from an oil tax is not compatible with the large volatility in annual incremental costs from bursts in RE-investments and fluctuating fossil fuel prices. Furthermore, the compensation modality did not allow CEB to benefit from the portfolio value of RE-power: its price stability! Instead, the modality has the pro-cyclical effect of reinforcing the reduction in CEB's average cost of generated power when fossil fuel prices fall (the financial transfers from SLSEF would increase) and reinforce the increase in CEB's net financial costs of production, when fossil fuel prices increase (higher avoided costs reduce the financial transfers from SLSEF). The Ministry of Finance would probably have opposed the introduction of a tax with a pre-defined use of revenue

France's approach to limiting the demand for solar PV. Early 2010, France cut its solar subsidies by 24%. In December 2010, France introduced a four-month suspension on feed-in tariffs for new solar PV installations of more than 3kW capacity. The 13,000 projects with capacities greater than 3 kW had represented 70% of capacity installed during 2010. In February 2011, a decree announced a strict limitation on yearly installed capacity to 500 MW. The tariff for solar PV systems with a capacity of over 100 kW was reduced to €0.12/kWh, resulting in a cut-back of the tariff for open-space systems of 57% and for roof-top systems of 70%. Feed-in tariffs for small PV systems were reduced by 20%. To limit the number of installations, all rooftop projects greater than 100 kW but less than 250 kW have to respond to a simplified Request for Proposal (a call for tender). Winners are chosen on several non-price factors and receive the fixed fee-in-tariff. Solar PV projects greater than 250 kW are removed from the French feed-in tariff programme. Rooftop projects greater than 250 kW, and ground-mounted projects of any size have to respond to more conventional RFPs, where winners are picked based on price, environmental impact, innovation, and other factors. Source: Bloomberg Newsletters

[10] The Ontario feed-in-tariffs adopted in 2009 ranged from CAD 104/MWh) for landfill gas larger than 10MW to CAD 802/MWh for solar PV-projects smaller than 10kW.

downward cost development on the market, the windfall profits from investments caused an explosion in demand in Spain, Germany and Italy.

Keep demand expansion within manageable bounds. The policy instrument introduced to control the demand and associated support explosion caused by a FiT differed by country.

(i) The huge costs of support led in 2010 and 2011 Governments *to reduce the FiTs for PV-systems*, in some countries even several times per year. Yet, demand continued to increase: despite three tariff reductions during 2010, Germany installed a record 8GW of new capacity. Germany, then attempted to set a soft target (without hard annual quantity limits) of 3.5 GW per year, but using a price mechanism to limit demand as it progressed beyond the targeted installment level. *Germany reduces the solar FiT by a base rate of 9% each year plus by a variable percentage rate, depending on how much new generation capacity is installed during the year*: the FiT in 2011 and 2012 will be reduced by 3% if projected annual capacity additions, based on previous 3 months' installation, pass the 3.5 GW annual installation target plus a further 3% tariff reduction for every increment of 1 GW above the 3.5 target.

(ii) The demand led some governments to *cap the amount of supported annual capacity*. France introduced a strict annual limit of 500 MW for new PV-installations; see the text box. [11]

(iii) The Italian government has a target of about 2.5 GW a year in new PV-capacity, yet, 9 GW were installed in 2011. With the aim to stabilize the annual subsidy bill at 6.5 billion euros Italy's year 2012 renewable energy law, the fifth Conto Energia, introduces three measures to contain subsidies. *Cuts to the FiT:* for a 3kW rooftop PV installation from 27.4 to 23.7 eurocents/kWh, for a 200kW installation from 23.3 to 19.9 cents/kWh. An *annual installation* cap of between 2 and 3GW on PV installations, systems over 12kW must register with the government and are eligible for the FiT only when they fall within the limits of the cap. *Installations over 5MW are to be put through a competitive bidding process*.

Ontario Feed-in tariffs with domestic content requirement. Ontario's *Green Energy & Green Economy Act* from May 2009 introduced a feed-in-tariff for eligible projects. The Ontario Power Authority is responsible for implementing the programme. The feed-in tariff pays up to C$0.71/kWh over 20 years for roof-mounted solar photovoltaic (PV) systems, with lower payments for ground-mounted solar and for other RE technologies. The dual objective is to phase out coal-fired electricity generation by 2014 and to boost economic activity by creating new green industries and jobs. The feed-in tariff has domestic content requirements to ensure that much of the RE technology comes from Ontario. For solar PV projects larger than 10 kW, developers must ensure that 50% of goods and labour are made in Ontario; the level increases to 60% in 2011. ***Impacts:*** A *Green Energy Investment Agreement* in 2010 between the Ontario Government's and Samsung called for the company to build four manufacturing plants in Ontario, invest $7 billion in the province and develop 2.5GW of wind and solar electricity generation, roughly 10% of Ontario's total electricity production. The Ontario Power Authority received 956 applications in October 2009 for the first round of feed-in tariff contracts. 510 of these were accepted, ranging from 10 kW to 500 kW in capacity, with total generating capacity of 112 MW (projects under a 500 kW threshold can be connected to the grid without detailed impact assessments). By January 2011, a total of 4,106 FIT applications were filed for planned projects totalling 16,245MW of renewable power. Of these 1,263 resulted in executed contracts for 2,630MW.

(iv) Some governments *scrapped the feed-in-tariffs for certain categories of supported investments*;(e.g. for open-land PV-systems, while roof-top PV continued to be supported.

(v) Some countries dropped the open-ended feed-in-tariffs, replacing it by a *tender regime for FiTs*.

[11] France did not see the expected green job impact of its solar PV-program fulfilled, as Chinese modules captured the majority of the French market.

(vi) Spain, which financed a large part of the FiT through the public budget, scrapped all Fit-support to RE-generators in early 2012.

How to adjust FITs to the downward trend in RE costs: During the 1990s, neither Germany nor Denmark changed their feed-in-tariffs for new windfarms although the cost of production per kWh dropped steadily to a total of 40% by the end of the decade. This led Germany to the system of pre-announced pluri-annual digression of tariffs in which each year the tariff for new plants is reduced by a certain percentage based on empirically derived progress ratios and forecasts for the different technologies. It was expected that the digression system reduced the scope for investment bubbles caused by windfall profits. The failure of the approach in the case of solar PV led experts to declare the death of the feed-in-system. That is premature for three reasons.

- First, policy makers do not normally jump from one modality to another when the alternative has its own weaknesses; instead, they adjust a given modality in the light of experience.
- Secondly, the pluri-annual price forecasts based on learning-curve theory did not take into account the two factors of demand shocks (German PV-demand leading to supply bottlenecks from 2004 to 2006; Chinese demand for commodities pushing up prices for metals used in wind turbines, whilst a jump in international demand led to bottlenecks in the manufacturing of wind turbines) and supply shocks (the entry of Chinese PV-module manufacturers on the world market). Policy makers have learned the lesson: pricing formulas with fixed pluri-annual digression rates are out; tariff adjustments based on market monitoring are in.
- Thirdly, the volatility of prices caught policy makers off-mark. However, one must assume that the disequilibrium situation was a one-time event in its severity.[12]

How to minimizing economic rents arising from varied RE resources. The differences in wind resources and of water resources at potential hydropower sites in a country result in great differences in annual capacity factors of plants, which raises the issue of *resource rents*. Under a uniform feed-in-tariff regime, projects at the best sites would reap substantial economic rents. In practice these would be shared between the developers and the owners of the land at the sites, the latter receiving their share through increases in lease payments. To reduce the rents at the best sites, yet enable projects at less attractive sites to be developed also, several approaches are used. A simple approach is *to award the feed-in-tariff for a specific number of 'full-capacity hours of production", e.g. for the first 25,000 GWh per installed MW, after which the RE-power plant has to sell its power into the power pool at the lower market prices*. In this approach, RE-power plants with high capacity factors recuperate their investment faster than plants with lower capacity factors, but the life-time feed-in-tariff payments are the same. Another approach is *tariff rates that decline stepwise with the expected GWh-output per MW*. In Germany eligible projects are classified into three categories according to the quality of the wind resource at the project site. Windfarms located at sites having a "category 1" wind resource are paid the lowest tariff, which is valid during the first five years only. Projects at the other sites get their – higher - feed-in-tariff tariff until a defined GWh/MW production has been attained. Projects producing less than 60% of the "standard output" for a "category 3" wind resource site are not eligible for a subsidized feed-in-tariff at all. In the French system of differentiated tariffs based on resource intensity, wind turbines are paid €0.082/kWh for the first ten years of a 15-year contract. During the years 11 through 15, the tariff varies based on the productivity of the wind turbine. Wind turbines at windy sites are paid as little as €0.028/kWh, turbines at less windy sites are paid up to €0.082/kWh. In China, a NDRC regulation introduced in 2009 standardised feed-in tariffs for new onshore wind projects. The regulation divided the country into four wind energy zones, with prices ranging from RMB0.51/ kWh to

[12] In MENA-countries, the cost of investment per MW of new windfarms went up by two thirds from €0.9 million in 2003 to €1.5 million in 2005/06; in the US-market the price of orders for new wind turbines fell 20% from 2008 to 2010. The spot price for PV system modules fell by 50 percent from third quarter 2008 to 1rst quarter 2011 (As a rule of thumb, modules account for 50 percent of installed system cost.)

RMB0.61/kWh according to available wind resources and construction conditions at the specific locality.[13] The costs of the wind feed-in tariff programme above the cost of coal-fired generation are split between provincial grid operators and the central government.

The *declining rate feed-in-tariff can also be tailored to the tenor of loans* offered by banks on the national market, as done in Sri Lanka, see the text box.

Adjusting feed-in-tariffs or extending loan tenor? Sri Lanka has a well-designed system of technology specific feed-in-tariffs for RE-generation up to 10 MW. The modality puts high emphasis on reducing the economic rent by paying investors prices as close to their true cost of supply as possible. Developers have the choice between a fixed feed-in-tariff over 20 years, or a three tiered tariff, with a high tariff during the first 8 six years, a lower tariff for year 9-14 and a low tariff for years 15-20. The three-step tariff is to facilitate local financing of projects: commercial banks in Sri Lanka award loans with a tenure of up to six years only.

Biomass FIT needs to factor in fuel price volatility: The design of *feed-in-tariffs for biomass-based power* faces the challenge of how to adjust for changes in the price of biomass fuel over time? This is a particular problem for dendropower plants as these, unlike bagasse-based power, contract their biomass on a commercial basis from outside suppliers. The *feed-in-tariff for dendro-power* in Sri Lanka has a built-in inflation adjustment for fuelwood equal to two thirds of the rate of inflation. This is not realistic. The inflation-fuelwood price ratio is based on the behavior of the development in fuelwood prices for industrial consumers in past years, when fuelwood was a marginal fuel in energy supply. But if dendropower plants come on streams they will become a commercial fuel subject to a powerful demand pull on its prices from the high and increasing prices for oil; as a minimum, the fuelwood price component needs to follow the national rate of inflation. In China, the govt. had to adjust the biomass FIT upward several times to reflect the rising fuel cost.

FIT for small-scale RE development: Several countries apply *different modalities for small and large RE-generators*. The *UK* introduced in 2010 a feed-in tariff for projects with a maximum size of 5MW. Projects smaller than 50kW receive the feed-in tariff; projects between 50kW and 5MW can choose between support under the Renewables Obligation or the feed-in tariff modality. Plants larger than 5 MW can only be supported through the Renewables Obligation. *Italy* introduced in 2009 a 15 years feed-in tariff for RE-plants with capacities below 1 MW, for plants with capacities larger than 1 MW, the Tradable Green Certificates system continues to apply.

Promoting a national RE-technology industry. To justify the high cost of support to RE-electricity, Governments point to the employment advantages of a 'green economy'. To maximize the economic benefits from RE-investments, Governments complement seek to integrate RE policy with a RE industry promotion policy. Some countries add *bonuses on top of the normal feed-in-tariff to promote local green economic and new technology development*. In Italy, projects get a 10% bonus to the feed-in-tariff if 60% of the cost of modules and inverters is made by EU-based companies. In addition, the Italian regime seeks to promote technological innovations by offering extra-high feed-in-tariffs for PV-systems using (i) innovative PV material, (ii) glass PV surfaces, and (iii) concentrating solar power plants. Countries like Spain, China and India have successfully developed national RE manufacturing capacity making linking their RE-support schemes with domestic content requirements. However, whereas the employment goal must be pursued, there are limits to this policy, see the text box on the Ontario. In July 2011, Japan and the EU filed complaints in the WTO against Canada for inconsistency of the FiT with WTO obligations, because it provides subsidies contingent on the use of domestic goods. The impact of FiT support on electricity bills became an issue in Ontario elections and made regulators hesitant to approve FiT applications: less than one

[13] The prices set by the Wind Prices Notice do not differ substantially from the results of the fifth and last round of granted wind power concessions; while the pricing structure is similar to the on-grid prices which the NDRC had confirmed for provincially-approved projects.

fifths were approved by January 2011. This is a blow to the market expectations of manufacturers who had set up operations in response to the domestic content regulations. Furthermore, in 2011, the agreement with Samsung was renegotiated. Samsung got a one-year extension of the commercial operation date of its generation facilities to 2014, the government reduced the incentives payable to Samsung by about 75% from a projected $437 million to $110 million and requires three of the four manufacturing plants to be operational by the end of 2011.

3.4.2 Feed-in-Premiums

Once RE-power penetration reaches two-digit levels, policy makers and regulators seek to achieve a better harmonization between the terms offered to RE-generators and the power market rules and conditions in general than those offered by a feed-in-tariff. in favor of a *feed-in-premium* is fixed by policy makers. In this scheme, the RE-generators sell their electricity output into the power pool being paid the daily market prices for their output and receive separately a 'feed-in-premium' per sold kWh. Selling to the pool, RE-generators are subject to the same market requirements as fossil-fuel based generation. Intermittent supply from windfarms, for example, must contract balancing energy to compensate for shortfalls in predicted supply.

Slovenia is an example of a country applying a mixed scheme: generation plants with a capacity up to 5MW are supported through a feed-in tariff; larger plants are paid a feed-in premium on top of the market price.

To what extent the system exposes RE-generators to the full risk of the variation in power market depends on the design of the scheme.

- In Denmark onshore wind turbines connected to the grid after February 20 2008 receive a *fixed feed-in premium* of 0.25 DKK/kWh (33.6€/MWh) for 22,000 full load hours. In addition, 2.3 øre/kWh are paid to compensate for their expenses for balancing costs for twenty years. Near-coast off-shore wind turbines get the same. Some states in India and Thailand apply a fixed premium policy as well.
- In 2012, an amendment to the German Renewable Energy Sources Act (EEG) introduced a market premium as an option for RE-generators. RE producers who market their electricity themselves – according to the supply and demand of the market – rather than receiving fixed tariffs to feed into the grid - can claim the premium. It is calculated as the *difference between the EEG feed-in tariff and the monthly ex-post average price at the energy exchange and includes a management fee*.
- The Netherlands applies a *sliding premium*, where the premium is a function of the average electricity price. This system keeps the total support cost for consumers at a lower level than a fixed premium.
- The UK intends to gradually replace its Renewables Obligation Certificate scheme with a 'Contracts for difference' (CfD) scheme, under which the RE-generators receive a top-up on the wholesale price of electricity. *The CfD guarantees generators a strike price for their electricity*, the level of which depends on the RE-technology. The top-up is added to the day-ahead wholesale electricity price for intermittent sources, such as wind, and on the year-ahead electricity price for dispatchable sources, such as biomass-fired power plants. If wholesale prices soar above the strike price, generators will have to give up some of their revenues.
- Spain applies a *cap and floor system*, where the latter acts as a bottom limit for the overall compensation, to compensate falling electricity prices.

The purpose of the feed-in-premium is to turn producers of RE electricity into market players who optimize production according to market prices. The exposure of RE-generation to the market prices of electricity acts as an incentive for a higher demand orientation of RE generation: the premium adds value to production which meets the energy demands of the system rather than just producing energy according to weather conditions. The ability of intermittent supply from windfarms and PV-plants to react to changes in demand conditions is limited. Yet, RE-generators can provide better supply estimates (with the help of weather forecasts), find least cost arrangements for the contracting of balancing power and for finding the appropriate

economic balance between investing in energy storage and the contracting of back-up power. For the integration of large RE shares into an electricity system such efficiency improvements gain importance.

3.5 Tenders for PPA-contracts or for feed-in-premiums

3.5.1 Tenders for long-term PPAs

Tenders for long-term PPA contracts for RE-power are organized either by national/state regulators to fulfill national targets for new RE-supply or by utilities/power suppliers who operate under a RE-portfolio scheme which is not organized as a green certificate scheme.[14] Tenders for power supply are also called reverse auctions[15]. The PPA-tariff fixed in an auction is equal to a feed-in-tariff in the sense that a fixed favorable green tariff is paid and that the supply of RE electricity enjoys preferential market access. But unlike a feed-in-tariff, its level is not fixed by political fiat.

California's Renewable Auction Mechanism for setting feed-in-tariffs. As a means to encourage mid-sized RE development, the California Public Utilities Commission (CPUC) issued in August 2010 a proposal establishing a 1 GW pilot program for power from RE systems in the 1 to 20 MW size range. The program requires Pacific Gas & Electric, hold biannual competitive auctions for feed-in-tariffs into which RE developers can bid. Utilities must award contracts starting with the lowest cost viable project, moving up in price until the megawatt requirement is reached for that round. The state had difficulty developing enough transmission to serve large-scale projects. This program encourages immediate activity for RE projects that can be incorporated into existing utility distribution infrastructure. Source: Bill Opalka 'Feed-in Tariff Advances, Renewable Biz Daily, August 27, 2010.

The normal procedure is to organise *technology-specific* procurement auctions. Often a tender includes a call for supply from several specified RE-technologies, each with a target quantity. In such cases one will typically see that the amount of contracted biomass and small hydro falls below the expectations of the organizers, whereas more wind capacity gets attracted than originally targeted. RE-projects that are easier to prepare and implement within the supply deadlines fixed in the tenders have a higher achievement rate than more complex projects..

Technology neutral auctions are also seen, where a RE-volume is tendered with the projects offering the lowest tariffs being awarded the contracts irrespective of which RE-technology is being used.

The tender documents fix either the called for quantity of power supply or the total subsidy amount which is available. In the first case the winning price bids will determine the financial cost of the tendered quantity. In the second case, the bids will establish how many MWh can be bought with the price support. [16]

Procurement auctions are *open-ended*: bidders identify the project sites for their projects. *Concession tenders* are for the *development of the RE-resource at an identified specific site;* the bids are for the concession to develop the site and get

Tenders and size of projects. A regulation from China's National Development Reform Committee (NDRC), which went into force on January 2006, provided that electricity prices for wind projects should be determined by tender. In practice, a two-tier pricing mechanism developed. Projects over 50 MW required approval by the NDRC, for these pricing was set through tendering. For a project below 50 MW, the provincial counterpart of the NDRC determined the pricing based on the production costs of the project and then submitted the price to the NDRC for final endorsement.

[15] Because it is the buyer of a product who organises the auction, not the seller as in a conventional auction.
[16] Source: Bauer & Barroso: Electricity Auctions and Overview of Efficient Practices, ESMAP, 2011

the long-term power supply contract for the output from the project.

In Brazil, where the acquired power is fed into the power pool at the contracted price, the green PPAs raise the average pool price. The increase in the pool price is subject to a politically fixed maximum: the average price of energy for end consumers can increase only up to a cap of 0.5% per year and 5% in total during the 20-years period.

The tender procedure has three *natural advantages*:

(i) If completed successfully, a tender provides the amount of new RE-generation targeted by policy makers; there is no risk of run-away-support costs.

(ii) The tariff is established by market forces, it involves no qualified guessing by the authorities as to what levels of feed-in-tariffs are required to provide a targeted quantity.

(iii) It controls economic rents. Tendering is effective at reducing costs. Competition will lead to only projects from the lowest cost resource sites having a chance to win contracts in a given tender round. The average capacity factor of winning projects in initial rounds will be high and decrease in later rounds as the best resource sites have been progressively developed.[17]

The tender regime has a number of *risks and weaknesses* not found in feed-in-tariff regimes.

- The sector attracts newcomers with less experience than utilities to the market; low bids from these lead to projects not being implemented when developers realize that their bid prices are below their costs of production.[18]
- The stop-and-go nature of tenders is not conductive to the stable conditions needed to develop a quality national supply chain.[19]
- Because the tender procedure enables only the least-cost projects to be implemented during early years, they lead to a high concentration of projects in the regions with the best RE-resources. For windfarms this is a problem: it leads to resistance by the local population in wind-resource rich area against the implementation of new projects.
- Due to the high costs of transactions of tenders and the economies of scale of larger plant size, only major players are attracted; the tender scheme is not the way to go if policy makers want to get small projects developed also.

In some countries, therefore, the tender mechanism has not been successful. The UK's NFFO and China's RE-tenders all failed to lead to substantial amount of RE generation, as many winning bids did not materialize.

Yet, adjustments can be made in the tender modality to address such weaknesses.

- In Brazil's auctions, developers are required to put up 10% of the investment as assurance against the non-implementation of their projects, facing penalties if they fail to supply the promised power.
- Green industry ambitions can be taken into account by organizing tenders for very large quantities that include minimum local content conditions; the scale of the investment provides the winning consortium with an initial guaranteed market for the output of a manufacturing plant it sets up.
- To avoid over-concentration, region-specific tenders can be organized.
- To enable small scale projects, some states carried out auctions specifically for small-sized plants – see the text box example on California – others introduce open-ended feed-in tariffs for small scale plants whilst keeping larger plants within their quota or tender system.

[17] The average capacity factor of the winning bids for Brazil's auctions for power from windfarms in December 2009 and August 2010 is around 45%.

[18] Of the 2.1GW of wind power purchase agreements offered by Brazil in its 2009 and 2010 tender processes, about 670MW are rated high risk from a deployment perspective, as they offer expected equity returns of less than 10% according to BNEF. Source: …

[19] The Irish and British RE-tenders during the 1990s brought little in terms of manufacturing capacity.

Supporters of the tender regime insist that the competition for access to a limited number of PPAs drives the tariffs down to lower levels than under an open-ended feed-in-tariff regime. To some extent that is correct. But, first of all, it depends on the existence of effective competition. Brazil's December 2009 auction to contract wind power for delivery in 2012 saw 13,000 MW of wind projects registering for the auction, where only some 1,800 MW of capacity were contracted. The average energy price of 77 US$/ MWh was 21% below the initial auction price. A tender scheme operating under quasi-monopoly conditions will not generate such low prices. Secondly, one must be aware that the costs of transactions associated with tenders are reflected in the bid-prices. Therefore, the reductions per MWh contracted RE-power resulting from tenders will be modest in practice. It is highest when there is a high information asymmetry between the developer's and the authorities' knowledge about the costs of production: those of a windfarm at an identified site can be estimated almost as well by outside experts as by the developer; for a complex hydropower sites requiring in-depth studies, the information asymmetry is more acute.

3.5.2 Tenders for kWh-premium payments

The Netherlands in 2010 announced their first tender for offshore wind energy of a capacity of 700 MW. The award of the contract will go to the *bidder asking for the lowest kWh-premium* (financed from the annual state budget) to be paid on top of the conventional tariff (paid over electricity bills). In CA, reversed auction adopted similar approach – bidding for the lowest subsidy…

3.6 Renewable Portfolio Standards

3.6.1 Tradable green certificate' schemes to fix RE-premiums

Tradable green certificate schemes impose on either electricity generators or on electricity suppliers the obligation to procure a certain percentage of their electricity supply from RE-resources. The RE-quato expressed as a percentage of total supply increases year-on-year. Under the scheme RE-suppliers sell power on the bulk market and green certificates to suppliers in need of fulfilling a RE-quota or to certificate traders.

The UK introduced its *tradable green certificate scheme* called the Renewables Obligation in 2002. The scheme imposes RE-quotas on the suppliers of electricity to consumers: a 6.7% obligation in 2007, 7.9% in 2008, 9.1% per cent in 2009, to reach the RE-penetration target of 10% in 2010. Socalled Renewables Obligation Certificates (ROCs) are issued per RE-generated MWh to generators. Suppliers of electricity must at the end of the year hand in an amount of certificates equal to the required RE-percentage of their MWh sales to consumers. If the number of certificates is insufficient, a fine is paid. The fine per missing certificate puts a cap on the price that certificates can fetch on the market. The RE-generators sign separate contracts for the sales of their power and for sales of their green certificates either with the same off-taker or in separate sales. .

When the first quota schemes were introduced, they were hailed as the ultimate market-based instrument - the state creates the regulatory conditions for support, but not the terms of the support: in the UK system, the state establishes the lifetime of the ROC-system – until 2034 – but not the length of the RC sales contracts signed between RE-generators and suppliers, nor their price, nor the price paid for electricity. [20] Therefore, due to the supposed superior ability of market forces to establish the right prices, they were assumed to be capable of delivering RE at the lowest *financial costs to electricity consumers*.

[20] A RE-generator in the UK system is guaranteed ROC-payments during a 20 years' period. The annual price received for the ROCs is determined by the demand-supply situation on the market. During the 2002 to 2010 period the ROC prices fluctuated between £39-54 per MWh, the average price was £45. The average price for electricity on the British bulk power market in 2010 was £42 per MWh. Source: Deloitte: 'Analyse vedrørende fremme af konkurrence ved etablering af store havvindmølleparker i Danmark', 2011

That naïve assumption overlooked the transaction costs imposed by the scheme on the cost of investment and the impact of price/revenue uncertainty on the cost of capital for RE-projects. Countries switching from a feed-in-tariff regime to a green certificate scheme, e.g. Sweden, experienced that the price of the certificates was higher than the green premium which was implicitly provided under the previous feed-in-tariff scheme.

The quota scheme offers several *advantages*.

(i) The gradual, incremental penetration path prevents investment bubbles with their associated costs for consumers or the public budget.

(ii) The path provides a clear quantified target for the medium-term penetration of RE on the market.

(iii) The scheme has, in theory, a lower risk of over-compensation than a feed-in-tariff scheme: in well-functioning markets, falling prices for RE-technologies lead to lower market prices for new certificates.

(iv) It allows an equal spread of the cost burden of national RE-penetration targets in Federal States. Distribution companies in states with lower than average RE-resource potential can purchase certificates issued to RE-generators located in states with high than average RE-resource potential. This was the key motivation for the introduction of India's certificate scheme.

The certificate scheme has *some weaknesses*.

(i) It tends to favour least-cost RE technologies and established industry players unless separate technology targets or tenders are in place. It cannot easily handle the simultaneous promotion of multiple technologies, above all the introduction of new technologies still being in the higher-cost end of their development. The mechanism to promote a range of RE-technologies with different costs of production per kWh is rather awkward. In the UK higher cost RE-technologies are awarded more certificates per generated MWh than lower-cost RE-technologies: between 0.25 and 2.

(ii) It lacks price certainty. As a result, countries with FIT policies tend to have lower RE tariffs than those with RPS policies.

(iii) The complexity and high administrative costs of the scheme make it inadequate for small projects. The UK, therefore, introduced in 2010 a feed-in tariff for projects with a maximum size of 5MW; other plants continue to be supported through its Renewables Obligation.

(iv) It requires an efficient and flexible supply chain and adequate high-quality RE-resources to function properly: the mechanism is inefficient when only a limited number of RE-projects are ready for development.

(v) It must have a reasonably large RE-market to provide the liquidity necessary for efficient price formation of the certificates. Denmark looked at the green certificate option in the early 2000s. But despite a priori strong political interest, it was dropped: the Danish market was too small, inter alia, because the landbased windfarm potential was close to being fully exploited.

3.6.2 Renewable portfolio standard (RPS) with negotiated supply

Directly negotiated PPAs between utilities subject to a RPS and individual RE-projects are feasible in some US-states. But they are subject to regulatory approval to ensure that the price is reasonable and does not impose an undue burden on consumers.

Chile adopted in March 2008 a RPS scheme, which went into force in 2010. The RPS is imposed on generator companies having an installed capacity larger than or equal to 200 MW. From 2010 and until 2014, at least 5% of the energy traded by these generators must be produced by RE. From 2015 the quota increases 0.5% per year until reaching 10% in 2024. Only power from RE-generation installed from 2007

onwards qualifies.[21] To reach the target, generators can invest in own RE-capacity or purchase green electricity from independently-owned RE- generators or from utilities that have surpassed their obligations. Generator companies who fail to reach the target are subject to a fine of USD 28 for every MWh of power left undelivered. This rises to USD 41/MWh, if the target is missed a second time within three years.

3.7 Comparative analysis, conclusions and recommendations

3.7.1 Case study of the modalities applied for off-shore windfarms

Germany, the UK and Denmark apply three different support modalities for making investments in offshore windfarms commercially viable. Germany applies its open-door feed-in-tariff model, Denmark organises single-site tenders for concessions that are awarded through the lowest tariff bid, the UK organizes multi-site tenders where winners are identified through a beauty contest and are remunerated through its ROC-system.

In *Denmark*, the development of off-shore windfarms follows a plan, which has identified the economically most interesting sites to develop and the economic size of the windfarm at each site. To keep the total support costs within manageable bounds, single site tenders are arranged at several years' intervals. To attract competitive bids, the Danish scheme relies on maximum transparency and simplicity. The 25 years concession for an offshore windfarm of a specified MW size in a specific area is offered to winning bidders through a tendering procedure, where the only parameter is the kWh price at which the bidder is willing to produce electricity. The areas is not leased, the concession is for the right to exploit the wind resources at the site. After the wind park is connected to the grid, the windfarm will sell its power into the Nordic power pool; a premium will be paid on top of the market price so that the sum will be at the level of the bid price. For the 400 MW Anholt windfarm which was awarded in 2010, the premium will be paid for the first 20 TWh (the output of the first 12-13 years), after which all revenue will come exclusively from the market price for the sold electricity. The Danish Energy Agency is single point of contact for interested bidders and for all administrative approval procedures. It ensures that the wind measurements at the site, preparatory geophysical investigations and environmental impact assessments are completed prior to the tender and are part of the tender information, and that all required approvals been secured for the windfarm. The Danish national transmission company is responsible for the construction of the transmission line connecting the windfarm to the national/European grid, which reduces construction risk and finance volume for the windfarm. The transmission company is required to pay compensation for the windfarm investor if the transmission infrastructure is not ready in time. Denmark concluded its first two tenders at the amazingly low prices of 0,0518 DKK/kWh (=10 UScents/kWh) for a 200 MW farm in 2005 and another 200 MW farm in 2007 at 0,0629 DKK/kWh (=12 UScents/kWh). These were the earliest larger scale offshore windfarms and, therefore, attracted considerable interest among developers and windturbine manufacturers interested in gaining experience and reference projects. By the time the 400 MW Anhold windfarm was tendered in April 2009, the situation had changed: it attracted only one bidder – the Danish energy company DONG; which in June 2010 was awarded the concession at its bid price of 1,05 DKK/kWh (=20 UScents) for the first 20 TWh of production. Other potential bidders were turned off mainly by the very short time given for the entry into operation of the windfarm: the first windturbine was to be operating by the end of 2012, the whole windfarm by the end of 2013!

The *UK* organizes multi-site tenders of identified off-shore windfarm sites for long-term leases with the British Crown Authority. The leasing fee is modest: £0,88/MWh for Round II projects. The UK has the largest and best wind resources in Europe and a much larger domestic power market than Denmark. This makes the multi-site tenders feasible and economically rational. The size of the UK market and the long-term RE-penetration targets allow large-scale investors to go in for the long term with a view to exploit

[21] Reaching the 5% target represents a challenge. Chile had mid-2009 commissioned 254MW of hydro, 241MW of biomass and 20MW of wind. But just 154 MW of this capacity was commissioned after 1 January 2007.

economies of scale and of scope in off-shore windfarm development. General offshore environmental impact assessments and preliminary wind measurements are undertaken by the UK authorities before the tenders. The winners are selected on the basis of a beauty contest. Since the windfarms are compensated through the ROC system which assigns 2 ROCs per MWh generated by off-shore windfarms, the bidders are not asked to submit price-bids for their output, but development plans for the site. The level of compensation, based on the average price for ROCs during 2002-2010 and average bulk power prices on the British market in 2010, the total revenue per kWh is around £0,134/kW (= 22 Uscents/kWh). The modality has proven its impact capability offshore: about 1 GW of offshore capacity is in operation, a further 4 GW are under construction and concessions for projects with a total capacity of 32 GW were awarded in the British Round III.[22] Yet, the British Government is considering to switch to feed-in-tariffs. Presumably, a the complexity of the ROC system is one reason for the policy change. Price formation for the ROCs interacts with the EU's ETS (emission trading system). When the prices for EAUs increase, the price for bulk power increases; therefore, the prices for ROCs ought to fall. But the impact is uncertain. Long-term price transparency is not a strength of the system and policy makers want to avoid the risk of heavy RE-premiums.

The *German* open-door modality offers published feed-in-tariffs to the output of windfarms and leaves it to windfarm developers to identify relevant offshore sites, undertake all necessary investigations and secure all approvals from involved authorities, state and national Government. Starting with a basic price of 13 eurocents/kWh (=19 UScents/kWh), the feed-in-tariffs are graduated according to water depths and distance from the shore. End of 2010, Germany had 72 MW of offshore capacity in operation and 442 MW under construction. Applications have been forwarded for projects totaling 26.5 GW, so far 7.5 GW have received approval.

3.7.2 Comparative analysis

Renewable Energy Policy Review[23]

	Quantity Of RE Development	**Cost/ Price Reduction**	**Resource Diversity**	**Market Sustainability**	**Local Industry Development**	**Investor Certainty**	**Simplicity**
Feed-In Laws	Large amounts RE in short time	Cost efficient if the tariff is periodically and wisely adjusted	Excellent	Technically & economically sustainable	Excellent	Can reduce investor risk with price guarantee & PPA	Most simple to design, administer, enforce, contract
RPS	If enforced, can meet realistic targets	RPS and Tendering best at reducing cost & price with competitive bidding	Favor least-cost technologies	Technically & economically sustainable	Favor least-cost technologies & established industry players	Lack of price certainty difficult for investors/PPA can reduce risk	More complex to design & administer & complex for generators
Tendering	Related only to quantity RE established by process	Good at reducing cost	Favor least-cost technologies	Tied to resource planning process; sustainable if planning supported, stable funding	Favor least-cost technologies & established industry players	Can provide certainty if well designed (more risk than feed-in)	More complex than Feed-in, simpler than RPS

[22] Source: Deloitte: 'Analyse vedrørende fremme af konkurrence ved etablering af store havvindmølleparker i Danmark', 2011

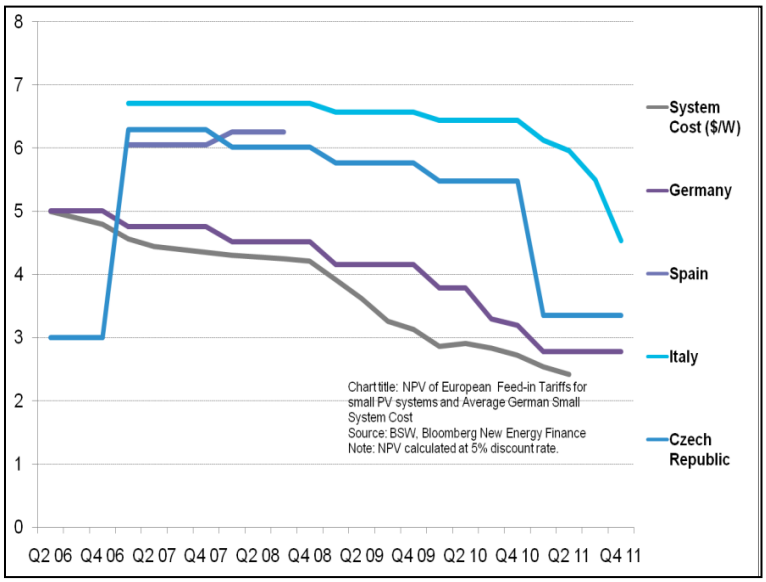
[23] Source: World Bank, 2006.

One can conclude from the experiences of the different modalities that no scheme is inherently superior to the others. None of the schemes enjoys a clear absolute advantage. Each has its pros and cons. Sometimes countries switch from one modality to another, e.g. from a feed-in-tariff to a green certificate system or vice-versa. But it is more normal for countries to make adjustments to an applied modality to achieve e.g. a higher impact effectiveness, a more appropriate sharing of the subsidy burden or a reduction in the cost of support per new RE-MWh.

Impact effectiveness

Market expansion. The *feed-in-tariff* has attractive features for investors: (i) there is no market risk, (ii) the project can be implemented any time during the year as soon as financial closure has been secured, and (iii) the formal procedure for signing the PPA with the system operator / local utility is simple. The feed-in-tariff scheme, therefore, is *capable of attracting a broader scope of investors* (small and large, professional project developers and ad-hoc project developers, utilities and IPPs) than the other two schemes. The investor impact is one reason for the *faster expansion of the market* that takes place under a feed-in-tariff: due to the larger number of investors, more projects and different categories of projects get implemented. The other reason is the absence of a limit on the amount of new capacity, except in schemes with caps on supported annual capacities. Due to the inclusion of small players, also the *potential size of the market* that can be developed is larger than for the other two schemes. The ability of the feed-in-tariff to speed market development and maximize market size is unbeatable; it has a clean advantage in distributed generation. A fast expansion, however, is not attractive for a Government if it leads to a significant overshooting of the politically desired annual penetration target.

Green industry development. For early 'green nations', the feed-in-tariff proved to be the unbeatable instrument for promoting national green industries Early starters that succeeded in building sizeable green industries - Germany, Spain, Denmark – all used the feed-in-tariff instrument. Those who used tenders or green certificates failed in doing so – e.g. U.K and Ireland. For 'later-starters' it is more difficult to identify a clear winning modality at least during the start-up phase. Emerging economies with potentially large national RE-markets – and Ontario/Quebec among OECD economies – have used minimum domestic content requirements as a condition for accessing incremental cost support, using this as a means to promote transfer of technology and build national green manufacturing know-how. Domestic content requirements can be and have been applied within both procurement tender regimes and feed-in-tariff regimes.



Hedging against volatility of fossil fuel prices. The *feed-in-tariff* and *procurement tenders* exploit one of the portfolio values of RE-energy: to offer long-term fixed prices for power supply. *Fixed FiT-premiums* provide zero hedging benefits, *flexible FiT-premiums* (giving full payment when the power market price hits a floor and zero payment when the power market price hits a ceiling) provide some hedging benefits. The hedging benefit of RE-power under a *green certificate scheme* is limited: in theory green certificate prices ought to go down when power market prices go up; in practice this feature is too uncertain.

Resource Allocation Efficiency

Costs of transaction. The *feed-in-tariff* has the lowest costs of transaction for investors and for public administration, the *green certificate* scheme has the highest.

Cost of support per generated kWh. Supporters of procurement tenders or of green certificates emphasize the superiority of 'price discovery' through the market. Supporters of the feed-in tariff, on the other hand, underline that the cost of capital (debt capital as well as equity capital) is lower for feed-in-tariff schemes than for green certificate schemes and that this, together with low transaction costs leads to lower overall compensation for RE-power than under a green certificate scheme. This in fact was confirmed by a study of the EU-Commission which compared experiences in Europe.[24] The average remuneration for RE-power in a scheme promoting multiple RE-technologies in a green certificate scheme also suffers from the clumsy mechanism of allocating different quantities of RE-certificates to RE-technologies having different costs. The feed-in-tariff, on the other hand, is vulnerable to political attempts at providing long-term price predictability for investors: when tariffs are not changed in response to falling prices, or nor changed sufficiently, it can result in high super-profits and run-away investments in new supply. This risk is particularly announced in the deployment area where the feed-in-tariff has its strongest comparative advantage: grid connected small scale solar PV. Consumers can order and get installed systems at rather short notice during a year. This is illustrated in the chart. Germany has a scheme of automatic price adjustment in response to demand development (in indirect way of price discovery).Italy, Spain and Czeck Republic took ad hoc political decisions to reduce prices. Provided that there is sufficient competition – that total supply is larger than the tendered quantity, the tender regime, as demonstrated by the reverse auctions in Latin America, is capable of providing RE-supply at a lower cost than the feed-in-tariff. In mid-2011, an auction in Peru got prices ranging from US$69 per MWh for a wind farm to US$120 for a photovoltaic solar park; Uruguay' auction for wind power got prices as low as US$63 per MWh, whereas wind developers in Brazil were awarded contracts at an average price of US$62 per MWh, making it the country's cheapest source of power! The same year, the feed-in-tariffs for on-shore wind farms were 77 euros per MWh in Spain and 82 euros per MWh in France.

Because of their differences in risks and in the costs of transaction, see the table below, projects have different financial cost-curves under the schemes. The higher market risks and costs of transaction of the mandated quantity schemes increase the cost of capital, and thereby, the RE-plant's cost of production.

Scheme	**Transaction Costs**	**Investor Risk**
Feed-in-tariff	Low:	*Low*: no market risk
Tradable Green-Certificate	*Medium*: fees for TGC-dealers and brokers; costs for negotiated long-term PPA-prices or for day-to-day power pool sales	*Medium*: risk of fluctuating market prices for electricity and for TGCs
Tender	*Medium/High* for Government (organisation and implementation of tender) and for investor (preparation of bidding documents and time in waiting for tender to take place)	*Medium/High*: risk of losing tender and that project implementation is delayed several years until tender prices have gone up

Market distortion. Any mandated market scheme has a distortioning effect on the power market: output from RE-generation that is fed into the grid and supplied to the market irrespective of the prevailing demand-supply balance, and thus of the market price, distorts the price formation on the market. Supporters of fit-premiums and of certificate schemes underline the fact that supply from RE-generators is paid the prevailing market price. But this does not change the fact that RE-supply, other than biomass based power, is a function of resource conditions, not of market conditions.

[24] 'Communication from the Commission, The support of electricity from renewable energy sources', COM(2005) 627 final.

Burden sharing efficiency

Energy poverty. Because of its dynamic deployment effect, by 2011, the feed-in-tariff costs German electricity consumers €13 billion in annual support, the cost for an average household amounts to €14 per month. Since the income elasticity of demand for electricity is substantially lower than 1, increases in electricity prices impose a disproportionately big burden on low-income consumers. Tax payer pays mechanisms in the form of investment grants, tax credits and tax deductions are, therefore, less onerous for low-income households than a mandated market scheme. Among the latter, the tender results in the lowest increase in the average tariff because of its ability to fix prices along the least-cost-first development path and because the amount of new supply per year is controlled. A feed-in-tariff with prices being fixed to achieve annual deployment close to the politically desired target will result in lower tariff increases than a green certificate scheme. A feed-in-tariff regime that is slow to react to changes in the market price for supported technology results in run-away costs.

Regional equity in burden sharing. In Federal Republics, tradable green certificates are seen as a mean to allow general RE-portfolio standards to be applied in all states, with the trading of certificates allowing investments in RE to take place in the states having the best RE-resources. In countries applying national feed-in-tariffs that are financed via a public service fee on transmission, there is only a regional burden issue in the sense of regions with the best resources receiving the highesr concentration of investments and associated visual impacts on landscapes in the case of windfarms.

3.7.3 Hybrid policy approaches

FIT and RPS cannot be applied to the same RE technology and plant size/market segment at the same time. However, recently, Italy and UK have implemented hybrid approaches where FIT is used for market segments e.g. small size RE projects (e.g. under 1-5 MW) that cannot be fully developed under an RPS system, whereas the RPS is used for larger-commercial scale projects.

3.7.4 Conclusions and recommendations

Of three 'mandated market' modalities, FIT has proven to be most effective mechanism to achieve a high penetration of RE in a short period. The green certificate scheme is clearly the inferior one: it imposes the highest transaction costs and the highest risk penalties on interest rates and on required returns on equity.

Investment grants and production tax credits can co-exist with mandated market schemes as a means to reduce the impact of an ambitious national RE-deployment program on electricity tariffs.

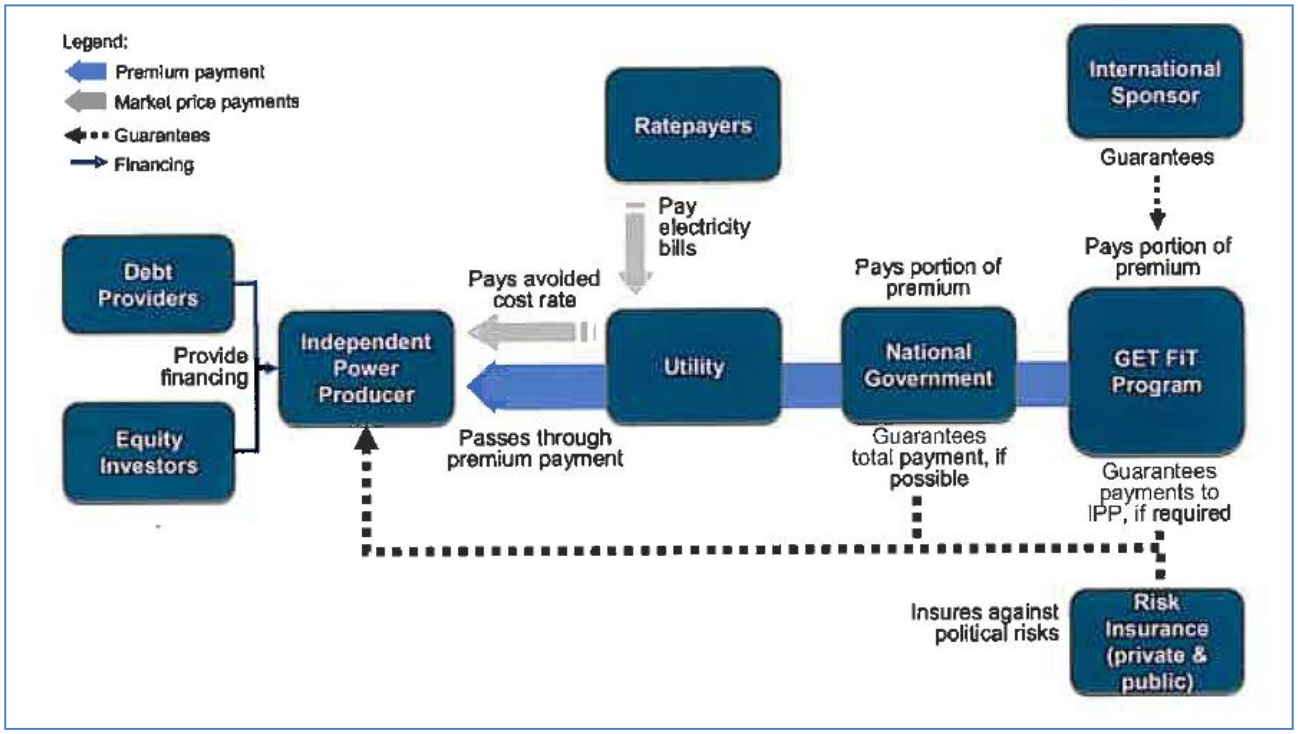
The feed-in-tariff's dynamic impact on market expansion has positive and negative aspects. The "explosion" of the German, Danish and Spanish markets for windenergy in the 1990s and later, for solar PV in Germany and Spain enabled the long-term cost reduction potential of these new technologies to be realised. Cost reductions – at unchanged feed-in-tariffs - made less attractive windsites financially viable expanding the scope (geographic location) and the size of the potential market. A costly, but productive, interaction took place between the demand side, reacting to cost decreases with a high price elasticity of demand, and the supply side, reacting to the economies of scale generated by the increase in demand with further cost reductions as predicted by 'learning curve theory'. But, the feed-in-tariff requires deep pockets and high ambitions. When no limits are imposed on annual new capacity, feed-in-tariffs pose a risk of *overshooting:* that the impact on annual market expansion is higher than expected a priori and higher than the politically desired. The subsidy burden imposed on consumers (and in some countries on tax payers) by feed-in-tariffs that are higher than the cost of supply from conventional power plants can become politically intolerable.

Support to grid-connected PV-systems poses a problem for feed-in-tariff schemes due to the fact that it is expensive and a mass-market technology – 'every house and landowner' can become investor. The market,

therefore, can expand very fast if generous tariffs are introduced. Between 2000 and 2009, global PV demand grew at an average annual rate of 51 percent, rising from 170 MW to 7,059 MW, reaching 19 GW in 2010 and 23 GW in 2011. Emerging economies wishing to apply feed-in-tariffs for solar PV systems must fix these at very stingy levels to reduce free-rider problems (investments that would have taken place also at a lower level of support) and control demand. Quarterly market monitoring is recommended in order that tariffs can be adjusted downwards if demand develops beyond the policy targets. The alternatives of fixed annual caps with support being approved on either a 'first come, first served' basis or through 'beauty contests' are less impact-effective and less cost-efficient.

3.8 North-South sharing of incremental cost finance

The GET-FIT (Global Energy Transfer Feed-in Tariffs for Developing Countries) Program is a joint German Government – Deutsche Bank initiative to assist the development of effective RE-deployment strategies and schemes in developing countries. GET-FIT has developed an interesting concept for a logical sharing of the incremental costs of RE between the implementing countries. The basic premise is that clean energy provides global greenhouse gas mitigation benefits and conventional national energy policy benefits. Also without a global warming issue, countries would invest in clean energy to pursue conventional policy goals such as security of supply, reduction in imported fuel dependence, local environmental improvement, price stability, employment creation and development of new manufacturing and service industries. These off-spins from investments in clean energy provide economic benefits to the larger economy that partially or fully compensate for the incremental cost of these compared to conventional power supply; they represent the portfolio value of RE-power supply and of energy savings.



Source: DB Climate Change Advisors: GET-FIT Program. April 2010

The *financial incremental cost of RE-power* is equal to the difference between the revenue per kWh paid to RE-power (RE cost of production) and the avoided financial cost in replaced conventional power supply. Because of the external benefits (the portfolio value of RE-power) the financial incremental cost exaggerates the *economic cost of RE-power* to the national community. The '*economic incremental cost'* is equal to the financial incremental cost minus the portfolio value of RE-power. GET-FIT suggests that the economic incremental cost be covered by donor grant finance, whereas the national community covers the incremental cost equal to the portfolio value through various finance instruments.

The modality can be implemented in various ways. The chart above shows one possibility. The chosen instrument is a FiT-premium paid on top of the power market rate, which the off-taking utility to the RE-generator for his power supply. Part of the premium is paid by the national state budget, the other part, the GET-FIT payment, by a donor financed fund.A donor would guarantee the GET-FIT payment. Either the national government or a donor, depending on the national context, would guarantee the transfer of the premiums to the independent RE-power producers.

4 Private Finance Innovations

This chapter shows examples of *private finance innovations* for RE-investments. The cheapest way of leveraging private finance is to assist the finance industry in a country to copy successful private finance models from elsewhere that they can be adapted to local conditions.

4.1 Drawing institutional investors into RE-project finance

Project finance depends on investors looking for long-term assets to match the profile of their liabilities. The most important are the socalled institutional investors: insurance companies and pension funds.[25] Investments in RE are, in principle, an attractive asset class for these: they offer relatively good risk-adjusted returns, a long duration, and have a low correlation with the capital markets. However, in many developing economies such funds either do not exist or limit their investment activities largely to the purchase of government debt. Getting these funds involved in RE-finance requires some creative structuring of project finance by project sponsors.[26]

Pension fund finance for the construction of the off-shore 400 MW Anholt Windfarm. The Danish energy company DONG Energy won in June 2010 the Danish Energy Agency's tender for the 25 year concession for the 400 MW Anholt offshore windfarm project. DONG's bid asked for a feed-in-tariff of 13.5 €cents/kWh for the first 20 TWH of production, after which the windfarm sells its power to the commercial power market. The first turbine is to operational by end of 2012, the last by end of 2013. The required investment was estimated at DKK 10 billion (=US$1.9 billion). In March 2011, DONG sold the ownership of the concession to a 'Special Purpose Vehicle', a Joint Venture Company created by DONG (50%) and the two Danish pension funds PensionDanmark (30%) and PKA (20%) to finance and own the project. The pension funds acquired their stakes in return for a total joint investment of DKR6bn (US$1.1bn). The JVC has signed a fixed price construction contract and a 12 years O&M contract with DONG. The rationale for DONG was to increase its investment capacity for the development of other windfarms: that's where DONG can achieve its highest value creation. The pension funds appreciated the time and risk profiles of their financial investment: the construction and operation risks are taken by DONG; the average annual revenue can be predicted with high certainty. The return on investment compares favorably with alternatives. The average annual returns from Anholt over the wind farm's 20-year lifespan are expected to be at least double the current Danish bond yields of just above 3 per cent. *Source: Various*

Because they are large, more costly per MW installed capacity and more risky than onshore windfarms, putting together a financing package for offshore windfarms is not easy. Project risks are highest in the planning and construction stages. Unlike on-land windfarms, offshore wind projects lack fixed price turnkey contracts. Projects are developed under a multi-contracting strategy where the developer is the one liable for the interface risk between the contractual packages. For these reasons, the investments in offshore windfarms have been funded largely through utilities' balance sheets. Once the plant enters stable production, the risks are lower; hence, institutional investor appetite exists for investments in operational assets. The demand is used by utilities to refinance their projects after commissioning.

Dong Energy used balance sheet financing to invest in its first windfarms, usually in partnership with other utilities. For the financing of the Anholt off-shore windfarm, DONG, one of the world's most experienced offshore windfarm developers and operators, chose differently (see the box). The financing structure in the

[25] The importance at worldwide level can be illustrated by the following figures. In 2010, the value of global *bonds* outstanding was US$95 trillion; global *equity* market capitalization amounted to US$55 trillion. US$40 trillion of bond and equity assets were held by pension funds and insurance companies.

[26] In some countries, it may, in addition, require changes in financial sector regulations to allow pension funds

form of the jointly owned special purpose vehicle manages in an elegant way the differences in the rate-of-return expectations of the project developer (as high-risk investor) and of the pension funds (as low-risk investors). The special purpose vehicle has acquired the concession from DONG and finances the project investment. The pension funds purchased their 50% ownership stake in the JVC at a price of DKK 6 billion to DONG, which, therefore needs to self-finance only 40% of the DKK 10 billion project finance. DONG collects its 'developer premium' upfront (compared to selling shares in the project after commissioning) and limits its corporate debt exposure during construction to DKK4 billion instead of DKK10 billion. The reduced debt exposure increases DONG's investment capacity for developing other windfarm projects - the activity, where DONG, being the most experienced offshore windfarm developer and operator in the world, can achieve maximum value creation. Another important novelty in the offshore business is the construction contract between the JVC and DONG: it commits Dong to deliver the wind farm at a fixed price by a fixed date. This feature takes the construction risk out of the financial investment by the pension funds into the JVC. The JVC's O&M contract with DONG does the same for the operational risk. These two risk reductions enabled the pension funds to go into construction stage financing. Structuring the finance for the Anholt project was not easy: the contracts count close to 10,000 pages.[27]

Institutional investors have an alternative entry point for construction stage financing of RE-projects: investment in an *infrastructure investment fund*. However, by investing in RE-projects directly, together with an industrial partner, instead of via an infrastructure fund, institutional investors avoid paying high management fees and gain greater control. It is, therefore, not surprising that institutional investors expand their investments in individual RE-projects. Yet, interesting new infrastructure fund modalities are evolving that improve their relative attractiveness. An example is New Earth, which invests in new waste treatment and recycling projects that are undertaken by a single industrial collaborating partner.[28] Financing projects that are developed, owned and operated by a specific partner with a solid track record makes it easier for institutional investors to assess the risks associated with the investment.

4.2 Green bonds for attracting retail and institutional investors

Climate bonds, also called green bonds, are issued to raise capital to fund specific projects aimed at reducing climate change risk. Some green bonds finance mitigation investments directly; some pay coupons tracking the performance of environmental indices such as the carbon price, some provide commercial and development banks with capital to finance green investment projects. They are increasingly being used to raise finance for RE&EE investments: by early 2011, some US$12 billion of bonds backed by investments related to climate change solutions had been issued internationally.

When banks face constraints in providing long-term lending, green bonds, in the form of *company bonds* or *asset-backed securities* backed by the cashflows generated by a RE project or by a portfolio of RET projects, are an interesting finance modality for RE project developers. Because they are considered safe assets and some institutional and small-scale household investors want to have at least a certain percentage of their portfolio invested in 'sustainable and socially responsible investing assets', green bonds can attract premium

[27] The alternative of *bank syndication* is equally complex. In August 2011, the private equity group Blackstone reached financial closure for its 288MW *Meerwind offshore windfarm* in the German North Sea. The project, to be completed by 2013, requires an investment of €1.2 billion. Blackstone invests equity of €322. The debt financing of €822 million is provided by a group of seven commercial lenders, alongside KfW and EKF, the Danish export credit agency.

[28] The New Earth investment sub-fund designs, builds, finances and operates waste treatment facilities, and generates renewable energy from waste-derived fuels. It was launched in 2008 by waste treatment facility operator New Earth Solutions Group and the Isle of Man-based fund manager Premier Group. The open-ended fund – investors include institutions such as pension funds as well as high-net worth individuals – invests in UK recycling and waste treatment facilities operated by New Earth. Since its creation, the fund has raised £70.7 million ($114 million) and invested in five waste management facilities across the UK. It aims to expand this portfolio to 40 waste treatment and energy-from-waste plants by 2016.

prices from niche investors. [29] They are, therefore, a price-competitive means of raising long-term finance; whilst offering socially conscious investors higher returns overall than Government bonds. Asset-backed securities are generally used for refinancing of projects which are generating positive cash flows, but they can also be issued in the form of project bonds ahead of construction.

Retail bonds are marketed to household investors and sold in small denominations to enable these to invest even with a small start-up capital. The retail demand enables bond issues in the €5-€20 million category, thereby allowing medium sized project developers to tap the bond market. The text box to the right provides an example of a *company retail bond*, the text box in section 8.2.1 gives an example of a *project retail bond*. Small bond issues are not tradable on the capital markets, making them a very illiquid form of investment. However, in Japan the household demand for green bonds is large enough to provide a market both for large bond issues[30] as well as for the creation of green asset management funds that invest in green bonds collectively on behalf of the households investing in the funds. [31]

Green bond issues of €100 million and more target the *international capital market*, in particular institutional investors; they offer the liquidity essential for these.

Green Company Retail Bond. Corporate bonds are essentially a loan to the Company, under which the sum invested by the bondholders will be repaid at maturity. In May 2011, the RE company *Wind Prospect Group*, wholly owned by its 200 staff, launched a corporate retail bond onto the UK market with the aim of raising £10m. The bond is not tradable in the capital market. The bonds, launched under the name Rebonds, pay 7.5% per annum rate of interest, with additional 0.5% interest payable to bondholders that subscribe for £10,000 or more; minimum investment is £500. Interest is payable semi-annually until the original sum is repaid at maturity. The repayment date is 4 years after the issuance date, at the bondholders option, or each anniversary thereafter. Each bondholder must give at least 6 months written notice before the repayment date, if they wish to be repaid. Funds raised by the offer of ReBonds are distributed to Wind Direct, or other UK subsidiaries within the Wind Prospect Group. Wind Direct specialises in providing green electricity directly to industrial and commercial clients, locating wind turbines on-site and supplying electricity direct to the client under long-term (up to 10 years) fixed price, green electricity PPA-contracts. The first £6m of ReBond revenue are to fund a 2 wind turbine 2 MW windfarm project of Wind Direct at South Staffordshire College. Surplus output higher than the demand at the College is sold to the grid. *Source: Rebond invitation prospect*. In the end, Wind Direct managed to raise just £2.3 million of the hoped for £10 million bond. *Source: Environmental Finance, November 1, 2011*

Issuers of green bonds include RE-project developers, development banks[32], commercial banks[33], state Governments in the US[34] and municipalities.

[29] The green label, however, calls for certification. For this purpose, the Climate Bond Initiative is developing a Climate Bond Standard, designed to certify the environmental integrity of the underlying projects being financed.

[30] Kommunalbanken Norway (KBN) is a bank collectively owned by the Norwegian municipalities to serve their needs for project finance. KBN launched in 2011 a US$180 million 'Clean Energy Bond' on the Japanese uridashi market (non-JPY denominated bonds sold directly to Japanese individual investors), the proceeds of which will be used to finance Norwegian municipal initiatives to reduce climate change.

[31] Strong household demand in Japan has given rise to retail funds that collectively invest in green bonds of the'capital market category; Nikko Asset Management has two funds that predominantly invest in World Bank Green Bonds.

[32] The funds raised from green bonds issued by the World Bank are ring-fenced for World Bank funded climate change projects such as energy efficiency, renewable energy and reforestation. The World Bank issued its first green bond in 2007, since then European Investment Bank, Asian Development Bank, Nordic Investment Bank and African Development Bank have issued green bonds as well.

[33] An example is the Dutch/UK bank Triodos. It has branded itself as a green bank willing to invest directly in renewable energy projects; and raises capital explicitly for that purpose through retail climate bond issues.

[34] Several US states also tap into this market to finance loan programmes for RE&EE investments by residential and commercial property owners.The programmes allow residential and commercial property owners to borrow the money

The willingness of banks to engage in RE&EE lending would be increased, if banks had an exit route out of project finance: if it were possible for primary loans issued by banks to RE&EE projects to be packaged and re-sold in secondary markets to pension funds, to institutional investors and to individuals. However, since the sub-prime loan scandals, securitisation has a negative annotation attached to it. It is a fact that the intrinsic structural flaw in the *loan-securitization* market - the ability to earn substantial fees from originating and securitizing loans, coupled with the absence of any residual liability - skews the incentives of originators in favor of loan volume rather than loan quality. However, because the RE-project market is much more transparent in its price-setting and revenue generation than the housing market, the structural flaw poses a very low risk in RE-securitisation.

Due to their great flexibility on both the supply side and the demand side, green bonds can be introduced in quite a few countries as an effective instrument to attract national capital, institutional investors as well as retail investors, into the financing of RE-projects. Sub-chapter 8.3 includes examples of finance enhancing instruments enabling the introduction of green bonds for project finance.

Unrated retail Eco-bonds to finance project equity. Mid-2011, the UK renewable energy utility Ecotricity had 4,000 business and 41,000 domestic customers and an operational RE-power capacity of 54.6MW of wind turbines, with 152.3MW in planning. Ecotricity has a 15-year track record and a £44 million balance sheet. Electrocity's RE-projects are typically financed with a mixture of 20% equity and 80% debt. Ecotricity raises the debt portion from the banks at around 6% rate of interest. Ecotricity could access *mezzanine debt* carrying a 13-15% interest rate to finance the equity portion of a project. But since 2010, Electrocity has turned to retail *bond issues* as a lower cost way of raising finance for its equity needs. In December 2010, Electrocity issued a £10 million ($16 million) bond with the intention in 2011 to build 20MW of wind and solar projects, investing a total of £35 million. 'Ecobond One' closed in December almost two times oversubscribed: both Ecotricity's retail customers as well as non-customers bid to buy £9 million worth of bonds. The company allocated 70% of the four-year bonds to customers paying these 7.5% in interest, and the rest to non-customers paying these 7% in interest. The bond was unrated. This handicap was overcome by the combination of a good track record and balance sheet and of interest rates that were far superior to bank deposits. Apart from raising capital, the bond issue served the strategic purpose of offering benefits to its customers and of advertising its existence to non-customers. 'Ecobond Two' is to close in December 2011. *Source: Environmental Finance*

4.3 Aggregation through third-party finance

Providing limited recourse finance for small RE projects is possible in rare cases only. In general, small projects are too small for local banks to bother with on a project finance basis. The creation of a portfolio of projects with a standard financing approach can bring the critical mass needed. ESCOs are well-known aggregators for EE-investments; in RE, *third party PV-financing* is a similar modality applied for RE.

In third party PV-financing, a solar power company/PV-installer offers customers to install a PV-system at no upfront cost to these on their premises. The condition is that the customer signs a power purchase agreement (PPA) with the PV-system installer for the purchase of the output of the plant at rates guaranteed to be equal to or lower than the tariffs charged by the local utility. The solar power company retains ownership of the system and responsibility for maintenance, the PPA-revenues serve as lease payment. At the end of the PPA, ownership of the PV system transfers to the customer. The length of the PPA is calculated to allow the installer to recuperate his costs of investments and earn a reasonable profit. Since the modality requires a minimum deal size to justify the costs of transactions, third-party PV installers seek

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for RE&EE investments from the state. The liability to repay the loan is attached to the property, rather than to the individual, as an assessment on real property. Loans are repaid over time through an annual assessment on their property tax bill.

customers with unshaded roof or site areas suitable for a 200-KW or larger PV system. Potential customers are commercial, residential and public buildings with an unshaded roof area of at least 2,000 square meters.[35]

4.4 Private Insurance products

The international insurance industry has reacted to the large volumes of annual RE-investments worldwide by introducing a range of insurance products that are tailor-made for the needs of the RE-industry.

For the banks, a concern is how the variability of annual output affects the ability of the generator to pay interest and instalments on the loan. This has led to the introduction of *weather derivates and weather insurance.* Insurance4renewables offers case-by-case coverage for RET projects including carbon delivery guarantees, carbon counterparty credit risk insurance and lack of sun / wind insurance.

Insuring green technology assets helps persuade banks to offer loans to investments in these and technology firms in creating investor confidence in its products. Munich Re, the world's biggest reinsurer, agreed in July 2011 to insure a Japanese solar module maker's liability for the performance of its products. Under the accord, Munich Re will insure the panel maker, Solar Frontier K.K., a unit of Showa Shell Sekiyu K.K., for as long as 20 years to cover any unexpected, substantial loss of quality. Solar Frontier started commercial operations in July 2011 at a 100 billion yen factory in southern Japan.

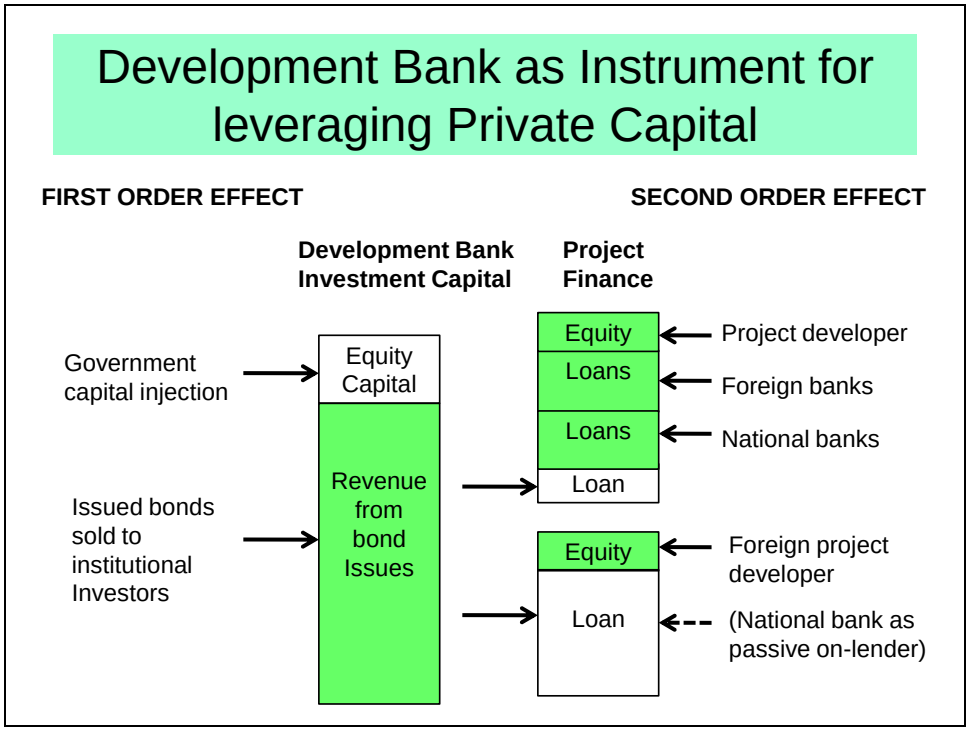
[35] In the USA, third-party PV-installers are active also in family-houses. This is helped by their access to a number of tax benefits that are available to firms with operating cash-flows, but not for households.

5 Public Debt Finance Instruments: Liquidity Support

5.1 Direct Project Finance from Development Banks

5.1.1 The double leverage effect from development bank loan finance

Financial transfers from Government budgets (raised from private citizens through taxation) provide developments banks with the equity capital needed for reaching investment grade status, as long as they follow prudent loan practices. Investment grade rating enables a development bank to issue bonds on the international capital market. This raises the finance for their loans to investment projects and programs. The finance raised from the international capital market is the first order leveraging effect of the Governments' original equity capital contribution. The second order effect is achieved when loans from development banks to private RE-projects attract co-finance in the form of private equity and commercial debt finance. (See the chart below).



(Senior) loans from development banks for RE-investments are called on in any one of five circumstances:

i. to cover RE-project demand for *long term finance* in countries, where the national banks are prevented from doing so by finance sector regulations;
ii. to cover the demand for RE-finance in areas, where *commercial banks are not active yet*;
iii. to act as *bank syndicator* for large scale RE-project finance;
iv. to serve as a *safety net for a minimum of RE-finance* when overall lending is restricted in times of uncertain financial climates:
v. to provide long-term finance at *lower rates* to RE-projects than the national capital market is capable of.

Project finance from MDBs: In some countries, banks are restricted by financial sector regulations to limit their tenor to 4-7 years as a maximum. In the *absence of local long-term finance* development banks may give direct loans to RE-projects without involving national banks.[36] The same approach may be used in *the absence locally of limited recourse finance, due to unfamiliarity with the concept or with new RE-technologies*. Such a situation provides public finance interventions with a clear goal and a strategy. The goal is through the demonstration effect to bring in commercial banks as the track record of RE projects showing sustained returns will lead to investments in RE becoming a recognized asset class. The strategy is through the loan investments both to introduce new RE-technologies and together with grant-financed TA build technical and financing capacity, and develop the commercial models and contracts for RE-finance and project development. An example of the direct project finance modality is EBRD's Ukraine Sustainable Energy Lending Facility (USELF). It integrates its direct project financing with a very comprehensive TA-package (see text box). Having a solid TA-finance facility for building a project pipeline is a key success factor for a direct lending facility. Another is to have a very competent facilitation manager who actively markets the finance facility in the country. In the USELF, the project development efforts of the facilitation team are closely monitored both by a local ERBD officer as well the officer in London who decides on loan approval before the formal decision by the Board. The officer follows a project from the time a project has passed the preliminary screening by the facilitator and has been issued a mandate letter.

TA to accompany direct lending. Ukrainian energy policy includes targets for a higher penetration of RE in power supply. For a country of its size, Ukraine has relatively modest RE sources and the regulatory framework for RE is still under development. The *Ukraine Sustainable Energy Lending Facility (USELF)* is established by the EBRD for fostering RE power generation projects in Ukraine: hydro, wind, biomass, biogas, solar. The lending volume is up to a total of € 50 million from EBRD and € 20 million from the Clean Technology Fund. USELF offers project developers loans ranging from €1 million to around 15 million, with EBRD's loan share financing up to 50% of RE project investment; CTF's loan portion is additional (project developers see one combined loan). Interest rates are at market conditions and maturity is up to 12 years for EBRD loan and possibly longer for the CTF loan portion, with the latter offering a grace period. USELF is structured to provide financing directly from the EBRD for small and medium projects with a simplified and rapid approval process, so reducing transaction costs. A *facilitation team* located in Kiev vets applications for finance from projects and assists project developers in making projects bankable for EBRD evaluation and approval. The free TA from international and local experts provided through the team to project developers is comprehensive: improvement of feasibility studies and documents required for project appraisal, support in permitting and licensing process, support in commercial negotiations related to agreements required by developers, legal support in preparation of loan documentation, support in overall project management for project development and preparation. In addition training is provided to local consultancy firms and banks. A separate regulatory support project under the USELF finances TA to the National Energy Regulatory Commission of Ukraine (NERC). The total TA is funded by a GEF grant of $8.45 million. *Source: Various, including USELF website*.

[36] Guarantee instruments to extend tenor are discussed later in the report.

Loan syndication is needed for financial close in large scale projects. The participation of a development bank in loan syndication facilitates bank participation because local banks can piggy-back on the development bank's experience in RE-project finance while foreign banks find the participation of development banks in project finance politically reassuring. Examples are plentiful of successful syndication in RE due to development bank participation: EIB and KfW participated in the financing of most offshore windfarms in Europe up to 2011. The ADB and the World Bank pioneered RE-project finance in Asia and the AfDB inter alia in Kenya with the Lake Turkan project. The IFC, EBRD, EIB and KfW pioneered RE-project finance in several Eastern European countries. A recent example is the syndication by IFC and the EBRD of loans to windfarm projects in Roumania developed by Pestera Power, a wind energy company majority owned by a Romanian unit of EDP Renovaveis, a Portuguese clean energy developer. Commercial banks had been skeptical about Romania's regulatory framework and the country's willingness to honor the obligation to finance feed-in-tariffs throughout the period stipulated in Government regulations. Yet, as IFC and EBRD each lend some €91.1 million, commercial banks lend €50 million.

Project finance from national development bank to provide low-cost finance. Specialized RE-development banks such as IREDA in India and NREA in Egypt are used as on-lending conduits for foreign concessional loans. As always, the intention is to kick-start a process that brings in private capital later on. In the IREDA case, local commercial banks became very quickly involved in the finance of windfarms (see text box). . During the 1990s and early 2000s, nominal interest rates on the finance markets in India were very high because of high inflation. IREDA's access to loans at concessional rates allowed IREDA to offer loans at very competitive rates. But as falling inflation brought down the nominal interest rates offered by commercial banks, IREDA lost its competitive edge in the pricing of its products, and, consequently market share. IREDA needs to charge interest rates and fees at close to market rates in order to survive as a viable lending institution. But the demonstration effect of IREDA's initial investments had an impact on commercial banks. Yet, even more important for their involvement in RE lending was the RE-support instrument used by the Indian Government during the 1990s and early 2000s: accelerated tax write-offs for windfarm investments and low wheeling charges to places of auto-consumption. This led to the investments in windfarms being done by industrial corporations on a balance sheet finance basis using their normal commercial bank connections to provide the loan finance.

IREDA was founded in 1987. Its business purpose is the promotion of environmentally friendly energy generation. IREDA is a Public Limited Government Company under the administrative control of Ministry of New and Renewable Energy. IREDA, a specialised financial intermediary, operates a revolving fund for promoting and developing RE projects. During the fiscal year 2008-2009, IREDA disbursed INR 7.7 billion. IREDA receives its funds from loans from development agencies and IFIs, and from loan repayments from clients. Finance products IREDA offers project financing of up to 80% of project costs, equipment financing of up to 75% of equipment costs and other types of medium to long term debts (up to 10 years) with interest rates in 2010 in the range of 10.25% to 12%. IREDA introduced initiatives to help overcome credit availability barriers in the rural market for solar PV systems, including arrangements for leasing systems and providing loans for PV through existing micro-finance organizations. IREDA also assists the State Bank of India, Canara Bank, Union Bank of India, Bank of India, and Bank of Baroda to formulate schemes for EE lending to small and medium enterprises and is in the process of extending special lines of credit to state electricity boards to implement projects to renovate and modernize thermal power stations. Impacts: Many commercial banks now play an active role in the financing of the established forms of RE (wind energy, solar PV) in India. While IREDA was almost the only lending institution in this field originally, IREDA's market share in the area of financing RE has decreased to 13 % in the financial year 2007/08 and to a mere 8.6 % in wind energy. But IREDA needs continued presence in the established subsectors in order to generate income with which to promote less established, higher risk sectors such as concentrated solar power plants and other new RE technologies.
Source: Various

Project finance from national development bank as a tool to promote national manufacturing of RE. The Brazilian National Economic and Social Development Bank (BNDES) has a yet more prominent position as a provider of finance to the RE-sector. Its financing of RE-power projects and bioethanol plants is part of the Government's tender programs for RE-projects: the PROINFA program from 2002 to 2008 and ANEEL's tenders for RE-power that started in 2009. BNDES gets its RE-finance from a number of funds managed by it: e.g. the Constitutional Financing Fund of the Northeast (FNE) and the Northeast Development Fund (FDNE). Access to BNDES finance is a tool to serve two policy objectives. One is to keep down the cost of RE-power from winning bids. The other is to promote foreign investments in the RE value chain: to benefit from subsidies and BNDES finance, projects under PROINFA had to fulfill national content requirements: Law 10762 mandated a minimum nationalization of 60% in total construction costs. BNDES could finance up to 70% of capital costs (excluding site acquisition) at the basic national interest rate (TJLP) plus 2% of a basic spread and up to 1.5% of a risk spread. Interests are not charged during construction and tenor is 10 years. BNDES's RE-lending amounted to US$2.4 billion in 2007, US$7 billion in 2008 and US$6.4 billion in 2009. Regionalization criteria limit the share of each State to a maximum of 20% of total capacity for wind and biomass and 15% for small hydros.

Development Bank finance to *accelerate syndication and safeguard to finance a steady flow of investments*. The German Government's decision in May 2011 to phase out nuclear power by 2022 adds to the urgency of realizing Germany's potential for grid-connected RE power. The development of more than 20 GW of windfarms in the German North Sea and the Baltic Sea is a key element in the Government's strategy. Yet, at least some experts doubt that the investments in the North Sea and in the required transmission systems to transport power from the North to Southern Germany can be build in time. Thus, the primary objective of KfW's finance facility for offshore windfarms in Germany (see text box) is not financial sector transformation: the German financial sector's expertise in RE-project finance is strong.

KfW's €5 billion facility for offshore windfarm finance. KfW launched its programme to support offshore wind development in June 2011. KfW can co-finance projects for up to 20 years in three ways: (i) directly lending as part of a bank syndicate, to a maximum of €400 million per project or 50% of total capital requirements; (ii) a financing package comprising a direct loan and an on-lent loan, via an intermediary, up to €700 million per project and 70% of total financing; (iii) or, with a direct loan for financing contingent additional costs arising during the installation phase, of up to €100 million. Already in August 2011, KfW committed €264 million to the Meerwind offshore windfarm project (footnote 25). *Source: Various*

5.2 Dedicated RE credit lines provided by development banks

Dedicated RE-credit lines finance smaller scale RE-projects: grid connected RE-power plants up to 20 MW and end-user RE-systems; they often finance end-user EE as well. In the RE-credit line modality a local commercial bank (or a number of banks) is used as on-lending vehicle. The bank can be a "pure" on-lender of received funds or an active co-financier: the award of the credit line to a participating bank is in most cases made conditional on its topping up the received funds with 25 % to 100% co-financing from own funds.

As barrier removal instrument credit lines have three major uses:

1. To increase the commercial interest of the participating banks in RE-finance through the *liquidity impact of giving these access to extra external sources of funds on attractive terms*; this enables these to expand the volume of their lending business.
2. Providing *credit lines with a long-term tenor* to participating banks removes constraints on their ability to lend long term which is caused by too strong mismatches between the average maturity of their in-loans and of their out-loans.
3. *Combining the credit line with an investment grant facility* removes the obstacle of high costs of finance on the commercial market.

The attraction of the modality is that the participating banks will continue their involvement in RE-finance also after the termination of the project. Transaction costs for project pipeline preparation may also be lower than in direct lending, because the collaborating commercial banks have established networks which they can use to identify and work with RET project developers.

The success formula for the RE credit-line modality is well-established: (i) careful selection of participating financial institutions (PFIs) through a competitive process with well-defined criteria, (ii) having at least three PFIs and preferably more, so developers can shop around for the best deal, (iii) have a grant facility to support project pipeline building, the capacity building of participating finance institution in due diligence appraisal of RE-projects and capacity of local project developer/consultant, (iv) contracting a competent management team to operate the project management unit, PMU. When there are several PFIs, the PMU is located independently, otherwise it is placed within the PFI.

The World Bank-financed *Turkey Renewable Energy Projec*t is an

RERED Sri Lanka Re-Financing Credit. The RERED Project is designed to on-lend funds through participating credit institutions (PCIs)) to sub-borrowers undertaking RE sub-projects (grid-connected RE power projects with capacity not more than about 10 MW, off-grid village based RE power projects, solar home systems) and energy efficiency investments. The RERED project is supported by US$ 115 million in World Bank loans and a US$ 8 million grant from GEF (for project support and investment grants for solar home systems) for the 2003-11 period. The Government of Sri Lanka, in consultation with the World Bank, appointed *DFCC Bank as the RERED Project Administrative Unit (AU)* to implement the Project. REDED has six PCIs one of which is DFCC. To avoid conflicts of interest, the AU is independent of and separated from the PCI function of DFCC Bank. The AU with a staff of six is responsible for the administration of the IDA credit line and GEF grant funds, and provision of project support. Two Special Dollar Accounts are maintained at the Central Bank of Sri Lanka to deposit the proceeds of IDA credit and GEF grant. The PCIs approve sub-loans to project beneficiaries following their own credit evaluation procedures. Once approved, PCIs forward a loan refinance application to the AU requesting commitment for a maximum of 80% of the approved sub-loan amount. After the PCI disburses funds against the approved sub-loan amount, the AU disburses the approved 80%. **Results**: By mid-2011, the project had financed 130,721 SHS with acumulative capacity of 5.8 MW. 71 grid connected projects with a capacity of 168 MW. electrified 7,500 households through isolated-grids served by micro-hydros with a total capacity of 2 MW.

example of a superbly well-designed project combining an on-lending facility with comprehensive TA-support, see Annex II. An example of a project offering a refinancing facility to participating banks is the World Bank financed *Vietnam Renewable Energy Development Project (REDP*), see Annex I.

The World Bank/GEF-financed Renewable Energy for *Rural Economic Development (RERED)* project in Sri Lanka and its predecessor, the Energy Service Delivery –ESD project is an example of a credit line to satisfy the need of PFIs for long-term finance. (see text box). In Sri Lanka, interest rate subsidies or investment grants are nor needed for grid-connected systems, because a feed-in-tariff regime was tailored to make investments commercially viable under market interest rates (see text box in section 2.2.3 page 14).

In the *Dominican Republic*, the longest repayment period that the banks are able to offer averages 5 to 7 years, just as in Sri Lanka. A loan loss provision, determined by the Dominican Taxes Superintendence, requires banks to set aside a high allowance in case of customer default, which in the absence of a guarantee facility makes banks hesitant to move into RE-lending. BHD is the only commercial bank that provides a credit line for RE, EE and cleaner energy production. Its move into the sector was supported by loan finance from IFC and a GEF grant for TA. BHD's credit line offers low-interest (around 5.5 percent) medium-term loans (repayment within 5 years with a 1-year grace period) for small to medium project developers, with 80 percent of the project's investment cost available for financing. BHD markets the facility and is responsible credit appraisal and approval. BHD has set up a TA facility for project development, which provides technical expertise (resource assessment, feasibility studies, etc.) and business assistance to developers through the project preparation process. By mid-2011, BHD has started lending to fuel-switching projects, but not yet to RE projects. *Source: Worldwatch Institute, July 2011*

5.3 Contingent project development grants

A *contingent grant that transforms to a loan if the project is successful* allows development activities to proceed without the developer taking on loans that they may default on if the project cannot be implemented for reasons outside their control. Contingent grants finance project development costs on a cost-shared basis, covering no more than 50 percent of estimated project development costs. To avoid over-invoicing, contingent grants are typically awarded as fixed amounts. The contingent grant addresses two barriers. One is the shortfall of finance for project preparation and development. The other is risk sharing: uncertain country environments make private developers reluctant to take on the development risk fully on their own; resource risks are particularly high in geothermal power projects, environmental risks can block hydropower and the NIMBY-effect windfarms projects.

Some assistance programs apply a different philosophy: *providing development support as a loan, which converts to a grant if the project is successfully implemented.* The stated philosophy for the approach is that it creates incentives for the developer to pursue rapid implementation of the project. To a certain extent the argument has logic: some project developers are interested not in the construction stage of a project but in selling the project rights for a project; they may delay project implementation waiting for better prices. Yet, the modality cannot be recommended as the risk sharing is too awkward: there is no upside for public finance participation in case of success, and a double financial whammy for the investor if he fails!

5.4 Public underwriting support for high priority infrastructure projects

In July 2009 the Victorian Government selected a winning consortium for the construction and operation of a 150 GL per annum desalination plant at Wonthaggi. The Project, due for completion by the end of 2011 has construction costs of A$3.5 billion, making it the largest PPP announced globally during 2009. A long term off-take agreement to purchase all water produced by the plant with Melbourne Water, an entity wholly owned by the Victorian Government, provides long term revenue certainty for the project. . Yet, despite the

long-term State-backed off-take arrangement, the project sponsor had been unable to raise a significant part of the financing required by the time the winning consortium was announced. The shortfall was A$1.7 billion equal to 46% of the project's capital costs. In response, the Victorian Government provided a "Treasurers Guarantee of Syndication" by which the State Government agreed to lend the funding shortfall at commercial rates if the project sponsor was unable to raise the amount by financial close. The debt shortfall was ultimately met by lending banks.

Public underwriting of project finance to ensure that high priority infrastructure projects succeed is a rather exceptional instrument: participants in tenders are supposed to be able to secure financial close. Yet, as seen by the outcome, it was a wise strategic decision, which, in the end, cost tax payers nothing, yet enabled the presumably more favorable project for tax payers / consumers to be implemented without delay.

5.5 Bank Deposit as Liquidity Guarantee

In 2002, a liquidity guarantee was structured for Uganda's West Nile rural electrification project as a means to overcome the hurdle of a central banking regulation which limited the longest maturity of bank loans in Uganda to eight years. The Government of Uganda had switched to a private sector led approach to rural electrification, in which a multitude of agents were to develop and implement rural electrification projects. Engagement of commercial banks in the co-finance of rural electrification projects was a necessity for the sustainability of this decentralised electrification modality.

The West Nile Rural Electrification Company (WENRECO) won a 20-year distribution concession for the isolated regional grid in the West Nile Region, which included operating a 1.5 MW thermal generator and constructing a new 3.5 MW hydro generator. To enable the concession to be commercially viable under the tariff-revenue that was feasible, roughly 80 percent of the total cost of investment was covered by rural electrification grants financed by the Government, assisted by a World Bank loan. Rest-finance was to be provided by investor equity and a bank loan from the investor's (the Aga Khan Foundation) normal bank connection, Barclays Bank, through its Uganda branch. In order to match the conditions of the loan finance with the long-term nature of the investment, a two-step loan finance backed by a liquidity guarantee was chosen. The amortisation profile of the seven year loan was calculated as if it had a term of 14 years, but with a bullet payment of the outstanding principal to be paid at the end of the loan term. The bullet repayment was to be paid by a new 7-year loan given by Barkleys Bank to the concession holder at the end of the 7th year. The arrangement was to be backed by a liquidity guarantee in the form of either a deposit placed by the project in a bank account, which with interest payments was to grow to the amount of the bullet payment within 7 years, or the purchase of a zero-coupon bond[37] by the World Bank with a redemption value, at the seven year point, equal to the required bullet payment. In case of liquidity problems, the Bank could draw the amount, but otherwise it was expected that the Bank would provide the loan without call on the liquidity facility, which then would be used to co-finance other rural electrification projects. In the end, Barclays Bank provided the loan without the liquidity facility being established.

The liquidity facility guarantee removes the risk for the project developer of his Bank not having the liquidity to provide a new loan after 8 years. But to establish a liquidity facility guarantee for a single project is not an elegant solution: the transaction costs are too high and the leveraging effect too modest. Because a cash-type instrument was used, it required a large sum. After seven years, the remaining principal on a 14 year loan will equal in the range of 67% of the original loan principal. Depending on the effective yield on the zero-coupon bond, the purchase price of the bond, will be in the range of 65% of the planned seventh

[37] A zero-coupon bond does not make periodic interest payments and has a face value paid at the time of maturity. It is bought at a price lower than its par (or redemption) value: the difference between the discounted purchase price of the bond and its par value equals the compounded interest paid at maturity.

year redemption value (based on a 6% yield). Therefore, the cash required to purchase the bond, or the original bank deposit, is in the order of 45% of the total loan amount.

In general, liquidity guarantees makes sense only for a portfolio of projects, so the liquidity reserve can be lower than the total guaranteed liquidity reserve. The effort made in the West Nile case must be understood in view of the long-term strategic objective of giving commercial banks in Uganda experience in rural electrification finance.

6 Public Support Instruments for Equity Finance

Medium- to larger sized companies can finance RE project preparation and development through balance sheet finance. As balance sheet finance is not feasible for smaller-scale project developers and for start-up technology companies, they have no access bank loans to finance project preparation and development. Instead, they have to find sufficient equity for this, which can be difficult as few outside equity investors are willing to risk capital in early-stage project or in SME business development activities. Public equity finance is used to cover two financing gaps: (i) capital for project preparation and development; (ii) equity capital for start-up clean energy technology firms.

6.1 Direct equity investments in the preparation of larger scale projects

Investors in *large scale RE projects* can be reluctant to provide pre-construction support; there is a limit to how much of such investment can be placed on companies balance sheets. For this reason, the *Crown Estate in the UK* participates with up to 50 percent in joint ventures for project development of (a.o.) offshore wind energy. The Crown Estate moves out of the project once it reaches financial close.

6.2 Equity funds for investing in RE-project development

Equity funds for clean energy, ranging in size from USD 50-250 million typically invest a minimum of US$5 million and up to US$35 million in individual projects. With these investments, they are relevant for *medium to larger scale RE-projects* only. Equity funds have high management costs. Fund managers typically charge a fixed annual management costs of 2-2.5% of committed capital and a performance fee of 20% of profits beyond a minimum rate. The equity fund instrument makes sense only in countries that have moved to a stage in their energy policy where investors can see the emergence of an interesting clean energy market. Otherwise there is no basis for the operation of private equity funds – the fixed annual management costs are too high to allow slow investment uptake.

Funds offer the target group of small-scale project developers and upstart RE-technology firms not only equity capital but often also management expertise.

Three modalities for public equity involvement can be seen. One is to invest in a fund-of-funds that in turn invests in private equity funds investing in clean energy projects. A second are direct investments in a private equity fund. The third is to set-up a public-private equity fund managed by a contracted manager found through competitive bidding; alternatively, if a private equity company wants to coinvest from the beginning as lead investor, it will typically also want to be fund manager.

GEEREF, set up in 2008 by the European Union, Germany and Norway, is a fund of funds that primarily invests in RE and EE infrastructure funds and similar investment structures in the African, Caribbean and Pacific region, non-EU Eastern Europe, Latin America and Asia. The committed €108 million are to be invested over a period spanning from 2009 to 2012. GEEREF typically invest below €10 million, a market niche usually ignored by private investors and international finance institutions. GEEREF is advised by the European Investment Bank Group: the European Investment Bank and the European Investment Fund.

Berkeley Energy's *Renewable Energy Asia Fund (REAF)*[38] received in 2010 commitments from six emerging market institutional investors - BIO, CDC, Calvert, DEG, GEEREF and FMO. This enabled

[38] Berkeley Energy, based in UK, is a private equity fund manager specialising in renewable energy infrastructure investments in developing markets with an initial focus on Asia.

REAF's first closing of €50.7 million; the target fund size for REAF is €150 million.[39] . With investments ranging from €5 million to €25 million, REAF aims to take controlling stakes in project developers and in development stage RE projects in wind, small hydro, biomass and solar power, geothermal and landfill gas, transform these investments into operating portfolios and generate superior returns through successful exits. The Fund's geographical focus is primarily India with additional target markets including Philippines, Sri Lanka, Thailand and Vietnam.

InfraCo Asia Development Pte. Ltd. (InfraCo Asia) managed by InfraCo Asia Management Pte. Ltd. a private sector infrastructure development company.[40] By acting as a principal project developer, InfraCo Asia aims to stimulate greater private investment in infrastructure development in low-income countries of South and Southeast Asia. InfraCo Asia focuses on smaller-scale projects (up to US$75m). InfraCo Asia aims to reduce the entry costs of private sector infrastructure developers by acting as principal, taking an equity stake in the project to shoulder the risks of early stage development costs and providing development expertise through its team of experienced developers. InfraCo Asia also arranges project debt and equity capital from third parties, as well as other InfraCo affiliate programmes. InfraCo Asia retains an equity stake in the projects it develops to provide market confidence through the earlier operating period.

6.3 Equity capital for early-phase RE technology firms and clean energy businesses

The EU-Commission's 2007-13 'Competitiveness and Innovation Framework Program (CIP)' has several schemes and a budget of over €1bn to facilitate access to loans and equity finance for SMEs where market gaps have been identified. The CIP financial instruments are implemented for the Commission by the *European Investment Fund (EIF)* on a trust basis. The *High Growth and Innovative SME Facility (GIF)* provides risk capital for innovative SMEs, including clean energy firms, in their early stages. It has two windows.

- *GIF 1 covers early stage (seed and start-up) investments investing in specialised venture capital funds* such as early stage fund, funds operating regionally, funds focused on specific sectors, technologies or research, technologies or research and technical development and funds linked to incubators, which in turn provide capital to SMEs. Co-investment in funds and investment vehicles promoted by business angels is also permitted. EIF can usually invest 10 to 25% of the total equity of the intermediary venture capital fund or up to 50% in specific cases.
- *GIF 2 covers expansion stage investments by investing in specialised risk capital funds*, which in turn provide quasi-equity or equity to innovative SMEs with a high growth potential in their expansion phase avoiding buy-out or replacement capital for asset stripping. EIF can invest 7.5 to 15% of the total equity of the intermediary venture capital fund or, exceptionally, up to 50%.

The Asian Development Bank (ADB) made an equity investment of $20 million in the *Clean Resources Asia Growth Fund (CRAGF)*, targeting private equity investments in promising clean energy technology companies. The private equity fund, sponsored by CLSA Capital Partners, a brokerage and investment group active in Asia since 1986, targets businesses engaged in clean energy-related operations in Asia, with the main focus in the PRC and India. It will make about 12 to 14 investments, taking significant minority positions in investee companies. The targeted fund size is $200 million.

The UK Innovation Investment Fund is a public-private fund of funds co-financed by the UK Government and private financiers. The manager is Hermes Private Equity/ European Investment Fund. It invests in funds covering low carbon/clean tech, and digital, ICT, life sciences and advanced manufacturing.

[39] ADB invested $20 million into the REAF in 2011.

[40] InfraCo Asia is part of the InfraCo Group funded by the Private Infrastructure Development Group (PIDG) members of which include the development agencies of Austria, Ireland, the Netherlands, Sweden, Switzerland and the UK, and KfW and the World Bank Group. ADB has invested US$20 million in InfraCo Asia.

6.4 Pulling private equity firms into seed finance

Seed finance is for the early-stage investment phase in a clean energy business. The objective of SCAF, see the text box, is to pull private equity capital funds and venture capital funds into the SEED capital phase (which they normally would not touch), as a means to build portfolios of new projects for them to invest in. The tool for this are cost-sharing grant instruments. SCAF has signed two SCAF Cooperating Fund Agreements in Asia, with Berkeley Energy a private equity fund focusing on wind and small hydro project developments in the Philippines, Sri Lanka and India, and with Aloe Group, a venture capital fund focused on new clean energy technologies and business ventures in India and China. SCAF provided support to five other fund managers to help prepare new clean energy funds with an early stage focus. These are Yes Bank, IndiaCo, E+Co, Low Carbon Investors Asia and Conduit Capital. In Africa SCAF signed last year an initial Cooperating Fund Agreement with Evolution The results on the ground are just starting to happen. As examples of enterprise developments activities, in India Aloe Group just ran an investment forum as part of the REFF India conference while IndiaCo has run a business plan competition for new energy efficiency ventures, also in India. In terms of projects being supported, in South Africa Evolution One fund has seed funded a development company called RedCap to undertake permitting and other development for a 100 MW wind farm development in the Eastern Cape province.

Seed Capital Assistance Facility (SCAF) is a GEF-funded initiative of UNEP, ADB and AfDB, operating in cooperation with EIB. SCAF helps venture capital and private equity fund managers to include portfolios of early stage focused seed transactions within their overall investment holdings. The Facility aims at mobilising private investment for early stage project developments and ventures. For each seed investment that fund managers make in first-time clean energy projects, the Facility cost-shares a portion of the project development and transaction costs.The SCAF support line for *Enterprise Development Support* is used to cost-share some of the elevated costs associated with deal sourcing, providing enterprise development services to and transacting seed scale investments. . Each cooperating fund manager decides the services they will offer, based on the local context, however the common elements of these services generally involve: (i) identification and training of new 'pre-commercial' clean energy entrepreneurs and project developers; (ii) targeted coaching or incubator services for specific promising investment opportunities and (iii) co-financing of pre-investment feasibility studies. The Enterprise Development Support comes in the form of annual fees, time limited to between two and three years, the time it normally takes to graduate seed financed developments into full-scale investments. This support is provided as a contingent grant, requiring that the cost-shared activities lead to corresponding investments being taken by the fund's seed window. The SCAF support line for *Seed Capital Support* is designed to help offset the hurdle of higher perceived risks and lower expected returns when dealing with early stage clean energy project and enterprise developments. The level of support provided is negotiated with each cooperating fund manager and then paid on a standard basis with each project. Typically the support is in the range of 10% to 20% of each seed capital investment, paid at the time of investment disbursement. This support is used for covering some of the elevated project development costs that normally are charged to or financed by the developer, for example technical assessments; contract negotiations for fuel-supply or off-take agreements; environmental impact analysis; and other aspects of the permitting process. Results: Cooperating fund managers to date are Evolution One Fund (Southern Africa); DI Fund (Southern/Eastern Africa); Berkeley Energy (South Asia); and Aloe Private Equity (India, China). In total these four funds are capitalised at approx. $550 million. Each PPP arrangement involves ~$1 million of project development grant from SCAF disbursed against $5 million of seed financing from the fund, helping leverage around $200 million of construction stage financing for RE or EE projects.

7 Mezzanine Finance: Debt and Equity Support

7.1 Closing debt and/or equity gaps

Mezzanine finance is a term used for very flexible forms of debt finance that take higher risks than normal debt finance and are compensated for this through higher rates of return. Mezzanine finance is the most versatile of all public finance instruments. One major form is *sub-ordinated debt*: a sub-ordinated loan stands behind other investors upon insolvency or winding-up. The other is '*quasi-equity'* in the form of convertible loans with patient and very flexible repayment terms. These instruments are used to cover two very different finance gaps.

1. One is inability to *secure debt* because commercial finance institutions consider the risk of default too high. Subordinated debt provides in the range of 10 to 25 percent of a project's sources of funds. A subordinated loan reduces the amount of senior debt and improves the senior lender's loan-to-value and debt service coverage ratios.

2. The other is to *cover an equity finance gap* when the investor's equity is insufficient to comply with the minimum equity requirement for loan eligibility, or, when a start-up technology company or a start-up project developer is unable to access commercial loan finance at all. A convertible loan is unsecured debt, requiring no collateral to be put up; instead, lenders have the right to convert their stake to an equity or ownership in the event of a default on the loan.

A mezzanine loan to a project can even satisfy both objectives, enabling an investor to get a project financed with a lower equity percentage (e.g. 20% instead of 30%) than is normal and with the senior loan financing a lower percentage of total project cost than in an average RE-project in the country (e.g. 55% instead of 70%).

Subordinated debt can also be used to *extend the effective term of loans*, thus helping project cashflows and project viability.

7.2 Sub-ordinate loans to leverage senior loan finance

In normal circumstances, the administrative costs of a loan transaction for a bank are the same whether or not another bank co-finances a project. Co-finance of project debt is of interest to commercial banks only when loan syndication is a necessity because the size of the required loan is beyond the bank's policy for exposure to individual loans. However, co-financing by a development bank in the form of a sub-ordinated loan provides two benefits to the senior lender. One is the reduction in lending risk provided by the sub-ordination, as the senior loan has priority access to recourse to a borrower's assets in case of loan default. The risk reduction can enable a RE-project to come within the risk limit of a bank's lending policy, enabling the responsible loan officer to engage in a risk project the bank otherwise would have shied away from. The other is to allow the senior loan giving bank to piggy-back on the RE-project experience of the development bank providing the sub-ordinate loan. The fact that an experienced development bank has sufficient trust in a project to engage in sub-ordination, provides added comfort to the senior lender's decision to engage and reduces the bank's costs for due diligence.

The sub-ordinated loan instrument can be useful in the early phases of RE-promotion and in connection with the introduction of new technologies, previously not tested in the project country. It is also useful in later stage phases, when no partial risk guarantee facility can be accessed.

7.3 Closing equity finance gaps for small scale RE-power projects

A prime virtue of mezzanine finance given in the form of a convertible loan is its flexibility. Unlike conventional loans its repayments need not be tied to a fixed amortisation schedule. It can be structured with equity-like patient capital features. For example, the amortisation on mezzanine finance for start-up SMEs developing RE-technology or providing RE-related services can be structured as royalty payments: a fee per product sold until the mezzanine loan including interest is repaid.

In RE-project finance this flexibility is an advantage for RE-power plants with variable resource flows from year to year; e.g. wind farms or mini-hydropower plants. The *Central American Renewable Energy and Cleaner Production (CAREC)* mezzanine finance fund managed by E+Co assists the finance of projects that is blocked by high collateral and project equity requirements for commercial loans. CAREC finances up to 25% of project capital costs for RE projects offering unsecured loans or additional project equity. The terms of CAREC finance are matched to a project's revenue stream, loan payment come out of revenues net of operating costs and senior debt service.

The difficulty on the equity-finance side arises from the fact that small scale power projects are not attractive to professional project development companies, or to power utilities: both look for projects in the size of 50 MW as a minimum. Entrepreneurial-type project developers who are interested in small-scale projects and often undertake the first steps towards the preparation of these, often have insufficient equity capital to secure financial closure. The French government's willingness to make mezzanine finance, rather than a PCG, available, is probably linked to the long French tradition of public-private co-investments in industry; the US government most likely would have chosen the PCG-instrument instead. Management of FIDEME insists that the mezzanine finance investment provided a better – positive – return to the public coffer.

French **FIDEME** is a public-private mezzanine fund open to French SME who face debt/equity gaps. FIDEME shows how "double leveraged mezzanine finance" can address lack of investor equity in project finance. Although the French Government had introduced feed-in-tariffs for projects up to 15MW, inter alia, for wind farms, few projects were developed as interested project developers were unable to secure sufficient equity. In 2003, ADEME, the French Environment and Energy Management Agency, and the French commercial bank Natixis launched FIDEME (Fonds d'Investissements de l'Environnement et de la Maîtrise de l'Energie), a €46 million public-private mezzanine fund. ADEME invested €15 million, one third of FIDEME's capital, as *a subordinated tranche within the private fund, providing a first loss guarantee to the private senior lenders* in the fund. The fund then provided *subordinated financing (convertible bonds or bonds with share warrants attached) to projects as a means to help sponsors to fill the debt-equity gap* and attract senior lenders. A typical finance structure would be composed of 80% senior debt, 10% FIDEME mezzanine loan and 10% developer equity. The fund was open to French RE-SMEs who faced debt/equity gaps on their balance sheets, and was based on the concept of non-additionality, meaning that if FIDEME did not finance the project, it would not be implemented. Results: The double leverage structure allowed ADEME to mobilise €320 million in investment, over 20 times its public funding contribution. By the end of 2006, FIDEME had financed 27 RE projects with a total capacity of over 300 MW in wind-power, biomass, hydro, and geothermal energy. The estimated IRR was 10%, whereas the initial target had been 7% only. The success led Natixis to establish a follow-up in 2008, EUROFIDEME2, this time on a purely commercial basis as the RE market in France has matured beyond the need for ADEME public finance support. Natixis put €25 million into the fund, and its target is €250 including contributions by other financial institutions. Source: Mostert (2009)

8 Consumer Finance

8.1 Finance facilitated through electricity bill invoicing

Several countries, as well as state and local Governments in the USA have given investment grants – or rebates, as they are called in the case of consumer goods – to *RE-systems at homes and offices*. Consumers apply for rebates at the time of purchase of equipment and systems. In some countries, the rebates are given under DSM-programs and paid for with public benefit funds collected as a fee on consumer purchases of electricity from utilities. In other countries, e.g. in the case of Tunisia's solar water heater support program, the finance for the rebates comes from the state budget.

Tunisia's Prosol program. In 1995, the annual market for *solar water heaters* (SWH) was less than 1000 sq.m per year. A GEF-supported project, which provided an upfront subsidy of 35% to the systems succeeded in pushing the market to 17,000 sq.m. per year by 2001. The disappearance of the GEF-subsidy after 2001 led to a 50% drop in annual the market; a further contributing factor was a perceived poor quality of the installed systems. Things changes with the launch in 2005 of the *PROSOL* program, which applies a well conceived and integrated approach that combines demand side and supply side actions. PROSOL is implemented by the Ministère de l'Industrie, de l'Énergie et des Petites et Moyennes Entreprises and l'ANME in close collaboration with STEG, the financial sector, and SWH-installers. PROSOL focused initially on the promotion of 200 and 300 litre SWH-systems for residences aiming to install 500,000 m^2 by 2009. The financial and TA-support provided by PROSOL is co-financed by the state, GEF, UNDP and MEDREP (Italian Government). Financial support to SWHs comprises a direct investment subsidy as well as an interest rate subsidy. SWHs get a subsidy of 100 DT (€59) per m^2 up to a total sum of 400 DT, which amounts to 19% of the installed price of a 200 litre 2 m^2 SWH (price of 1100 DT) and to 22-27% for a 300 litre 4 m^2 system (1500-1800 DT price). The purchase of a 2m2 SWH costing 1100 TD is financed by the subsidy of 200 TD, consumer cash payment of 150 TD, the remaining 750 TD by a five-year bank loan with an interest rate of 7% instead of the usual 14%, and which is repaid through a surcharge on the monthly electricity bill. The interest rate reduction is achieved partly by a US$2m GEF-grant, partly by STEG administering the amortization of the loan on behalf of the banks: it reduces the costs of transaction for the banks and eliminates the need for collateral. Supply side actions to increase annual production capacity as well as the quality of SWH. In 2006, Tunisia had 11-13 SWH-dealers (manufacturers and importers) and more than 380 "société installatrices". The installers are in principle authorized - ANME gives short term training courses (1-3 days courses) to installers - but in practice the criteria for authorization are applied softly in order not to slow down the development of the market. ANME also gives training courses to SWH-consultants for dimensioning systems for commercial buildings and supervising the construction work, also here an authorization system is used. Consumers get a one year guarantee for installation, a 5 years for the water tank and 10 years for the solar collector. STEG is represented by offices in all districts in the country and provides information about the program. The residential program is now supplemented by a SHW-program targeting hotels.

8.2 Lowering barriers to bank entry into RE-consumer finance

UNEP's solar loan program in India drew on inspiration from innovations introduced by SELCO, a solar home system developer active in several third world countries, including India. Equity investment for its India subsidiary was provided, inter alia by E+Co; which also gave a bank guarantee allowing SELCO to access funds for direct consumer financing. SELCO pioneered several methods to engage local participating banks. (i) Using its own funds and in some cases grants funding, SELCO paid banks a small closing fee for each loan closed; this helped address high transaction costs and keep loan pricing attractive for borrowers. (ii) SELCO provided a small security deposit to the banks equal to two months loan payments; these funds were deposited with the lending and applied to the borrower's last two monthly payments. The deposit therefore performs two functions: added security for the lender and an incentive to the borrower to complete their monthly payments so as to earn the discount represented by these funds. (iii) SELCO also provides buyback guarantee to the local banks to repurchase the SHS systems from defaulted borrowers. This is a contingent liability, not on the SELCO's balance sheet.

India - UNEP Solar Loan Programme. The objective of the program was to motivate CFIs with a large number of bank offices in rural areas to engage in solar homes system finance. The program used two public finance instruments: an **interest rate subsidy** for borrowers, distributed through participating local banks and **transaction cost support** in the form of fees paid to the participating local banks per closed loans. Simplified loan application and procedures where used to process the solar loans to make them more appealing to the targeted households. Grant funds were used for training and other capacity building activities, including qualification of SHS vendors. The UNEP interest rate subsidy does not cover the interest rate per se, but is calculated as an amount equivalent to buy down the interest rate (for example from a 12% commercial rate to only 6%) over the term of the loan. The local banks still lend to borrowers on a commercial rate basis. The calculated subsidy amount, equal to 2-6 monthly loan payments on a five year loan, is placed on deposit with the bank and applied to offset the borrower's last monthly payments. Hence, the customer would only get the subsidy after successfully repaying the loan. The banks receive training and assistance in business planning and marketing of the SHS loans. The partnership between the vendors and the banks and the subsidized loan help to promote the sale of SHS to an annual level that makes lending to SHS commercially interesting for the banks also after the terminiation of the program. **Impact:** The programme disbursed around 19,500 loans, with 2076 bank branches participating in the programme and 5 qualified vendors.

9 Public Risk Sharing Instruments

Finance institutions classify RE-projects as higher risk clients because of:

(i) lack of full competitiveness on the market, making them dependent on policy and regulatory support;
(ii) higher capital intensity than conventional energy technologies;
(iii) newer, less proven technology; and
(iv) in some cases, small project size by project finance standards.

The situation makes risk reduction instruments an effective tool for leveraging private finance.

9.1 Publicly-backed guarantees to attract commercial debt finance

A publicly-backed guarantee (PBG) is a contractual obligation by which a government (institution), against payment of a fee, assures compensating payment to a lender or an investor in case of default on an obligation that another party is committed to. Whereas insurance involves two parties, guarantees involve interlocking contracts between three parties.

- In the case of *partial credit guarantees (PCGs*), the contracts are between lender and borrower (loan agreement) and between guarantor and lender (guarantee agreement).
- In the case of *partial risk guarantees (PRGs*), the contracts are between guarantor and investor/lender and between guarantor and the host country government (for example a commitment to pass a law introducing feed-in-tariffs).

PBGs can assist beneficiaries in: (i) providing them access to finance, (ii) reducing their cost of capital, (iii) expanding loan tenor or grace periods to match project cash-flows. In some cases, these qualities make PBGs complementary to other public finance instruments; in others, PBGs are the least-cost alternative.

9.1.1 Guarantees to RE project loans

If the ability of a guarantee facility to pay claims is to be credible, it must have a large portfolio and a solid capital base to draw on. Guarantors must keep enough money in an account to cover the contingent liability of the loan guarantee: the present value of the expected payouts on the guarantee, inclusive of any recovery in liquidation (from selling the project's assets). An outside counter-guarantee facility could help establish the credibility.

Guarantee to pluri-annual PV-investment program. *NRG Energy Inc*., *an independent power producer*, was awarded a conditional loan guarantee from the Financial Institutions Partnership Program of the U.S. Energy Department to a $2.6 billion distributed solar PV- program, named *Project Amp*. The guarantee covers 80 percent of $1.4 billion in debt facilities provided by *Bank of America Corp*, which will use a structured method of loan disbursement that takes into account the project size, risk, and capital intensity. The four-year program aims to install rooftop photovoltaic projects with a total capacity of 733 megawatts on 750 industrial buildings owned by *Prologis Inc., the world's largest warehouse manager*. The systems will feed electricity into the grid, rather than supply power to the buildings where they are built. An initial 15.4-megawatt installation in Southern California will sell power to Edison International utility Southern California Edison Co. NRG has agreed to provide equity financing for the program over the next 18 months and has a right of first offer to fund the remainder. Prologis also invests in each phase.

The normal procedure, when a loan guarantee for a specific program with multiple loans is set up, is to establish a *first loss guarantee facility*.

The US federal government's loan guarantee program has been a particularly important risk reduction instrument for projects implemented in the wake of the 2008 financial crisis. The Section 1705 loan guarantee program expanded the eligibility criteria to include also RE-projects using well-known technologies as a means to secure RE-investments going at a time when the risk willingness of banks and their lending ability had become sharply reduced. A large number of windfarms, CSP-plants and PV-power plants had signed committed PPAs with utilities, but without loan guarantees the private commercial banks could not have provide debt under the long terms and the interest rates that are needed to match the PPA-contracts. In addition, loan guarantees were a condition to draw debt financing from the Federal Financing Bank.

9.1.2 Guarantees to loans for high tech start-up firms

As a means to promote the goal of green job creation, the US federal government's loan guarantee program also gave guarantees to the debt financing of investments in new clean technology firms. The bankruptcies of three American solar power companies in August 2011: Solyndra, Evergreen Solar and SpectraWatt. Solyndra and Evergreen suffered because they pursued innovative technologies whose competitiveness depended on their using less polysilicon, the main material for solar panels. That became less important because polysilicon prices have tumbled more than 80 percent in the last three years as output has caught up with demand. Because these companies had received loan guarantees for hundreds of millions of dollars - Solyndra received US$535 million in federal loan guarantee the program was heavily critizised by the Republican politicians as yet another example of wasteful use of tax payers money. Yet, the criticism that high-tech gambles fail and that the private investors risked US$1 billion on the Solyndra project.

Korea is setting up a $97 million-guarantee fund for investments in small renewable-energy companies. The fund can provide guarantees equivalent to 12 times its face value, meaning it could provide guarantees to as much as 1.24 trillion won ($1.16 billion) in debt finance. Finance for the fund is raised from power generators, energy distributors and banks. The Korea New & Renewable Energy Association, acting on behalf of the contributors, receives applications, and an eight-member recommendation committee will create a shortlist and propose them to the two specialized guarantor organizations the Korea Credit Guarantee Fund and the Korea Technology Finance Corporation that managed the Fund. Successful applicants will get five-year guarantees on as much as 10 billion won in loans, and pay lower fees and interest rates.

9.1.1 Wrapping of project bonds to pull institutional investors into RE-project finance

Project bonds are issued after commissioning to refinance the costs of project development and construction: due to their risk characteristics, project companies are generally not able to issue bonds of investment-grade rating until after the completion of the project construction period and the confirmation of operating results. Compared to the US, where projects in the energy and infrastructure sector have accessed debt capital markets, the depth in the institutional market is low in other countries, making banks the major providers of RE-project finance. Yet, the change to low-carbon economies calls for more active involvement of institutional investors in project finance through the bond finance market. This requires that issued project bonds achieve investment grade status, (meaning at least a BBB rating from Standard &Poor or a Baa rating by Moody): financial sector regulations permit banks and institutional investors to invest only in investment grade bonds. Institutional investors have a preference for 'AAA' and 'AA' (high credit quality) bonds rather than in 'A' and 'BBB' (medium credit quality) bonds. Before the 2008 financial crisis, the investment grade status requirement was fulfilled by having capital market issuances in the RE sector be insured by monolines insurers with AAA credit ratings. The credit rating of the insurer is implicitly transferred to the insured bonds; insured/guaranteed bonds are called 'wrapped bonds'. The analytical work of the insurer permits institutional investors to invest in wrapped RE project bonds without having the specialist expertise to

appraise complex RE project structures. However, most monolines lost their AAA credit ratings during the financial crisis and this source of insurance cover dried up.

The *Risk Sharing Finance Facility (RSFF)* was set up by the European Commission with a €1bn contribution from the European Investment Bank (EIB) and the same amount from the Commission's 7th Research Framework Programme (2007-2013). The credit risk sharing between the European Community and the EIB extends the ability of the EIB to provide loans or guarantees for investment with a higher risk profile. Under the RSFF, the EIB can accept exposure to higher credit risks than under its normal lending activities, either in the form of counterparts with a higher risk profile or through transaction structures involving higher financial risks for the EIB. The RSFF enables the EIB to lend more than EUR 10bn for the target types of project investments. The share of EIB financing is limited to 50% of the total amount of eligible project cost.

Wrapped tranch for solar power project bond for Montalto di Castro solar park. The US firm SunPower Corporation manufactures solar energy systems and acts as solar power project developer. SunPower closes industry-first solar bonds 16 December 2010 . It sold €195.2 million of bonds linked to the Montalto di Castro solar farm in Italy. The proceeds will be used to refinance the final two 44MW phases of the completed solar farm. The 18-year fixed rate bonds were issued in two €97.6 million tranches. The first tranch was guaranteed by SACE, the state-owned Italian guarantee company, and rated Aa2 by Moody's; it pays 5.715% and was sold to institutional investors. The second tranche was naked and rated Baa3; it pays 4.839% and was purchased by the European Investment Bank (EIB). The higher payment rate on the first tranch covers the cost incurred by institutional investors for the guarantee. The lead managers for the issue were BNP Paribas and Société Générale. Results: This is the world's first publicly rated bond issue for a solar project, as well as Italy's first rated project bond. Achieving investment grade ratings is a milestone for the solar sector. It opens up a new global-scale pool of capital to fund solar projects beyond traditional project financing from banks. *Source: Environmental Finance, 16.12.2010*

The innovative project bond finance facilitated by the EIB for SunPower Corporation's Montalto di Castro solar park is one outcome of the RSFF (see the text box). EIB and SunPower Corporation looked into the possibility of a loan syndication arrangement with private Italian banks with the EIB providing its debt finance as a junior loan to the senior loans provided by private banks. That option was dropped for two pragmatic reasons. One was that the banks were unwilling to provide project loans with a tenure of 18 years, on terms that were acceptable to the project owner. The banks insisted either on giving a senior loan of 18 years, but with the bank having the right to revise its pricing after 8 years. Or, they insisted on the hard term of requiring a new loan to be negotiated after 8 years. The other reason was the demand by the banks for higher equity co-finance than the project owner was interested in. Instead, it was decided to get institutional investors involved in the finance by issuing a project bond, using RSFF-money to beef the project bonds up to the rating required by institutional investors for project bonds. Getting the bond finance structured involved hard work on the legal side. In Italy, the National Bank regulates bond issues. The regulations are heavy on protection of investors, requiring the project to create several vehicles to protect investors.

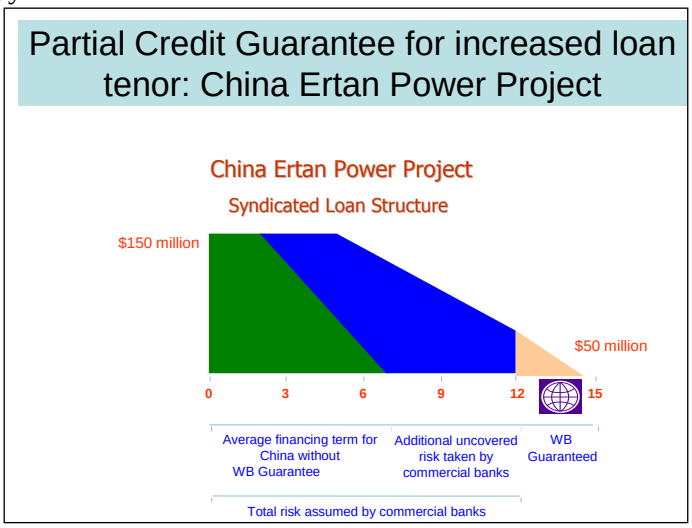
9.1.2 Liquidity guarantee for extension of loan tenor

The length of tenor can be a key limitation experienced by project developers seeking local financing. By covering certain risks GuarantCo[41] can help extend tenors to more appropriately match the financing requirements of the project developer. For example, assume the project developer is seeking ten year money but a local bank is only able to provide 7year money. The loan can be structured as a ten year loan with

[41] GuarantCo was developed and is financed by the Private Infrastructure Development Group (PIDG), a multi-donor organisation. Members include: the UK Department for International Development (DFID), the Swiss State Secretariat for Economic Affairs (SECO), the Netherlands Ministry of Foreign Affairs (DGIS), the Swedish International Development Cooperation Agency (Sida), the World Bank and the Austrian Development Agency (ADA).

GuarantCo providing a guarantee for the repayment of all outstanding debt in year 7. The fees and margin payable to the local bank and GuarantCo would be structured in order to provide an incentive for the local bank to continue with the financing for the full ten years.

The World Bank issued a US$50 million partial credit guarantee in the China Ertan Power Project covering the later maturities of commercial loans to finance the expansion of a public sector hydroelectric power plant. The guarantee agreement expanded loan tenor from 7 to 15 years, although the guarantee only covered payments during years 13-15.



9.1.3 Put option to guarantee payment of principal in bond issue

The *Leyte-Luzon geothermal power plant project* was implemented by the National Power Company (NPC) and the Philippine National Oil Company (PNOC), both state owned companies. The NPC raised US$100 in project finance through a 15 years' bond issue on the international capital market. The World Bank provided a credit guarantee to the bond issue structured as a put option for principal repayment at maturity: it allowed bondholders to present or "put" their bonds to the World Bank at maturity for payment of principal. The purpose of the PCG was to help the government entity access long-term financing on the international capital market and thereby to give NPC access to debt with a longer tenure than the 10 years that were feasible on the national finance market.

9.1.4 Guarantees for contingent cost over-run facility

A partial guarantee has been provided to a $75m contingent cost overrun facility for an oil refinery in Southern India. So far no RE-project seems to have benefitted from a similar guaranteed contingent cost overrun facility; but it is a feasible instrument.

9.2 Resource risk cover

9.2.1 Resource insurance

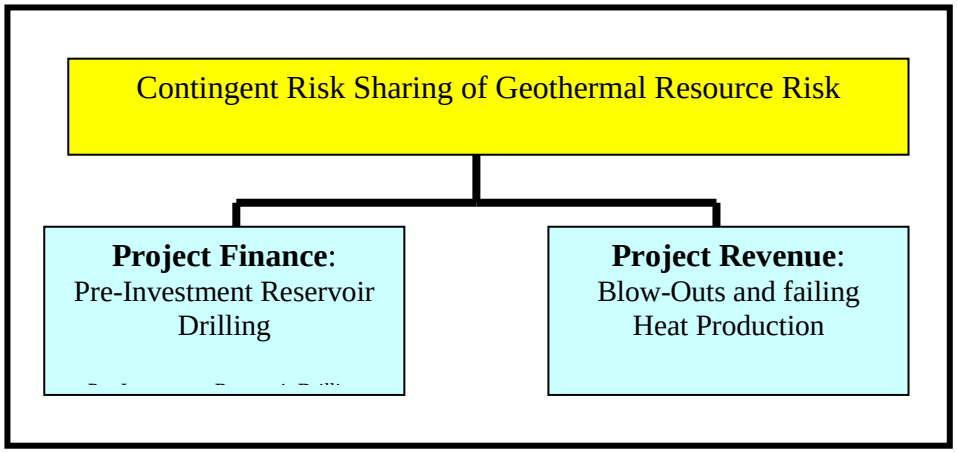
For technologies which are inherently dependent on uncertain resources, wind and solar insurance can be used to provide coverage against unusually cloudy or still periods. Insurance would generally not be available for hydrology risk or for biomass projects.

Commercial insure exists against lost revenue in event of lower than expected output due to lack of wind or sun (wind / solar insurance).

9.2.2 Geological risk insurance

Although geothermal power projects in countries with high-quality resources can offer their output at tariffs that are reasonably cost-competitive by RE-technology standards, it has been difficult to get projects off the ground. High upfront investment requirements, geological risks associated with drilling and a typical five-year development timeline, from resource exploration to commercial operation present heavy obstacles.[42]

Geothermal energy poses two risks for investors. During the pre-investment phase, rather large investments are needed to establish the geological resource potential at the investigated site, and checking whether it can be exploited commercially. During operation, the resource may turn out to be less attractive than estimated, with the result that peak production capacity declines after a few years.



Annex II provides a detailed description of the experience of two World Bank/GEF's GeoFund Program, which provides guarantee facilities for geothermal resource exploration:

- The *World Bank-GEF's ECA Geothermal Energy Program*, started in 2004, set up a Geothermal Energy Development Fund with three financing windows: a technical assistance window, a partial risk guarantee window, and an Investment Funding Window. The PRG facility, endowed with US$12 million, partially insures project investors against the short-term up-front geological risk of exploration and/or the long-term geological risk of facing a lower than estimated temperature, higher than estimated mineralization, or difficult re-injectivity.

- The African Rift Geothermal Energy Development Facility (ARGe) Risk Guarantee Fund gives PRGs to early stage exploration drilling, where there is a considerable probability of unsuccessful drilling. For later stage production drilling for advanced field assessment, the drilling-failure rate is much inferior; therefore, insurance for this to be provided on a commercial basis. The recipient of a guarantee will be charged a fee of 2-3% on the eligible drilling expense and payable upfront upon signing. The guarantee premiums and fees to be charged to the applicants are not set at the level to make the facilities financially self-sustainable. It is believed that commercial insurance premiums would be prohibitively high for investors. Depending on the frequency and severity of the payout events, the financial resources allocated to the guarantee cover will eventually be depleted overtime.

Due to the prolonged global financial crisis, the private sector risk insurance market for geothermal development has not expanded as expected at the time of the launching of the GeoFund Program, which limited the opportunity for leveraging GEF resources with the private risk insurance market. Nor has the off-

[42] In some countries, good resources are located in national parks, which poses additional restrictions.

take in terms of geothermal exploration projects been as high as expected when the fund was launched. But that is not the fault of the instrument but of the framework conditions for RE-investments in the countries.

Chile has potential to host upwards of 3GW in geothermal capacity but geothermal exploration risk constitutes a barrier to development of this potential. The Government of Chile announced in 2009 a *program to insure 30-70% of the costs of unsuccessful geothermal exploration wells*. The dry-well insurance will be made available to any company that manages to secure a geothermal exploration concession. The first unsuccessful well will have 70% of its costs repaid by the government program; this will decrease to 50% for the second and 30% for the third. Total liability is capped at USD $8 million.

9.2.3 Credit lines for high-risk investments in geothermal drilling

KfW is implementing agency for the German Ministry of Environment's *credit program "Resource Risk in Deep-Geothermal Exploration Drilling*". Drilling projects comprising at least two deep-well drills in the business plan (production and injection drill) are eligible. KfW will lend to cover up to 80% of eligible costs. Maximum loan amount is €16 million per project. No collateral is required. Maximum tenor is 10 years, grace year is 2 years.

A particularly interesting aspect is the collaboration of a commercial insurer in the program. The commercial Munich Counter-Guarantee Company (Münchener Rückversicherungs-Gesellschaft AG) collaborates with specialist advice and provides a *partial counter-guarantee for KfW loans* to project developers. KfW must protect its AAA-rating!

9.2.4 Tolling arrangement for removing geothermal risk

The *tolling arrangement* represents the extreme case of upfront risk sharing. In this, a Government entity invests in the exploration and development of a geothermal resource. Once the commercial feasibility of exploiting the resource is established, the national energy regulator issues a tender for the *electrification part* of the project. The tender can be:

- for a *steam purchase contract*, in which case the electricity generator sells the electricity on the power market,
- or a *steam-to electricity conversion* contract, in which case, the government entity – a state owned power company - provides steam to the plant without cost and accepts power generated from the plant against a conversion fee.

The scheme has two drawbacks: no private capital is attracted to finance geothermal exploration and the geothermal plant; and the assumed efficiency advantage of private investors in the construction and operation of the plant is not exploited.

9.3 Other Insurance

9.3.1 Regulatory risk insurance

A risk project developers face is that a feed-in-tariff awarded to a project is taken away a few years after project start. An option is to buy an insurance policy for the project developer against the feed-in tariff disappearing. The policy can be structured as a 'put option.

9.3.2 Insuring technology risks

To promote entry of new technologies, private-public cooperation could design insurance for RE-technologies regarded as too risky for conventional insurances, providing protection against a technology not performing at the level projected by its developers. Project developers would pay a premium for the insurance for the reparation or replacement of underperforming pieces of equipment and receiving liquidated damages up to the value covered by the policy. Insurers would provide the requested technical skills to assess specific technology risks and some of the finance for the insurance pool, with public funds providing finance to the pool on a first loss basis.

9.3.3 Political risk insurance

The political or regulatory risks associated with many RET projects intakes the form of **political risk insurance** (PRI) or a **partial risk guarantee** (PRG). These are offered by a number of multilateral institutions and bilateral credit agencies, including IDA, IBRD, IFC and MIGA within the World Bank Group. Such a guarantee covers the risk that a project defaults due to the actions of government or public sector agencies, for example, expropriation or a breach of contract, , e.g. failure to honour PPAs, that cannot be relieved by other means. PRGs offered by IDA and IBRD are secured against a matching counter-guarantee from the host country government (so that, if the PRG is called, IDA or IBRD then seek recovery of the costs of the guarantee from the government). This acts as a very powerful incentive for the host country government to meet its obligations.

10 Public RE Funds and RE-Finance Agencies

An emerging international trend is to create *national RE-funds with authority to decide how a multiple of public finance instruments can be used to achieve maximum impact from the fund's capital*. The funds represent the institutional answer to address two specific complexities of clean energy finance: (i) different RE-technologies pose very different finance challenges due to differences in technological maturity and financial competitiveness; (ii) the technical supply chain for RE can have very specific financing gaps.

10.1 Funds and specialized agencies for RE-project finance

The last two years have witnessed a proliferation of RE-Funds. Some are national, e.g. the UK's 'Green Investment Bank', Kenya's 'Green Energy Fund' and Australia's 'Clean Energy Finance Corporation' endowed with AUS$10 billion for the commercialization and employment of RE, EE and low-carbon technologies.[43] Others are international, some of these were created specifically to assist the pledged US$100 billion per year transfer of funds from Annex I-countries to developing countries.

Funds can be structured either as *funds* that take direct investments in companies and projects, or as "*funds of funds*" (referred to as cornerstone funds) that invest in a number of commercial managed funds, each of which then invests in projects or companies. The cornerstone funds approach can be more catalytic, leveraging private capital both into the fund itself and later into the investments that the fund makes.

On the *fund off-take side*, the creation of specialized public-private RE-Funds serves two purposes: (i) one is to promote initial RE market introduction/financial market development, (ii) the other is to serve as safety valve against finance volatility important in markets of high uncertainty. On the *fund sourcing side*, the objective of the funds is to attract co-finance into the funds from private investors and to leverage further private funds when they invest in individual projects or in individual private finance institutions. Structured funds use risk reduction offered by public first loss equity to attract direct private equity investments into the fund. Non-structured national funds attract finance from institutional investors through bond issues on the international capital markets.

If they are to attract and not crowd-out private capital, RE Funds must operate in areas where there are identifiable and addressable market failures. For example, a Fund could step in if the collapse of an effective banking syndication market prevents projects from being financed. [44] Or, a Fund could develop new, commercially-priced insurance projects for the construction phase that could attract equity in the short term that can be re-financed by traditional infrastructure investors once the projects are operating successfully. Not surprisingly, new funds being created typically employ a range of different public finance instruments and fund managers are given discretion of choice in deciding which instruments to employ in order to maximize achievement of the objectives of the Fund.

The discussions leading to the British government's decision in 2011 to set up a '**Green Investment Bank' (GIB)** shed light on the present thinking in the RE-community (developers, investors, finance sector, policy makers) about how public finance can drive low-carbon investment in OECD countries with well-developed

[43] In addition, Australia's RE Agency has AUS$ 3.2 billion for R&D, demonstration and commercialization of new technologies.

[44] The impact of the financial crisis in India provides an example. "Pre-crisis, an estimated $600 billion of RE investment in India had largely been through corporate balance sheets, backed up by guarantees. In 2007-2008, the first 'non-recourse' RE project financing was successfully closed, however, by the peak of the crisis this had become "last year's business". Banks that were doing business under the constrained financial conditions were operating on the basis of short loan tenors, making raising longer-term debt to cover the duration of a project extremely difficult. Things were very difficult at the smaller scale end of the market." Source: Hamilton: Scaling up RE. 2009.

financial markets. It will be endowed with an initial public capital commitment of £3 billion obtained from sales of public assets; From April 2015, the bank will be able to borrow on its own against the credit of the government if the national debt is declining as a percentage of the economy. GIB will be a statutory body and employ 50 to 100 people. One can distinguish between the institutional rational and the public finance instrument rationale for the creation of the GIB: the GIB is less a single financing mechanism than an umbrella agency of government for increasing the availability of capital to low carbon investment. [45]

According to the report by the Green Investment Bank Commission for the UK Government, the institutional function of the GIB is "to consolidate within a single institution the existing disparate sources of public investment in the low carbon economy, such as the Carbon Trust and the Marine Renewables Deployment Fund. This will provide a clearer focus for prospective investors as to where to go for investment help, will leverage in external investment and will ensure that public funds deployed are focused and efficiently managed; in order to fund the investments required for meeting UK's emissions reductions budgets." [46] A report by the National Audit Office in 2010 had criticized the uncoordinated proliferation of institutions providing public support to the RE and EE sector.[47] GIB will inter alia replace the Carbon Trust and the Marine Renewables Deployment Fund. Comments by industry participants have been supportive of the centralization. Some argue that one of the biggest risks for all green projects is policy uncertainty and that the GIB could mitigate this by improving the quality of advice going back to government on how its decisions and future actions will impact the investment community. Others believe that it will increase the quality of the advice given to private industrial investors, including investing in the right technology and not betting on technologies doomed to failure.

The report by the Green Investment Bank Commission defines the public finance function as follows: "to act as an intermediary to help attract and package investment opportunities in forms acceptable to investors." The report proposes that the primary focus of the GIB should be on lowering risk for investors, rather than simply providing capital. It suggests the GIB could help catalyse low carbon investment by unlocking project finance through equity co-investment, first loss debt and insurance products for low carbon technologies and infrastructure. Industry representatives also argue for guarantees for the early stages of projects, where risks are highest and that particular attention should be given to financing needs of small projects since commercial banks steer clear of complex technologies at the small end of the market and, if they do engage, charge prohibitively high due diligence costs.

The GIB must have sufficient capitalisation and funding to sustain its ongoing operations. GIB would use the government's AAA rating to raise funds on international markets. Several finance experts underlined the importance of future asset-backed green bond issues from the GIB to make the large pools of capital held by institutional investors available for low carbon investments. The argument is that green bonds would fit with the long-term investment horizons of pension funds and life insurance companies and would provide the scale of capital needed to fund the low carbon transformation. The bonds would aggregate the debt from multiple RE projects to produce large bonds with significant liquidity. By forming liquid bonds the GIB would enable fixed income investors to purchase these bonds within their regulatory framework. It is claimed that that institutional investors would prefer to finance RE projects through GIB liquid bonds rather than through private equity or project financing investments because of the risk diversification provided by the bonds.

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[45] The Government's medium-term requirement to meet the legally-binding obligation established under the EU Renewable Energy Directive 2009 is to increase the proportion of all the UK's energy needs, covering electricity, heat and transport, which are supplied from renewable sources from 2.3 percent in 2008 to 15 per cent by 2020. The government estimated in July 2009 that investment totaling some £100 billion would be required to achieve the 2020 target.

[46] Green Investment Bank Commission: "Unlocking investment to deliver Britain's low carbon future", June 2010

[47] National Audit Office: "Government funding for developing renewable energy technologies".

InfraCo is a donor-funded infrastructure development company. It acts as an 'honest broker' seeking to create viable infrastructure investment opportunities that balance the interests of host governments, the national and international private sector and providers of finance. InfraCo acts as principal, shouldering much of the upfront costs and risks of early stage development, thereby reducing the entry costs of later stage private sector infrastructure developers. InfraCo operates in low-income developing countries, primarily located in Africa (InfraCo Africa) and parts of South and South East Asia (InfraCo Asia). It develops a pipeline of operations giving priority to situations where there is strong host country support for its involvement and where it believes conditions exist to allow it to mobilize additional private investment. InfraCo is managed as a private sector infrastructure development company by InfraCo Management Services Ltd. InfraCo's capital is provided through share subscriptions by the Private Infrastructure Development Group (PIDG) donor group, made up of the development agencies of Austria, Ireland, the Netherlands, Sweden, Switzerland, the UK and the World Bank. The above initiative is still relatively new; InfraCo Asia has only been operational for about one year. InfraCo Africa has successfully developed a wind turbine project in Cape Verde in which private developers had previously displayed no interest.

10.2 Fund structured to attract multiple sources of finance

In order to attract private investments into public-private funds that invest in regions or in types of projects considered relatively high risk, yet need finance at 'normal rate' terms (meaning without risk premiums), such public-private-partnership funds can be set up as structured funds: public finance within the fund is used to increase the risk-adjusted rate of return for private investors. Typical instruments are "first-loss" equity and 'capped return'. *First loss equity* means that the public sector takes the equity stakes in a fund with a first loss position; this increases the number of projects within a fund that can fail before the private sector investors lose money. In a *capped return* arrangement, the returns of income on the capital investment of the government are capped, allowing other co-investors access to higher up-side on their investment.

The ***Global Climate Partnership Fund (GCPF),*** founded in December 2009 as an initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and KfW, provides *refinancing resources* to private local banks in developing and emerging countries for innovative lines of credit for climate projects by small and medium-sized enterprises and households. The tenor of the loans is expected to be medium to long-term. To a lesser extent, the Fund will invest in EE and RE projects as opportunities arise. GCPF's resources are deployed on a rotating basis: credit repayments are continually reinvested. Because the GCPF invests in both high-risk regions (developing, transition and emerging countries) and innovative sectors (financing of climate protection programmes), the goal of attracting private co-finance into the fund required a creative solution. The Fund is a structured fund, offering three different tranches of shares and notes to its investors, each with a different risk and return profile. *Bilateral donors* invest in the equity capital tranche of the GCPF; the equity capital serves as the primary risk buffer against losses. *Development banks* invest in the mezzanine and senior tranches; among these the IFC with US$ 75 million. *Private capital investors* invest in the senior tranche of the Fund. The Fund is organised under private law and the fund manager is Deutsche Bank. A TA facility is available to support the fund. Results: The Fund in 2011 stands at US$ 200 million and is set to rise to US$ 500 million within the next four years, mainly through the involvement of private investors.

The *Global Climate Partnership Fund (GCPF)* is one example of a structured public-private-partnership fund, see the text box. Another is the *European Fund for Southeast Europe (EFSE),* based in Luxembourg, a public-private partnership fund with a total of €756 million in commitments from donor agencies, international financial institutions and private investors. The existing donor or public capital of €262 million (35%) constitutes the "first loss" tranche, the first tranche to be used in the event of losses. Development finance institutions and international financial institutions invest in the mezzanine tranche, private investors in the senior tranche. Due to the investment structure of the Fund, EFSE is able to provide nearly unlimited

access to long-term financing resources at market conditions for qualified financial institutions in the region of Southeast Europe and the European Eastern EU-Neighbourhood region. This leveraging potential is critical for the region, which is still in the stages to develop its capital markets. While mezzanine and senior investors invest at regional level, donor funds can either be earmarked to a specific country or the region at large. Country-specific donor funds are exclusively used for investments in one particular country, facilitating a possible later transfer of ownership to local stakeholders. To undertake an investment, different sources of funds representing different risk tranches are pooled to constitute one single source of financing for the Fund. For the investment portfolio in each country, the proportion of the different risk tranches contributing to the total amount of pooled funds remains intact. Hence, donors as well as the other investors hold a specific share of the pooled funds in the amount of their original contribution to the Fund in nominal terms.

11 Context and Choice of Instrument

11.1 Tailoring the instrument to the type of barrier

The basic lesson is the confirmation of the well-known fact that 'best practice is always circumstance based', context matters.

The public finance instruments chosen must be tailored to the specific type of finance gap, the characteristics of the technology, the finance sector, and the developer community. It is widely recognized that a 'surgical approach' gets the required results in the most cost-effective manner: selecting instruments based on a careful diagnostic of the finance and project situation in the country and offering a range of public finance instruments, each addressing a specific problem and targeting the achievement of a specific objective.

A primary point of departure for the diagnostic is to find out whether *lack of liquidity* or *lack of risk cover* is the main problem which blocks access of RE-projects to debt or equity capital, or whether a combination of risk cover and liquidity support instruments is needed. :

- Used in their most straightforward manner as instruments to reduce the risk of conventional debt, *sub-ordinated debt*, *publicly backed guarantees* and *first loss reserves* have very similar impacts as far as risk reduction is concerned. First loss reserves make sense for portfolio finance, the first two can be used for individual project finance also.

Investments by institutional investors are essential to provide stability in the supply of finance to RE-projects. Drawing in institutional investors into RE project finance will, therefore, be a key objective of new public finance initiatives in countries with growing RE-markets. Since the structuring to achieve institutional investor entry is complex and very heavy on the legal work side; contracting good legal expertise is an important success factor. The main avenue for access to institutional investor finance is through the bond market, where wrapping is essential to beef up project bond ratings to investment grade status. But one can in private finance see very creative approaches to attract investments from institutional investors already to the construction finance phase.

Private insurance/guarantee companies and public-private funds offer risk cover on commercial terms to RE-projects in emerging and developing economies. Rather than setting up a specific risk product as part of a public finance program, the availability on the international markets of appropriate insurance and guarantee products should be checked. Purchasing commercial risk products with program funds will be more cost-effective.

Some public finance funds have had disappointing experiences with contracted fund managers being too passive, waiting for project proposals to arrive, instead of actively marketing their finance products. The risk of passive managers can be reduced by close monitoring. But an effective incentive instrument is to change the conventional formula for calculating the typical 2 percent basic fee of the Fund Manager for fund management[48]: instead of basing the 2 percent fee on paid-in capital into the Fund it should be based on committed fund investments out of the Fund. The formula will demonstrate confidence of the Fund Manager in the business model of the Fund. This will also make it easier to convince potential investors to place money into the Fund.

Concerning the applicability of Publicly-backed guarantees (PBGs), a few conclusions can be drawn. First, guarantees can be essential for emerging/higher risk technologies. Either lenders won't lend without PBGs

[48] The performance payment in the form of a 20% share of profits above a benchmark comes on top.

(e.g. to next-generation ethanol projects), or only against payment of a high premium (e.g. interest rates on loans to off-shore windfarms compared with loans to on-shore windfarms). Second, in asset finance, PBGs can help bring down bank costs of transactions in dealing with mass-requests for end-user finance. Third, PBGs are useful when policies require speed of implementation but the uncertainties for projects are above average. Fourth, guarantees are particularly valuable during times of tight credit and market uncertainty when banks aren't lending, as they provide the grease that can open up the "credit valves. Fifth, start-up SMEs have little access to bank credits. This makes them dependent on *risk capital* for their survival during their so-called pre-seed, seed, and venture capital phases of development. For high-tech SMEs under three to five years old, several governments make PBGs available that provide partial risk cover to share capital and mezzanine finance investments undertaken by business angels (BAs) and venture capitalists (VCs). The design of the PBG depends on the size and sophistication of the national BA and VC community. In countries with "underdeveloped" communities, PBGs are designed to expand the pool of national BA/VC investors as well as the pool of risk capital. Countries with well-developed BA/VC communities may opt to directly expand the pool of risk capital through public investments in BA/VC funds specialised in RE&EE investments. Sixth, some business finance PBGs solve special finance problems: e.g. PBGs for mortgages on laboratory buildings that would be difficult to sell in case of a company's bankruptcy.

However, PBGs are not a panacea. , even though they tend to have the large leveraging ratios that theoretically are feasible: e.g. that a portfolio guarantee with a 5 percent default rate can leverage debt finance 20 times larger than the loss-cover amount that must be deposited. In some applications, PBGs are effective: e.g. as a bond wrapping tool to attract institutional investors or to allow the launch of an issue onto the international bond market. But in conventional debt guarantee applications, the effect of PBGs depend on the sophistication and the psychology of the local finance markets. The USA uses PBGs more frequently as instrument in energy policy than any other country.[49] Whereas EU-countries implement broad EE&RE initiatives without including PBGs in the package of measures; it is difficult to envisage a program proposal from US-DOE without PBGs. The higher use of PBGs in US energy policy is due to three factors. (i) The more sophisticated the financial markets is, the more potential applications can be identified for PBGs, and the easier it is to influence the flow of funds through subtle changes in arbitrage opportunities. (ii) Pro-market ideology: PBGs have more "market flavour" than direct grant finance. (iii) Habit-formation: once a subsidy product like a PBG has entered the market, very soon neither the providers nor the off-takers can imagine life without it.

No matter how well-designed a scheme is, its impact on RE-investments will always depend on the quality of the overall framework conditions in the target country. The experience of the World Bank's insurance scheme for geothermal resource exploration risk, promoted by the the GeoFund projects for ECA and for East Africa illustrate it: in Hungary the rate of return on geothermal projects was probably not good enough to attract more than the one project that was insured (and failed in finding adequate resources), in East Africa the resources are good, but the general framework conditions too uncertain.

Venture capital (VC) for RE can be increased by *providing partial guarantees to equity investments* by private investors in VC-funds, by *direct public equity capital investments* in existing VC-funds, by *setting up public-private equity and mezzanine finance funds* from the scratch (with returns on private capital being capped – or not!), by *paying incentives to equity funds* to engage in early stage finance. The choice depends on three main factors. (i) Belief in *what works fastest*. Public investments in VC-funds provide new risk funds directly, including from the private sector, since public funds are provided on a 50%/50% matching fund basis. (ii) Whether the *development of a broad-based business angel venture capitalist community is a major side-objective*. Publicly backed guarantees to equity-investments are an instrument to attract more individuals/firms to become interested in entering the BA-field. (iii) Whether there is a strong wish from public investors to *share in the upside potential of supported investments*. The potential for this is "automatic" for public co-investments in VC-funds. In PBG-schemes upside potential can be build in

[49] Some East Asian countries use PBGs much more than the US; e.g. South Korea. But they use PBGs as subsidy instruments in industrial policy.

through success-dependent fee rates; but this does not allow for the “windfall profits” of VC-capital investments when a highly profitable technology is developed.

11.2 Tailoring the instrument to the stage of RE market development

Table 2: Objectives for Public Finance Instruments by Stage of RE-Market Development in a Country

Public Finance Instrument	Initial Market	Developing Market	Mature Market
DEBT Finance			
National Development Bank project finance	Provide low-cost finance and finance RE-projects to serve as showcase for commercial banks (IREDA, India)	Provide low-cost finance and incentivize investments in national manufacturing of RE (BNDES, Brazil)	Accelerate loan syndication and provide finance safety net to safeguard a steady flow of investment (KfW, Germany) Allow commercial FIs to piggy-back on RE-project experience in new and higher risk RE-project types with good prospects for further similar projects
Multinational Development Bank project finance	Build capacity in RE-finance at collaborating commercial FIs	Loan syndication of large scale RE-projects	
Dedicated RE-credit lines	Build capacity in RE-finance at collaborating commercial FIs End-user RE finance Finance small-scale RE-projects less than 10-20 MW (USELF, Ukraine)	Finance small-scale RE-projects less than 10-20 MW (REREC/ESD in Sri Lanka)End-user RE finance Provide loans with long-term tenor	End-user RE finance (KfW)
Public underwriting support	n.a.	Avoid delay in securing finance for high-priority infrastructure projects	Avoid delay in securing finance for high-priority infrastructure projects
Mezzanine finance as sub-ordinated debt	Encouraging commercial FIs to test loan-finance to RE-projects	Introduction of new RE-technologies, previously not tested in the project country, encouraging commercial FIs to loan-finance these	Securing financial close for high-priority infrastructure projects
Transaction cost support	Attract commercial FIs into RE-consumer loan finance (UNEP Solar Loan Program, India)	Attract commercial FIs into RE-consumer loan finance (UNEP Solar Loan Program, India)	
Contingent project development grants, transforming to loan in case of success	Facilitate loan finance to preparation of high-risk investments and reduce risk of these (e.g. investment in exploration and drilling of geothermal projects)	Facilitate loan finance to preparation of high-risk investments and reduce risk of these (e.g. investment in exploration and drilling of geothermal projects)	Facilitate loan finance to preparation of high-risk investments and reduce risk of these (e.g. investment in exploration and drilling of geothermal projects)
"Green Investment Banks" with freedom to employ different finance instruments			Flexibly meet ad-hoc finance challenges in an environment characterized by rapid technological change and shortage of bank finance

EQUITY Finance			
Public equity investment	Pre-construction support	Pre-construction support	Pre-construction support to development of off-shore windfarms and geothermal projects
Investment in equity funds and funds-of-funds	Expand number of smaller scale private project developers (GEEREF/ InfraCo Asia)	Expand number of smaller scale private project developers (GEEREF/ InfraCo Asia)	
Mezzanine finance as quasi equity		Closing equity gaps for smaller-scale project developers and for SME-size RE-technology companies (CAREC, Central America)	Closing equity gaps for smaller-scale project developers (FIDEME, France)
VENTURE CAPITAL			
Investment in venture capital funds	Stimulate creation of innovative clean energy service firms (AREED, African Rural Energy Enterprise Development)	Stimulate creation of innovative clean energy technology firms (Clean Resources Asia Growth Fund, CRAGF of ADB,	(High Growth and Innovative SME Facility, EU)
Co-financing by grants of transaction costs of SEED-finance investments		Incentivising private equity capital funds and venture capital funds to invest also in the SEED capital phase to stimulate creation of innovative clean energy technology firms (SCAF)	
RISK COVER/REDUCTION			
Partial credit guarantees to RE-projects		Promote investments in leading edge RE demonstration plants, transmission for RE-connected power and smart grids	Promote investments in leading edge RE demonstration plants, transmission for RE-connected power and smart grids (US-DOE loan program 2009)
Partial credit guarantees to RE-investment programs			Allow economies of scale in finance, in RE-technology procurement and in installation (Project Amp, USA)
Publicly backed guarantees to RE-technology start-up firms	Partial credit guarantees to bank loans to innovative SMEs in renewable energy	PBGs to equity investments by business angels and venture capital	PBGs to equity investments by business angels and venture capital
PBGs for technology transfer	Insurance against political risks: war and civil disturbance, expropriation, currency transfer risks, and breach of contract (MIGA)	Insurance against political risks: war and civil disturbance, expropriation, currency transfer risks, and breach of contract (MIGA)	
Wrapping of project bonds			Pulling institutional investors into RE-finance (Montalto di Castro solar park, Italy)
Credit guarantee to bond issue structured as a put option for principal repayment at maturity		Enable RE-investor to launch bond issue on international capital market	

Liquidity guarantee	Extend tenor to match the financing requirements of the project developer (GuarantCo)	Extend tenors to match the financing requirements of the project developer (GuarantCo)	
Partial risk guarantees		Facilitate loan finance to preparation of high-risk investments and reduce risk of these (e.g. investment in exploration and drilling of geothermal projects (African Rift Geothermal Energy Development Facility)	Facilitate loan finance to preparation of high-risk investments and reduce risk of these (e.g. investment in exploration and drilling of geothermal projects
Resource Insurance			
Geological risk insurance			