CIF/DM.2/Inf.2/Rev.1
May 15, 2008

Design Meeting on Climate Investment Funds
Potsdam, Germany
May 21-22, 2008

ILLUSTRATIVE INVESTMENT PROGRAMS FOR THE CLEAN TECHNOLOGY FUND

Introduction

1. The Clean Technology Fund (CTF) will aim to finance transformational action by providing positive incentives for accelerating and scaling-up the deployment, diffusion and transfer of low carbon technologies, embedded in nationally appropriate mitigation actions by eligible countries.

2. The attached illustrative investment programs were prepared by the multilateral development banks based on experience working with a range of developing countries that have indicated an interest in transitioning to low carbon growth. Thus, while hypothetical, the programs are indicative of actions that could be taken within the existing and potential future policy and institutional settings of client countries. Their purpose is to provide participants in the Design Meeting with examples of how concessional financing at scale could leverage a shift to low carbon technologies across a sector or sub-sector, or demonstrate global application of a low-carbon technology. In particular, the case studies seek to illustrate the potential scope of the challenges to be addressed, the proposed transformational response and impacts, key factors for implementation readiness, the rationale for concessional financing from the CTF, and an indicative financing plan (including the grant element[1]).

3. The case studies cover the following range of potential investment programs for low carbon technologies:

- (a) Energy Efficiency/Demand Side Management;
- (b) Transport Sector;
- (c) Concentrating Solar Power
- (d) Integrated Gasification Combined Cycle Power Plants;
- (e) Large-Scale Wind Power;
- (f) Residential Lighting.

[1] Illustrative CTF loan financing terms:
Maturity: 40 years
Grace Period: 10 years
Principal Repayments: 2$ (years 11-20) and 4% (years 21-40)
MDB Fee: 0.25%
Discount rate: 6.43%
Grant element: 73.8%

Energy Efficiency/Demand-Side Management Transformation Program

1. **Problem Statement**: The combined problems of oil and gas prices nearing or exceeding all-time peaks and concerns regarding long-term security of energy supply have driven many countries to pay more attention to coal for their energy needs. In countries where the energy sector accounts for a significant portion of total CO2 emissions and much of the energy consumption is from coal, decreasing emissions from coal-fired power is a priority target.

2. **Proposed Transformation**: Energy efficiency is regarded as a "win-win" intervention to address climate change and mitigate the pricing and energy security concerns. Reducing energy use at the source would decrease losses up the full supply chain – loss reduction in the transmission and distribution networks as well as a reduction in generation supply needs. Among potential that could be considered are:

- (a) implement market-based rationing approach, similar to the successful experience in Brazil, to cut down power consumption by 10%;
- (b) standard offer approach to pay certain $/verified kWh saved from an EE/DSM fund to achieve a further 10% savings over five years;
- (c) distribute Compact Fluorescent Lamps (CFLs) nationwide, equivalent to 4 CFLs per household over the next 3 years; and
- (d) install solar water heaters (SWH), which can make substantial inroads in meeting a country's renewable energy targets.

3. For countries in which coal-fired power plants are the marginal source of supply, absolute **emissions reduction would be in the order of**[2]:

- (a) This EE/DSM program as a whole can achieve **20% energy saving**, which result **in reduction of CO2 emissions by 41 Mtons** per year;
- (b) Reduction of 10% power consumption results in 5,000 MW energy savings and 25 million tons of CO2 reduction per year;
- (c) An EE/DSM fund is expected to reduce demand by about 3,300 MW and can reduce CO2 emissions by 12 million tons of CO2 per year;
- (d) Distribution of 35 million CFLs can cut peak demand by 1,750 MW, reducing CO_2 emissions by 14 million tons of over the lifetime of CFL (roughly 1.5Mton/year);
- (e) 1 million SWHs can cut peak demand by 1,000 MW, or 2% of a 50,000 MW system. This program could reduce 35 million tons of CO_2 emissions over the lifetime of SWH (about 1.8Mton/year).

4. **Implementation Readiness:** EE/DSM measures are off-the-shelf, commercially available technologies. Many countries are committed to implementing such programs, having assigned energy efficiency a high priority within the broader development context because of the impact it could have on energy cost, security and both local and global environmental impacts.

[2] The above is designed for a generic country which has an installed capacity of 50,000 MW: less than 10% of China, less than half of India and about 25% larger than South Africa.

5. **Rationale for CTF financing**: Energy efficiency investments suffer from a number of market barriers, including:

(a) Information failure is considered to be the single most important barrier to implementing energy efficiency;
(b) Energy costs are relatively low compared to other factors. Labor costs, for example, contribute to averting investments in EE, particularly when considering the relatively high transaction costs;
(c) In many cases, electricity costs are relatively low and, hence, ignored. Studies have shown that consumer decisions in upgrades focus more on health, safety, comfort, aesthetics, reliability, convenience and status before EE is considered. Perverse fiscal incentives such as operating costs being fully deductible while capital costs are depreciated over as many as 30 years;
(d) The principle-agent (split incentives) problem in which the person making the decision on capital investments does not suffer the impacts on operating costs;
(e) Transaction costs for energy efficiency investments tend to be high as they are often for low cost options that require relatively large labor cost investments for information acquisition, analysis and procurement.

6. **Financing Plan**: Blending CTF resources with IBRD and other financing would make what is otherwise a marginal project financially attractive for the borrower.

7. Total program costs: roughly $5 billion:

(a) power rationing cost: $400M;
(b) EE/DSM fund cost: $3.5 billion: host country utility could pay for 50%, while the other half is paid by the consumers;
(c) CFLs: $100M;
(d) SWH: $1 Billion, of which the utility would pay 25% subsidy and consumers pay for the rest;
(e) **$4.2 billion would be financed from consumers; IBRD would finance $500 M; $300M would be financed from Clean Technology Fund,** to buy down the cost of the program to the host country.

Grant element from CTF in total financing: 4.4%

Urban Transport Transformation Program

1. **Problem Statement**: Transport is a major contributor to greenhouse gas (GHG) emissions, accounting for about 14 percent of the global total, and is the only sector of the world economy in which carbon emissions have risen consistently since 1990. Indeed, transport sector emissions grew by 1.4 billion tons (31 percent) worldwide between 1990 and 2003. This has resulted in an increase in transport's share of CO_2 emissions from 22 percent in 1990 to 24 percent in 2003. Over 70 percent of the emissions from the transport sector and 10 percent of the global greenhouse gas emissions are linked to surface (road) transport. Large urban areas in rapidly growing developing nations are anticipated to continue a trend for increased rate of motorization, including passenger vehicles, further increasing their carbon footprint.

2. **Proposed Transformation**: Low cost mass transport systems, such as BRT (bus rapid transport systems), have the potential to reduce emissions, as a result of reduced congestion and use of high capacity vehicles. A transformative program that includes BRTs that emphasize modal shift (from passenger vehicles to mass transport), the use of low-emissions high-capacity vehicles, comprehensive scrapping programs targeting low capacity low efficiency vehicles, and dedication of public space to public transport, could drastically reduce the carbon footprint of the urban transport sector.

3. For metropolitan areas in rapidly growing developing nations, GHG emissions are strongly linked to the transport sector, in cases surpassing 40% of the total carbon footprint. A low carbon BRT is anticipated to achieve rapid (in less than five years) reductions of 5% of total carbon budget of the transport sector and 10% or more over a longer period of time (5-10 years). If widely implemented, low carbon public transport systems, based on the BRT concept, could result in:

(a) Reductions of 5% to 10%, of fuel use by transport (in urban centers), in a sector which typically accounts for 30% or more of total fuel requirements in developing countries;
(b) The adoption of low carbon BRTs, in a large metropolitan area and 4 medium size cities, with a capacity of 5 million-passengers day, could reduce about 1.0 million tons of CO_2 eq. per year;
(c) Low carbon BRTs based on low carbon, high capacity vehicles, at scale, would send a strong signal to vehicle manufacturers, reducing over time the differential costs between standard and hybrid drive systems;
(d) Modal shift measures associated with the operation of BRT systems could shift 20% of riders from passenger to high capacity vehicles, freeing public space and easing congestion, further catalyzing reductions in GHG emissions;
(e) Adoption of BRT systems, can effectively reduce exposure to air toxics in their area of influence, by 30-60% of particulate matter, carbon monoxide and aromatic compounds, all linked to health ailments of exposed populations;
(f) Scrapping programs linked to the entry of BRTs in one major metropolitan area and four medium sized cities could take out of the roads an estimated 8,000 fuel inefficient public transport vehicles, transforming the associated

carbon footprint of transport in the long term and dramatically shifting its carbon intensity.

4. **Implementation Readiness:** BRTs are relatively easy to implement when compared to large scale infrastructure for new highways or underground systems. Scrapping of vehicles is technically feasible. Many large metropolitan areas in developing nations are considering BRT systems, which could be upgraded to maximize emission reductions. Cities would adopt those cost effective systems that combine ease of congestion and health benefits with substantial emission reductions.

5. **Rationale for CTF financing**: Low-carbon BRTs face a number of barriers:

(a) City-wide BRTs, while typically cheaper than investments in new highways or underground systems, require massive public sector investment which is normally not readily available from municipal or regional authorities facing a multitude of demands for public funds in education, health and other sectors;
(b) Adoption of low carbon technologies (hybrid drives) is currently 30-40% more capital expensive than regular drives, even though their use would typically reduce maintenance expenditures by a similar margin. The additional upfront capital costs thus constitute a significant financial barrier;
(c) Scrapping programs are also capital intensive, involving the purchase of many old vehicles and large transaction costs, which are typically not considered cost-effective.
(d) Modal shift measures, while representing significant reductions in carbon intensity over the long run, also face strong institutional and political economy barriers, requiring fiscal measures that may not prove popular in the absence of financial and regulatory incentives.

6. The availability of low cost financing would facilitate decisions to adopt low carbon BRTs and reduce the initial financial barriers faced. Blending CTF resources with IBRD and other financing would make available investment capital in infrastructure and rolling stock which may otherwise not be readily available or facilitate the speed of adoption and scale up of city-wide BRTs. The low cost financing would be instrumental in decisions taken to adopt advanced (hybrid drive) systems, and scrapping programs, internalizing some of the climate benefits that are not typically rewarded by the financial markets.

Financing Plan

7. Total costs: ~$2 billion:
(a) Municipal budgetary resources: $800 million;
(b) CTF: $250 million;
(c) IBRD: $250 million;
(d) Other loans or sources of finance: $200 million;
(e) Private sector participation: $500 million.

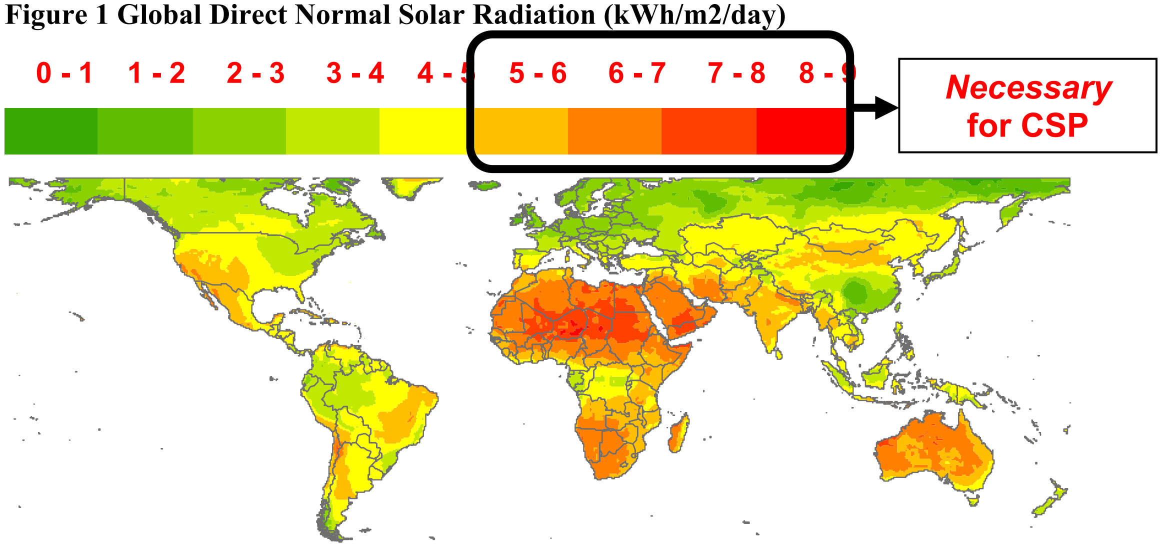
Grant element from CTF in total financing: 9%

Large Scale Deployment of Concentrating Solar Power (CSP) Projects

1. **Problem Statement**: The power sector is the largest contributor to greenhouse gas (GHG) emissions, accounting for about 25 percent of the global total. Emissions from the power sector grew 66% worldwide between 1990 and 2002 and are projected to grow a further 50% by 2020. The sector plays a vital and enabling role in economic activity and is central to future development prospects and improvements in quality of life in developing nations. Yet, in most situations, fossil-fuel based power generation represents the cheapest and most expedient option to meet future demand and would consequently lead to a continuing increase in the carbon footprint of the sector.

2. **Proposed Transformation:** Solar energy represents an enormous resource that is particularly large in many of the world's developing countries (see figure 1). Solar thermal power generation using concentrating collectors, commonly referred to as concentrating solar power (CSP), involves the conversion of solar radiation to thermal energy, which is then used to run a conventional power system. Solar thermal power generation using concentrating solar collectors can integrate well with conventional power generation plants, as well as with advanced emerging technologies, and therefore provides significant opportunities for grid-connected renewable energy.

Figure 1 Global Direct Normal Solar Radiation (kWh/m2/day)



Source: D. Wheeler et al, "World Bank Power Projects: Crossroads on Renewable Energy", Presentation at the World Bank, April 14, 2008

3. The proposed transformational approach is to offer industry a credible commitment to developing a large scale multi-country portfolio of projects, on the assumption that such aggregation will induce the employment of mass production techniques, resulting in lower costs and improve performance. The approach envisages a framework for market aggregation in the form of a CSP Market Transformation Consortium that would have as partner organizations interested utilities in both developing and developed countries, venture capital companies, and manufacturers. The purpose of this consortium will be to develop a portfolio of projects across a number of eligible countries of about 1000 MW to be implemented within a 10 year period, thereby increasing global installed capacity by 150%. The development of this capacity will be

offered as a portfolio or package using a standardized procurement approach to an industry consortium/contractor based on providing electricity at, for example, a levelized cost of 7.5 US cents/kWh across the whole portfolio. The consortium that requires the lowest subsidy for the maximum installed capacity committed would be awarded the contract.

4. **Implementation Readiness:** CSP is represented by four types of technologies: parabolic troughs, linear Fresnel reflectors, power towers and parabolic dish/engine systems. Parabolic troughs have been deployed in nine commercial plants totaling 354 MW. Other technologies have been developed to the point where early commercialization could be planned now.

5. There is resurgence of interest in recent times in CSP given the increasing importance of climate change and the rising fossil fuel prices. In Europe, particularly in Spain, the industry is expected to add 170 MW of CSP capacity during 2008. In the U.S, there are several upcoming projects (at least 8 projects with a total capacity of about 3500 MW are in the pipeline). In developing countries there is growing interest in the technology, with projects under implementation in Algeria, Egypt and Morocco, as well as a tender evaluation ongoing in Mexico.

6. **Rationale for CTF Financing**: However, major market barriers are preventing the development of a global CSP industry and uncertainty surrounds many of the planned CSP projects due to technical, regulatory and planning issues which often lead to delays and cost overruns. Barriers include high capital costs, technical risks, financial risks, and competing fuels whose full costs are not accounted for (subsidies, environmental externalities etc), as well as uncertain policies, inadequate legal frameworks, lack of infrastructure, and lack of regional power sharing agreements and networks. Given the uncertainties of future business, the supply industries have operated on the basis of serving one-off customers instead of setting up complete R&D, large-scale manufacturing, and operations and maintenance programs. The result is very high cost, underexploited economies of scale, and limited investment in R&D leading to technology development and innovation.

7. **Financing Plan**: The program would consist of:

(a) An investment financing facility tied to the CSP Market Transformation Consortium that will administer the required subsidies.

(b) A partial risk mitigation facility to insure utilities that will contract to buy power from the CSP plants against any higher cost differentials in case marginal electricity supply costs drop below the levelized cost price offered by the CSP contractor. Alternatively, this facility could cover the premiums for commercial insurance as well as technical insurance.

(c) Technical assistance to prepare the international cooperation agreements, prepare the feasibility and detailed engineering studies, develop bidding and contracting packages and power purchase agreements, establish the regulatory frameworks, support developing the regional power grids needed to evacuate power to the load centers.

8. Total costs required to set up a 1000 MW CSP program through a private consortium is estimated to be roughly $2.5 billion:

(a) Sponsor equity: ~$300 million
(b) CTF: ~$1 billion
(c) IBRD/other debt: ~$700 million
(d) GEF: ~$10 million
(e) Carbon revenues: ~$500 million

Grant element from CTF in total financing: 30%

Supporting the Deployment of IGCC (Integrated Gasification Combined Cycle) Power Generation Technology

1. **Problem Statement:** Coal based electricity generation is expected to account for the largest and rapidly growing share of power capacity mix in several developing countries – and in some it could account for over 75% over the next 25-30 years. In some of these countries, coal combustion accounts for as much as 60% or more of CO2 emissions. The capacity base built in this period would continue operating for several decades more, with significant implications for CO2 emissions and carbon intensity of their economies. The imperative is therefore to reduce the adoption timeframe of clean coal technology in several of these countries – and also establish a basis for future deployment of Carbon Capture and Storage (CCS). CCS has yet to be "proven in operation" in conjunction with coal-fired power generation, and IGCC is expected to be a key technology to lead CCS deployment.

2. IGCC can achieve (a) efficiencies of ultra-supercritical plants today, but future efficiency gains are expected to be greater for IGCC; (b) higher system efficiency than conventional plants if using carbon capture and storage; (c) higher coal resource savings; (d) lower emissions of SOx and NOx; and, (e) savings of 30-50% in water use.

3. **Proposed Transformation**: Adoption of IGCC will require the establishment of a replicable model for large-scale commercial-scale deployment of IGCC power generation technology and initiating the detailed field assessments for carbon capture and sequestration (CCS) additions that would follow. For example, a transformative program would lead the implementation of at least two commercial-scale (~300-400 MW each) IGCC plants in a country that could deploy 3-5 projects to gain experience for wider application.

4. The transformative impacts expected by deploying IGCC technology and beginning CCS implementation studies include:

(a) Commercial-scale experience with system integration and operation to begin reducing system costs. Large-scale deployments are necessary to achieve cost reductions to make IGCC more competitive and contribute to its accelerated deployment worldwide. Experience with the initial plants would also provide important learning about different organizational models, which is a significant barrier in the adoption on new technologies;

(b) Pave the way for implementing CCS by completing the detailed CO_2 storage and sequestrations studies. Currently, there are no IGCC based CO_2 capture and storage operations anywhere in the world;

(c) Enhance domestic capabilities to manufacture and operate IGCC, which is a highly integrated technology requiring high level of expertise in engineering, manufacturing and management;

(d) Assuming that these plants will be of the 400 MW scale, the 2x400 MW plants will lead to a <u>CO_2 savings of about 600,000 tons/year</u> – when compared to advanced sub-critical plants. [Assuming IGCC efficiency of about 5% higher than sub-critical plants].

5. With further scale-up in implementation, the CO_2 savings will increase substantially. Given the rate of adoption of other clean technologies such as wind, super-critical and also ultrasupercritical coal generation plants, the scale of adoption in a country could be 2-3 GW per year initially and reaching 10-20 GW per year within 10 years.

6. **Implementation Readiness:** IGCC technology has globally been employed in five (5) generation projects – Europe (2), Japan (1), and North America (2). While there are at least 3 or more experienced international suppliers of the key technology components (i.e. gasifier, high efficiency gas turbines, gas clean-up equipment, air separation units, etc) – the system integration experience is more limited. The technology relating to IGCC-based CCS is available in concept, it has never been operationally tested with an IGCC plant as yet.

7. Feasibility studies have been completed for about five pilot projects. At least two sites are near producing oil fields – which may be suitable for CO_2 sequestration. Detailed geological investigations and assessment of existing well logging data would be necessary to establish injection potential and designs. Institutional readiness to pursue implementation is high – the barriers relate to the current cost levels of the technology.

8. **Rationale for CTF financing:** The principal role of the CTF would be to help overcome the significant cost barrier to the deployment of a technology that has the potential to greatly reduce the CO_2 emissions from coal based power generation. While IGCC is technically capable of achieving higher efficiencies than conventional power generation technologies (supercritical and ultra-supercritical pulverized coal plants) – and will also deliver higher efficiencies when combined with carbon capture and sequestration (CCS) – it continues to be substantially more expensive than conventional, advanced coal generation technologies. IGCC generation plants are estimated to cost between 100-150% more than advanced sub-critical and supercritical power plants.

9. **Financing Plan:** Based on the costs of sub/super-critical plants of comparable scale, it is estimated that the investment gap will be about $400 million. A CTF contribution of about half this amount is assumed – leading to a leverage of about 1:5 of total project costs.

10. Total project cost: ~$1 billion:

(a) Sponsor Equity: ~$160 million;
(b) Sponsor Debt: to cover funding gap;
(c) CTF: ~$150-200 million;
(d) IBRD: $200 million;
(e) GEF: ~$10 million (to support CCS field studies);
(f) Carbon Finance: Revenue of $70 million for 7 years.

Grant element from CTF in total financing: 11-15%

Residential Lighting Transformation Program (17,000 MW CFL Power Plant)

1. **Problem Statement**: Constraints of existing energy infrastructure and the continued threat of spiraling costs of imported energy to medium- and long-term energy security in several developing countries. Several electricity grids are starting to experience severe capacity shortages. Especially in rural areas, residential lighting is the largest contributor to the early evening demand peak, thereby causing load factors to drop below 45%. Across all socio-economic classifications, residential electricity users in developing countries still operate incandescent lamps in an average of 4.05 (of the total 6.60) light points per household. The penetration of compact fluorescent lamps (CFLs) in these markets as replacements of incandescent lamps, although progressing slowly, is still hampered by market failures brought about by the still-significant first cost barriers[3] and influx of low-quality CFLs.[4] It is estimated that residential lighting contributes as much as 16% of total residential electricity consumption.

2. **Proposed Transformation**: There is a clear opportunity to create virtual power generating capacities by accelerating the replacement of incandescent lamps with CFLs through a comprehensive market transformation program. The ***"CFL power plant"*** will free up an estimated 17,000 MW[5] from the electricity grid by permanently washing away 1 billion incandescent lamps from the end-use side of the electricity market. The market transformation program will be implemented through the following integral components:

(a) Massive utility-led CFL retrofit projects using CTF-financed bulk procurement and innovative distribution (and lamp swaps) through traditional CFL retail channels;
(b) Building utility capacities for scaled-up DSM project implementation, microfinancing, and clean development mechanism (CDM) cost recovery;
(c) Building market capacities for CFL testing and certification;
(d) Building market capacities for CFL waste management (including mercury extraction); and,
(e) Policy interventions[6] for the accelerated market phase-out of incandescent lamps and other inefficient lighting technologies.

3. Through the 1 billion CFL retrofits, the country market transformation program will reap the following impacts:

(a) Permanent phase-out of 1 billion incandescent bulbs from the country market;
(b) Accelerated replacement of incandescent bulbs by non-project participants in other end-use sectors (small commercial, public/municipal services, etc.);

[3] Ratio of first costs of incandescent lamps and CFLs is 1:6.
[4] The proliferation of low-quality CFLs causes user dissatisfaction, which in turn reinforces market reversals towards resumed use of incandescent lamps.
[5] Assuming average incandescent lamp wattage of 32.6 W per light point and 67% peak coincidence.
[6] Policy interventions can be targeted at legislated trade bans and/or virtual bans through radical upgrades of minimum energy performance standards (MEPS) of incandescent lamps for general lighting service (GLS).

(c) 52.3% reduction in household lighting electricity consumption from 276.5 kWh/yr to 132.0 kWh/yr;
(d) 8.4% reduction in energy intensity of residential sector;
(e) Reduction in annual electricity consumption: 35.7 TWh/yr; and,
(f) Reduction CO2 emissions: 36 million tCO2e/yr or 154 million tCO2e through the lamp life of the first wave of CFL replacements.

4. **Implementation Readiness:** Although at varied quality and market maturity levels, CFLs are commercially available in almost all developing country markets. They are distributed and sold through the same market channels as the incandescent lamps and enjoy high awareness (but not utilization) levels among households. Moreover, many developing country governments are now driven towards short- to medium-term reduction of energy intensity and see CFL programs as an immediately implementable and replicable measure to shave off peak demand in the residential sector.

5. **Rationale for CTF Financing**: Policy and financial intervention is necessary to correct persistent CFL market failures:

(a) Although the lamp initial costs per burning hour of the incandescent lamp and CFL are now comparable, neither technological innovation nor production aggregation will bring down the retail price of a CFL to that of an incandescent lamp;
(b) The significant market presence of low-quality CFLs delays the scaled-up deployment of this technology as a replacement of incandescent lamps;
(c) The CTF will allow bulk procurement to lower unit prices of CFLs, which in turn will ensure consistently higher quality CFLs through adopted safety, quality and energy performance specifications and through rigid testing and certification programs;
(d) The CTF will allow upfront financing for the procurement of CFLs, which will eventually enable downstream capital recovery through CDM;
(e) The CTF can provide technology financing up to a level that enables complete market phase-out. (Smaller loan funds can only replace a portion of the technology utilization in the market);
(f) Massive technology replacement funding by CTF can leverage policy reforms towards mandated obsolescence and/or virtual banning of low-efficiency technologies.

6. **Financing Plan**: ADB can blend CTF and GEF with its clean energy resources to fund the CFL power plant program:

7. Total program costs: roughly $ 1.62 billion:

(a) CFL procurement and distribution[7]: $1.35 billion (50% sourced from CTF; 50% from ADB);
(b) CFL testing/certification and lamp waste management capacity building (in various local governments): $ 100 million (from GEF);

[7] CTF and ADB assistance of $1.35 billion has the maximum potential for 93% recovery through CDM sale of 36 million tCO2e/ye for 3.5 years at $10/tCO2e.

(c) Utility capacity building for DSM and CDM preparation: $ 15 million (from ADB TA funds and donor climate funds);
(d) Country-level program management: $ 5 million (Government co-financing);
(e) Lamp waste management facilities: $ 150 million (private sector investments).

Grant element from CTF in total financing: 31%

Sustainable Transport Investment Program

1. **Problem Statement:** Rapid economic growth in developing countries carried with it a corresponding rapid increase in transportation demand and energy use. Between 1990 and 2004, both freight and passenger activities nearly tripled in metropolitan areas in most countries, leading to corresponding tripling of total transportation energy consumption over the same period. This causes substantial environmental impacts mainly reflected as worsening air quality in many metropolitan areas. The typical CO_2 emission from the transport sector is about 7 to 10% of typical total country emissions. Typical fuel consumption and air quality conditions in most cities are indicated below:

Emissions/Fuel consumption	Current Levels
Fuel consumption	38% higher than the acceptable limit on a per passenger-km or per ton-km basis
CO	10% higher than the acceptable limit
CO_2	35% higher than the acceptable limit
SO_x	20% higher than the acceptable limit
NO_x	20% higher than the acceptable limit
PM	35% higher than the acceptable limit

2. **Proposed Transformation**: Adoption of a comprehensive approach to solve the problem is not only necessary; it is vital, if the solution is to be sustainable over the long haul.

3. Mitigating greenhouse gas and other emissions from the transportation sector requires understanding and managing the growing transportation energy use, with specific focus on on-road transportation modes and other country-specific conditions. Effective implementation of the following strategies may reduce fuel consumption (per pass-km or ton-km) and transport-related emissions including CO_2, by as much as 60% and may improve, by the same proportion, the overall air quality conditions in a typical city.

(a) Transportation demand management (TDM) strategies and policies, focusing on encouraging the use of less energy-intensive forms of transportation. These include promoting public transportation, encouraging people to drive less, and developing effective sustainable urban planning to minimize transportation needs.

(b) Strategies and policies to reduce greenhouse gas emissions from the automotive sector by improving the energy efficiency of the vehicle fleet. This includes fiscal policies encouraging people to buy and use more efficient vehicles, policies to promote advanced and more fuel efficient vehicle technologies, and vehicle fuel economy standards. This can be accomplished by accelerating the adoption in developing countries of the most fuel efficient technologies, implementing stricter fuel economy standards, and developing fiscal policies promoting improved fuel economy. The use of energy efficient vehicles can potentially reduce CO_2 emission by up to 30% over conventional vehicles.

(c) Strategies and policies to replace transportation energy sources in developing countries with greenhouse gas minimizing alternative such as natural gas or renewable fuels, such as bio-fuels. The use of bio-fuel can possible reduce CO_2 emissions by up to 25% over gasoline or pure diesel.

4. **Implementation Readiness:** Each mitigation strategy is to be designed and implemented on a country-specific basis considering the specific local conditions. Most countries will be ready, with substantial external assistance, to implement improvements in fleets' efficiency by adopting more energy-efficient vehicle technologies, developing fuel economy standards and policies, and promoting improved fuel economy. However, specific options such as the use of hybrid electric vehicles or the use of bio-fuels are difficult to assess, especially against a backdrop of conflicting international experiences, complex local conditions and significant initial investments. Sustainable urban planning to reduce transportation needs will likely go on a slow pace depending on each country's ability to decongest metropolitan areas and build self-sustaining communities. Switching to cleaner fuel depends heavily on the availability of gas/bio-fuels and related infrastructure in each country.

5. **Rationale for CTF financing:** The CTF may be used to reduce the perceived barriers and risks to implementation of the identified solutions. It can help finance the following:

(a) The incremental cost of energy-efficient vehicles, the cost to convert engines to run on gas or bio-fuels or the incremental cost of factory-built natural gas vehicles;
(b) Part of the cost of the gas storage and distribution system including filling stations;
(c) Services to develop plans, policies, regulations, standards, incentive schemes, taxation systems related land use, fuel economy and vehicle technologies;
(d) Development of local capacity and technology to manufacture locally energy efficient vehicles such as hybrid or electric vehicles including manufacturing improvements to being the cost down;
(e) Capability building to service energy efficient vehicles (such as hybrid, electric, gas/bio-fuel-fed) including necessary service equipment and instrumentation;
(f) Capability building and instrumentation to do performance testing on all vehicles on the roads and in service centers;
(g) Capability building and instrumentation to monitor air quality parameters in cities;
(h) Development and adoption of land use planning codes/practices that encourage decongestion of metropolis, formation of self-sustaining communities and use of non-motorized travel modes.

Financing Plan:

6. Total project cost for a typical city of 10 million people: ~$1 billion:

(a) Host City Equity: ~$300 million;
(b) CTF: ~$200 million;
(c) ADB: $200 million;

(d) Other sources (Private Sector): 300 million.

Grant element from CTF in total financing: 15%

Large Scale Wind in support of Low Carbon expansion path for the power sector

1. **Problem Statement**: The power sector is the largest contributor to greenhouse gas (GHG) emissions, accounting for about 25 percent of the global total. Emissions from the power sector grew 66% worldwide between 1990 and 2002 and are projected to grow a further 50% by 2020. The sector plays a vital and enabling role in economic activity and is central to future development prospects and improvements in quality of life in developing nations. Yet, in most situations, fossil-fuel based power generation represents the cheapest and most expedient option to meet future demand and would consequently lead to a continuing increase in the carbon footprint of the sector. Climate and health costs associated with thermal generation are not generally accounted for.

2. **Proposed Transformation**: Renewable energy, in particular wind, has the potential to substitute for thermal-based power generation to meet future demand for power, in areas with high wind regimes. Wind energy has a negligible carbon footprint and can be scaled up in modular fashion to meet step-wise increases in demand. The use of wind resources could contribute to a low carbon development path, reduce vulnerabilities associated with resource scarcity (including water supply during periods of drought for hydro-based systems), strengthen the resilience of the power sector to future shocks (peaks in fuel costs, loss of resources or impacts of climate variability on hydro power), manage the risk/return combination of investment portfolios by diversifying energy investments and reduce the impact of oil imports.

3. For example, in a country where installed power is about 15,000 MW, of which about 10,000 MW of capacity is in hydropower plants and less than 5,000 MW is fueled by thermal (mostly natural gas plants), but demand is growing at 3% annually and future demand is expected to be met mainly by coal, a large scale wind program could transform the expansion path for the power sector:

(a) A 400 MW scale up program, in such a scenario, would be equivalent to 20 times current capacity and would displace future emissions equivalent to about 1.0 million tons per year (reducing emissions from the power sector by about 10% of current emissions);

(b) Large scale wind energy capacity to meet growing demand for power in developing country markets would send a strong signal to suppliers and generators, reducing over time the differential costs between wind and standard fossil fuel options.

4. **Implementation Readiness:** Wind generators are technically proven and commercially available. Several smaller scale units are already in operation in some developing nations, constituting a suitable basis on which to base a scale up effort.

5. **Rationale for CTF financing:** Large scale wind plants face a number of barriers. Under current financial conditions, prevalent in the market, the wind option is unlikely to be able to compete with coal or gas for power generation. Wind power capital costs are typically higher than combined cycle gas or coal. While operation costs would be lower over time, the higher capital costs constitute a serious financial barrier for power generators or for public sector investment.

6. A financial analysis of wind energy generation, at the proposed capacity level under current conditions, shows that the project at such a scale would not be financially attractive. The estimated financial rate of return on equity investment (assuming a 70:30 debt ratio, with debt in commercial terms) is estimated at 1.0%. The anticipated revenues from emission reductions to 2022 at Euros 10/ton CO2 eq, would cause the IRR on equity to increase to 3.5%. The use of the CTF, blended with IBRD lending, could increase the IRR on equity to 11.5%.

7. The availability of low cost financing would facilitate decisions to adopt low carbon power options and reduce the initial financial barriers faced. Blending CTF resources with IBRD and other financing would make available investment capital in infrastructure which may otherwise not be readily available or facilitate the speed of adoption and scale up of wind power capacity. The low cost financing would be instrumental in decisions taken to adopt wind power, internalizing some of the climate benefits that are not typically rewarded by the financial markets.

Financing Plan:

8. Total costs required to set up a 400 MW wind power plant is estimated, under current conditions, to be roughly $0.9 billion:

(a) Sponsor equity: $270 million;
(b) CTF: $225 million;
(c) IBRD: $225 million;
(d) Other loans: $140 million;
(e) Carbon finance: $50 million.

Grant element from CTF in total financing: 18%