Climate Investment Funds

CTF/TFC.4/4/Rev.1
November 9, 2009

Meeting of the CTF Trust Fund Committee
Washington, D.C.
October 27, 2009

**CLEAN TECHNOLOGY FUND**
**REVISED INVESTMENT PLAN FOR SOUTH AFRICA**

**Note:** The CTF Investment Plan for South Africa was revised to include the AfDB and private sector co-financing amounts which were inadvertently omitted in the previous version.

**Clean Technology Fund Investment Plan for South Africa**
**Executive Summary**

## Introduction

1. This Clean Technology Fund Investment Plan for South Africa proposes CTF co-financing of $500 million to support South Africa's goals of generating four percent of the country's electricity requirements from renewable energy by 2013 and improving energy efficiency by 12 percent by 2015. Specifically, the Investment Plan proposes CTF co-financing for grid-connected solar thermal power, utility-scale wind power development, solar water heaters, and energy efficiency, particularly in the commercial and industrial sectors. The CTF investments will mobilize financing of about $1 billion from bilateral and multilateral financiers, plus private sector financing. A Phase 2 of the Investment Plan is expected to include substantial investment in low carbon transport, on the basis of a transport sector greenhouse gas inventory that the Government is currently undertaking.

## Country and Sector Context

2. The 15 years since the end of apartheid have witnessed South Africa's transformation into a stable and robust economy, with a four percent average annual economic growth rate over the past ten years. Strong GDP growth in South Africa has important regional implications, given the inter-linkages between its economy and the rest of Africa. This strong economic performance has resulted in a 60 percent increase in demand for electricity by industry and households between 1994 and 2006, with coal accounting for 75 percent of total energy consumption. South Africa's historically low-cost energy supplies, together with the predominance of extractive industries, have combined to create a relatively energy-intensive economy, although there has been a reduction in energy intensity relative to 1990.

3. South Africa is the eleventh largest emitter of $CO_2$ globally and its per capita emissions are the eighth highest in the world. The energy sector is the single largest source of $CO_2$ emissions, with coal accounting for more than 90 percent of total emissions by fuel source. The transport sector represents about 13-15 percent of South Africa's greenhouse gas emissions, and emissions from the sector are expected to grow by about 17 percent between 2007 and 2011. If South Africa continues with a business-as-usual growth path, its emissions will almost quadruple by 2050.

## Priority Sectors for GHG Abatement

4. South Africa's Long-Term Mitigation Scenarios (LTMS) have allowed for the development of national climate policy based on what is required by science to limit temperature increase to two degrees Celsius above pre-industrial levels. The LTMS developed several mitigation scenarios designed to illustrate how the huge gap between "Growth without Constraints" and the "Required by Science" cases (about 1,300 million

tons of $CO_2$ or almost three times current levels) could be closed. The policy-relevant scenarios include:

(a) The Start Now scenario, which reflects immediate implementation of policies already articulated but not yet implemented, such as efficiency in industry and transport, as well as more renewable energy and nuclear sources for electricity. This scenario significantly reduces the growth in $CO_2$ emissions;
(b) The Scale-Up scenario can yield a leveling off in $CO_2$ emissions by 2050 through a transition to zero-carbon electricity, with nuclear power and renewable energy expanding to 50 percent of electricity generated; and,
(c) The Use the Market scenario relies on economic instruments (such as carbon taxes), which would achieve almost three-quarters of the reductions needed to achieve the Required by Science scenario.
(d) The Reach for the Goal scenario fills the remaining gap through investments in new low carbon technologies, changes in consumer behavior, and restructuring of the economy away from coal towards more climate-friendly energy sources.

5. In response to the LTMS, the Cabinet has adopted the following mitigation strategies:

(a) Implement the Start Now options, focusing on accelerated energy efficiency across all sectors --industrial, commercial, transport and residential;
(b) Invest in the Reach for the Goal strategy, including ambitious low carbon technology research and development, new clean energy resources, and behavioral change; and,
(c) Pursue regulatory mechanisms contained in the Scale-Up scenario, together with the economic instruments from the Use the Market scenario.

As a result of these strategies, emissions would grow, albeit at a reduced rate, in the short term, plateau by 2030, and decline gradually thereafter.

6. Specific Government policies stemming from the Cabinet decision include:

(a) Ambitious, mandatory targets for energy efficiency;
(b) Adopting levies on $CO_2$, beginning with a levy on coal-fired power production;
(c) Introducing more stringent thermal efficiency and emissions standards for coal-fired power stations;
(d) Providing incentives for private sector-led renewable energy development via feed-in tariffs;
(e) Developing carbon capture and storage for coal-fired power stations and coal-to-liquid plants; and,
(f) Reducing transport emissions through fuel efficiency standards, modal shifts towards public transport, and promotion of hybrid and electric vehicles.

**Rationale for Selected Sectors for CTF Co-Financing**

7. The priority activities selected for CTF co-financing are:

(a) Final design and risk mitigation review, followed by construction and operation of Eskom's proposed 100 MW-capacity Upington Concentrated Solar Power (CSP) plant, which will be the first-ever commercial scale CSP plan in sub-Saharan Africa. CTF financing would be used to reduce the high capital cost and/or to mitigate potential risks, such as cost overruns and/or performance risks, through risk mitigation instruments. CTF support would have the transformational effect of promoting CSP deployment, particularly in the private sector, by proving the technology in actual operation and establishing benchmarks for cost and performance. The particular promise of CSP in the LTMS is the fact that it provides a realistic alternative to coal power plants for base load capacity.

(b) Development of the first utility-scale wind power plant -- Phase 1 of Eskom's Western Cape Province Wind Energy Facility, consisting of a 100 MW wind farm -- as well as support to pioneer private sector projects amounting to 100 MW new generation capacity. CTF support would transform the nascent wind sector by creating a robust pipeline of large-scale wind power projects, based on proven construction and performance experience in the South African context. In addition, the investment program would address first-mover costs and risks related to negotiating bankable power purchase agreements and learning processes involved in local lenders and contractors engaging in wind development for the first time. Investments in transmission capacity to connect Independent Power Producers to the grid would catalyze substantial private sector investment in wind power.

(c) Support to municipalities and the private sector in a large-scale program to deploy solar water heaters SWH), with a target of achieving 50 percent of the Government's ambitious goal of converting 1 million households from electric to solar water heating over the next five years. CTF support would accelerate SWH market penetration and development of a domestic SWH industry by buying down high installed cost, market development, and demonstrating business models.

(d) Scale up energy efficiency investments by catalyzing the expansion of bank lending to the commercial and industrial sectors through lines of credit to commercial banks, contingent financing to foster energy service companies (ESCOs), and financial incentives or risk products to market leaders, such as large industrial customers. CTF support would seek to address barriers to energy efficiency investments, such as high preparation and other transaction costs, perceived risk of energy efficiency projects on the part of commercial lenders, and organizational biases against investing in cost reduction.

9. *Potential for GHG reduction:* Cumulative emissions savings from the CSP and wind plants over a projected 20-year plant life would be nine million tons and five million tons of $CO_2$, respectively. The SWH conversion program could result in cumulative emissions savings of about 32 million tons of $CO_2$, assuming a 20-year life. It is more difficult to estimate the emissions savings from the energy efficiency sub-

sector, given the nature of the investments; however, an initial estimate suggests annual emissions savings of about nine million tons of $CO_2$.

10. *Demonstration potential:* The replication potential of CSP plants in southern Africa is vast; in South Africa alone, Eskom estimates 40 GW of commercially viable CSP in the Northern and Western Cape provinces. Replication in Namibia and Botswana could double or treble this potential. Wind power, too, has considerable potential for scale-up at an estimated 10,000 GW of economic wind potential. The market for SWH is significant; a 50 percent market penetration for the seven million households with water heaters would treble the Government's one million SWH target, in line with the LTMS estimate of 307 million tons of $CO_2$ reduction by SWHs over 40 years. Given South Africa's energy intensity, the scalability potential of energy efficiency interventions is substantial. Realization of the national target laid out in the National Energy Efficiency Strategy (i.e. 12 percent reduction in electricity consumption) would represent electricity savings of 110,000 GWh.

11. *Development impact:* Since most of the component value of CSP and wind power plants can be sourced locally, the economic and social benefits of these renewable technologies would include domestic industrial development and employment. The SWH program would also have very substantial benefits for the South Africa economy and specifically for low-income households as a result of lower electricity bills (in the context of rising tariffs), as well as increased jobs in a growing domestic SWH manufacturing service industry, particularly in small and medium enterprises. Energy efficiency measures play an important role in limiting the need for new generation capacity, which imposes a significant fiscal burden on the South African economy as a whole. All the interventions will have environmental co-benefits such as reduced NOx, SOx and particulates emissions from avoided coal-fired base load power plants.

12. *Implementation Potential:* The most significant enabling policy in place for renewable energy sources is the feed-in tariffs recently established in South Africa. The Government is also undertaking a number of enabling efforts, such as updating the wind atlas, outreach programs, and development of the grid code. The CTF financed SWH program would implement a national strategy for SWH market development that is currently under development through a GEF-supported project. For energy efficiency, a Standard Offer mechanism – under which any energy user or energy service company that can deliver energy or demand savings would be paid a fixed amount – is being rolled out and would provide a favorable basis for private sector-led energy efficiency project development. A generic risk for all investments is the low cost of electricity, pending projected rate increases, to which the Government is committed.

13. *Additional costs and risk premiums:* The capital cost of the CSP plant is projected to be more than three times that of a supercritical coal-fired power plant. Adjusting for fuel and operations and maintenance costs, there still remains a viability gap of more than 1 Rand/kWh, in addition to substantial commercial and performance risks and cost uncertainties. Similarly, the production cost gap between a typical wind farm and a new supercritical coal-fired power plant is about 0.7 Rand/kWh. South Africa's feed-in tariff is expected to attract wind developers, but there remains a need to address the additional

costs and risks of first-movers: such as grid connection and transmission infrastructure, as well as the transaction costs of project development and financing. SWH will require bulk procurement to bring down costs and ensure quality of equipment, as well as financial incentives to address affordability issues faced by low-income consumers. In the energy efficiency subsector, CTF support would help provide easier access to financing and risk mitigation instruments to provide positive incentives alongside tariff increases.

**Table 1: Results indicators for the CSP Subsector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Grid-Connected Solar Thermal Power Capacity in South Africa | 0 (2009) | 100 $MW_e$ of new solar capacity |
| Estimated annual GHG emission reductions | 0 (2009) | 0.45 MT $CO_{2e}$/year |
| Rapid replication potential towards Govt's goal of 4 % renewable energy power production by 2013 | 0 (2009) | 100MW new STP plants per year for four years yields 2,064 GWh annual production by 2013 |

**Table 2: Results Indicators for the Wind Power Sub-sector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Wind Power Capacity in South Africa | 20 MW (2009) | 200 MW of new wind power capacity (100MW public, 100MW private) |
| Estimated annual GHG emissions reductions | 0.04 Mt $CO2_e$ (2009 est.) | 0.50 MT $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 4% renewable energy power production (e.g., 10,000 GWh) by 2013 | 44 GWh (2009 est.) | 10 total new 100 MW wind farms would produce 2,700 GWh annual output |

**Table 3: Results Indicators for SWH Subsector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Commercial and Household SWHs | 25,000 SWH installations (2009) | 500,000 SWH installations |
| Estimated annual GHG emissions reductions | 0.081 Mt $CO2_e$ | 1.62 Mt $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 4% renewable energy power production (e.g., 10,000 GWh) by 2013 | 90 GWh | 1 million SWH installations would reduce electricity production needs by 3600 GWh/year |

**Table 4: Energy Efficiency results indicators**

| **Indicators** | **Baseline** | **Investment Program Results** |
|---|---|---|
| Installed Industrial, Commercial and Household EE | 1,000 GWh (2008 Eskom actual results) | 10,000 GWh |
| Estimated annual GHG emissions reductions | 0.9 Mt $CO2_e$ (2008 Eskom actual results) | 9.0 Mt $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 12% reduction in 2015 projected consumption | 1,000 GWh | 10,000 GWh yields 10 percent of the 110,000 GWh required to meet the 2015 goal |

**Table 5: Indicative Financing Plan**
**(in US$ millions)**

| **Project** | **CTF** | | | | **ADB** | **IBRD** | **IFC** | **EIB** | **KfW** | **AFD** | **Private Sector** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IBRD | ADB | IFC | ADB (private sector) | | | | | | | | |
| Eskom CSP | 200 | 50 | | - | 50 | 150 | | 50 | 100 | - | | 600 |
| Eskom Wind | 50 | 50 | | - | 50 | 110 | | - | - | 140 | | 400 |
| Private Sector Renewable energy/energy efficiency/SWH | - | - | 75 | 75 | 200 | - | 200 | 50 | - | 210 | 540 | 1,350 |
| **Total** | **250** | **100** | **75** | **75** | **300** | **260** | **200** | **100** | **100** | **350** | **540** | **2,350** |

CURRENCY EQUIVALENTS

(Exchange Rate Estimated as of September 21, 2009)

Currency Unit = Rand
Rand 8.00 = US$1

FISCAL YEAR
April 1 – March 31

ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AFD | Agence Francaise de Developpement |
| AfDB | African Development Bank |
| BRT | Bus Rapid Transit |
| CFL | Compact Florescent Lamp |
| CIPA | Climate Investment Program for Africa |
| CO2 | Carbon dioxide |
| CTF | Clean Technology Fund |
| DoE | Department of Energy |
| DPE | Department of Public Enterprises |
| DSM | Demand Side Management |
| EIA | Environmental Impact Assessment |
| ESCO | Energy Services Company |
| ESMAP | Energy Sector Management Assistance Program |
| GEF | Global Environment Facility |
| GHG | Greenhouse gas |
| HVAC | Heating, Ventilation, and Air Conditioning |
| IBRD | International Bank for Reconstruction and Development |
| IDC | Industrial Development Corporation |
| IFC | International Finance Corporation |
| IP | Investment Plan |
| IPP | Independent Power Producer |
| LTMS | Long Term Mitigation Scenario |
| MDB | Multi-lateral Development Bank |
| MPD | Municipal Power Distributor |
| PCP | Power Conservation Program |
| PPA | Power Purchase Agreement |
| PV | Photovoltaic |
| REFIT | Renewable Energy Feed-In Tariff |
| SANERI | South African Energy Research Institute |
| SME | Small and Medium Enterprise |
| STP | Solar Thermal Plant |
| SWH | Solar Water Heating |

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# I. INTRODUCTION

1. The Clean Technology Fund (CTF)1 Investment Plan is a "business plan" agreed among, and owned, by the Government of South Africa for the International Bank for Reconstruction and Development (IBRD), the African Development Bank (AfDB), and the International Finance Corporation (IFC). It supports the low-carbon objectives and priorities outlined in South Africa's Long-Term Mitigation Scenarios (LTMS), its National Climate Change Response Strategy of 2004, Renewable Energy White Paper of 2005, and National Energy Efficiency Strategy of 2009. This multi-year Investment Plan (IP) identifies transformational programs to be co-financed by the CTF jointly with the IBRD, AfDB, and IFC. It will be presented to the CTF Trust Fund Committee in October 2009

2. The IP is a dynamic document, with the flexibility to take into account changing circumstances and new opportunities. Such flexibility is particularly important in the private sector and all the more necessary during the current period of uncertainty associated with worsening global economic conditions and financial markets.

3. This IP reflects the experience and results of IBRD, AfDB, and IFC engagement on climate change and development since 2007. IBRD, through the Energy Sector Management Assistance Program (ESMAP) and the Global Environment Facility (GEF), has supported South Africa's efforts to develop a long-term mitigation strategy and to transform the markets for renewable energy and energy efficiency. IFC has supported South Africa's private sector mitigation efforts with carbon finance investments under the Clean Development Mechanism, and has worked with financial intermediaries in South Africa to develop their lending for energy efficiency projects. IBRD and AfDB are also engaged in parallel efforts to support the New Build and Major Maintenance programs of Eskom, the public power utility (i.e., Eskom's capital expenditure investment plan).

# II. COUNTRY AND SECTOR CONTEXT

4. The 15 years since the end of apartheid have witnessed South Africa's transformation into a stable and robust economy. Prudent economic management and a supportive global environment have helped the country to attain a 4 percent average annual economic growth rate over the past 10 years. South Africa's growth is also important regionally, given the inter-linkages between its economy and the rest of Africa. South Africa accounts for nearly one-third of Sub-Saharan Africa's GDP and more than two-thirds of the combined GDP of the 14 Southern African Development Community (SADC) members.

[1] The Clean Technology Fund invests in projects and programs that contribute to the demonstration, deployment, and transfer of low carbon technologies with a significant potential for long term greenhouse gas emission savings. The CTF Trust Fund Committee oversees the operations of the Fund. The World Bank (IBRD) is the Trustee of the Fund.

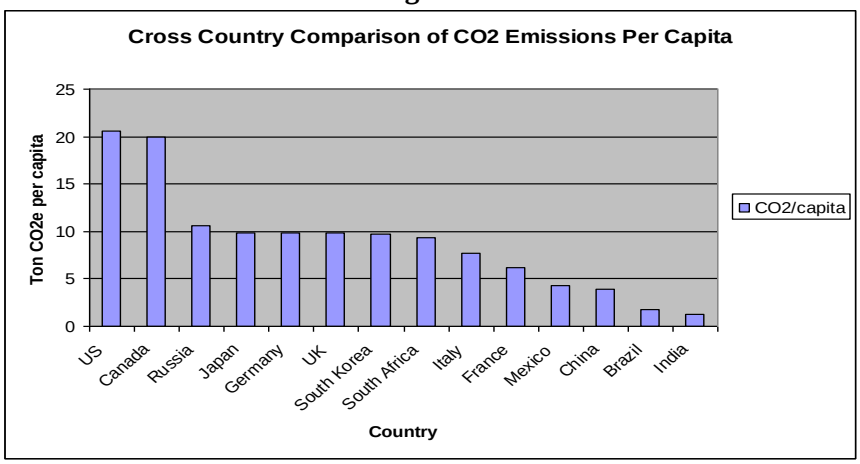
5. The Government of South Africa's development strategy is economic growth with equity. It has two main pillars. First, the strategy addresses key social and economic constraints to greater equity, defined in terms of access to job opportunities, housing, education and training, health services; and enhances the Government's capacity to deliver these essential services. Second, the strategy creates an enabling environment for economic growth, including through investments in the energy sector.

6. After several years of sustained economic growth, supported by reliable and sufficient electricity supply, South Africa's electricity system is now under considerable strain. The electricity sector, though generally operationally efficient, has run into major capacity constraints during the last few years, and especially in 2008. Demand for electricity by industry and households increased by 60 percent from 1994-2006, but no new generating capacity came on-stream from 2001-2006. Power rationing and other measures instituted to prevent the electricity system from collapsing have affected the entire economy, especially the country's mining industry, leading to shutdowns of the largest mining operations and putting thousands of jobs at risk. The impact of the global economic slowdown and electricity disruptions led to a 1.7 percent drop in GDP growth in the first quarter of 2008, resulting in the lowest rate in more than six years.

7. The Government has responded quickly to the energy crisis, assigning the highest priority to improving the generation capacity and the reliability of electricity supply. To meet the country's forecast demand growth (more than 12 GW in 5-7 years), Eskom has started constructing two new coal-fired plants. There is no other low-cost (or low-carbon) generation option available in the required timeframe that could substitute for the coal option and ensure energy security. At the same time, the Government needs to be supported, particularly during the current economic crisis, to achieve its commitment to reduce greenhouse gas (GHG) emissions in the long term, as outlined in its Long-Term Mitigation Scenario (LTMS).

8. South Africa is the largest contributor to GHG emissions in Africa. According to the LTMS, emissions were 415 million tons of carbon dioxide equivalent ($MtCO_2e$) in 2000, placing South Africa as the $11^{th}$ largest emitter globally. The country's emissions per capita are about 10 tons of $CO_2$/person, the eighth highest in the world (see Figure 1).

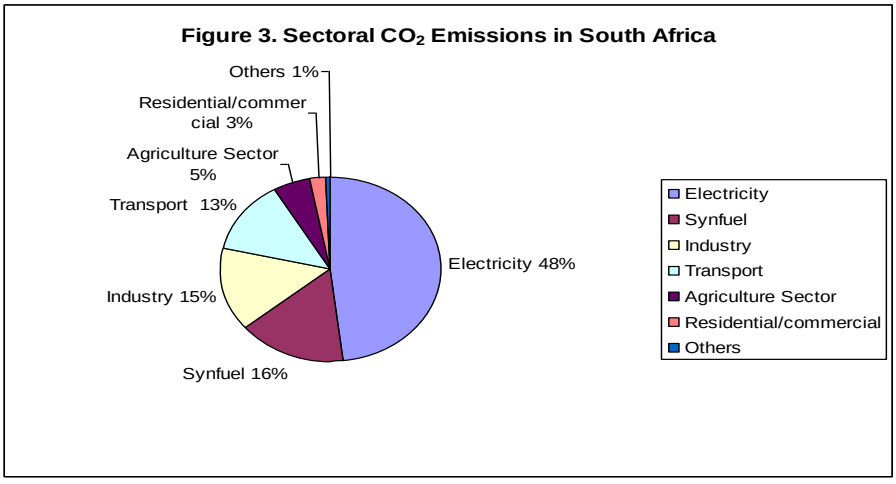
**Figure 1**




*Source:* World Bank and International Energy Agency, 2007

9. The energy sector is the single largest source of $CO_2$ emissions, accounting for more than 70 percent of the total $CO_2$ emissions in the country. This is mainly because of South Africa's heavy reliance on coal to meet its primary energy needs (75 percent of total energy consumption in 2004 was from coal). Coal-fired power production accounts for almost half of $CO_2$ emissions, but synthetic fuel production, energy-intensive industries (mining, iron and steel, cement), and transport are also important contributors (see Figure 2). If South Africa continues with a business-as-usual growth path, its emissions will almost quadruple to 1600 million tons of carbon dioxide equivalent by 2050.

**Figure 2**

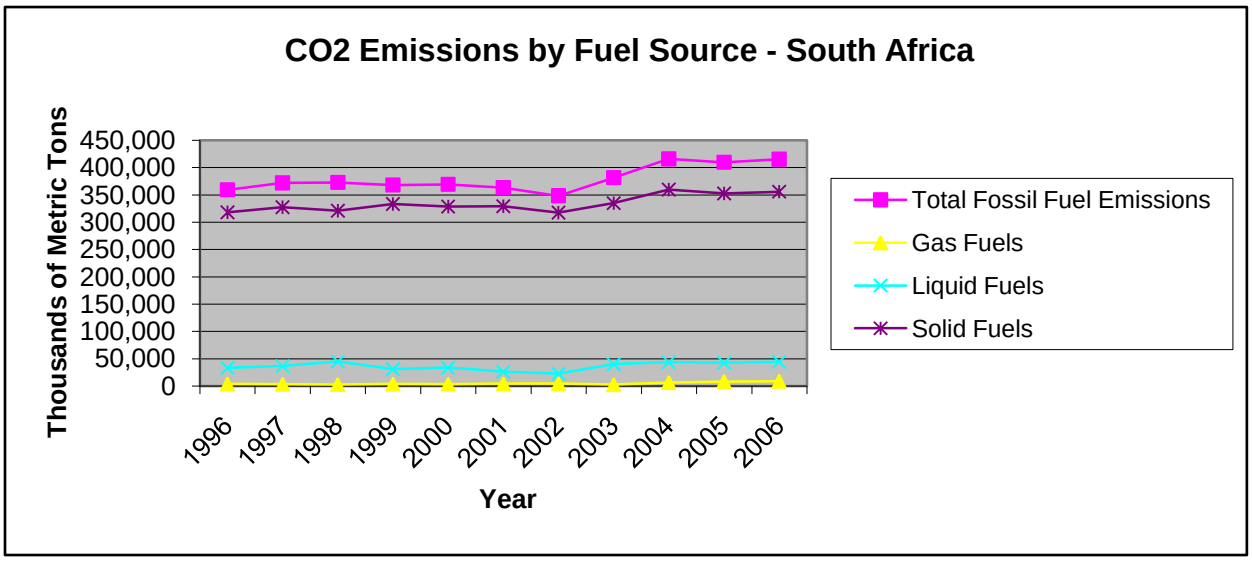



*Source:* South African Department of Energy, 2007

10. Coal dominates primary fuel consumption in South Africa. Since the 1960s, coal has accounted for more than 90 percent of total $CO_2$ emissions (see Figure 3). Small amounts of liquid and gas fuels, mostly imported, are used primarily in transportation.

This reliance on coal and the lack of cleaner fossil fuels makes renewable energy of vital importance to satisfying growing energy demand in the medium to long term.

**Figure 3**

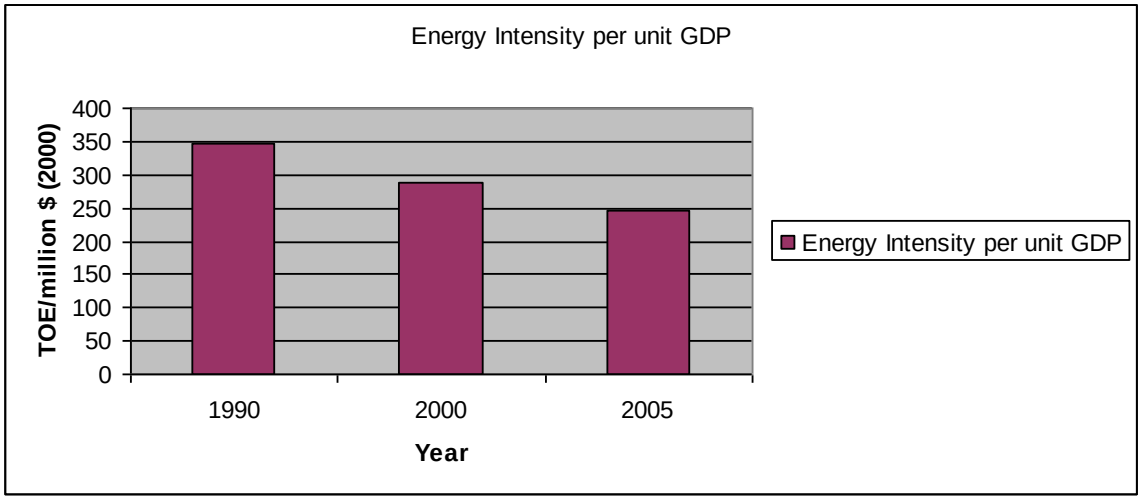



*Source:* Oak Ridge National Laboratory, 2008

11. South Africa's historically low-cost energy supplies, together with the predominance of extractive industries, have combined to create a relatively energy-intensive economy. Although South Africa ranks 42nd globally in GDP, it is 21st in terms of energy consumption. The result is both a high energy intensity per capita (Figure 1) and a high energy intensity per unit of economic output (see Figure 4). Although the period 1990-2005 has seen some reduction in energy intensity, there are clearly large opportunities for technical improvements in utilization of primary energy inputs.

12. The transport sector also represents about 13-15 percent of South Africa's GHG emissions, and emissions from the sector are expected to grow by about 17 percent between 2007 and 2011. The transport sector has great potential to reduce its carbon footprint through some relatively inexpensive interventions, including shifting passengers towards public transport, particularly bus rapid transit (BRT).

**Figure 4: Energy Intensity of the South African Economy, 1990-2005**




*Source:* World Resources Institute, 2008.

13. South Africa is highly vulnerable to climate change, particularly in the areas of human health, agricultural production, plant and animal biodiversity, water resources, and rangelands. If the business as usual approach continues, it is projected that an additional 5.2 million people will be at risk of malaria in the expanded areas prone to malaria over the next 50 years in South Africa, as a consequence of prolonged summers. In addition, maize production will decrease by approximately 10 to 20 percent at a time when food demand is expected to grow. It is the poor who are usually confined to living in risk-prone areas and are the first to suffer the consequences of climate change. Therefore, global efforts to mitigate human-induced climate change are consistent with South Africa's national interest.

14. The Government of South Africa is a leading voice in the developing world on climate change issues. The Government has committed to doing its part to stabilize global temperature at 2 degrees Celsius above pre-industrial levels, as recommended by scientific consensus. Recognizing South Africa's development needs, the mitigation strategy the Government has adopted envisages an increase in emissions over the short term, stabilized emissions by 2020-2025, followed by an emissions decline in absolute terms by mid-century.

15. South Africa has taken concrete steps towards realizing these long-term goals. In particular, South Africa has:

- Ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997, and acceded to the Kyoto Protocol in July 2002;
- Developed a *National Climate Change Response Strategy* in 2004, outlining a broad range of principles and policy measures for mitigation and adaptation to climate change;

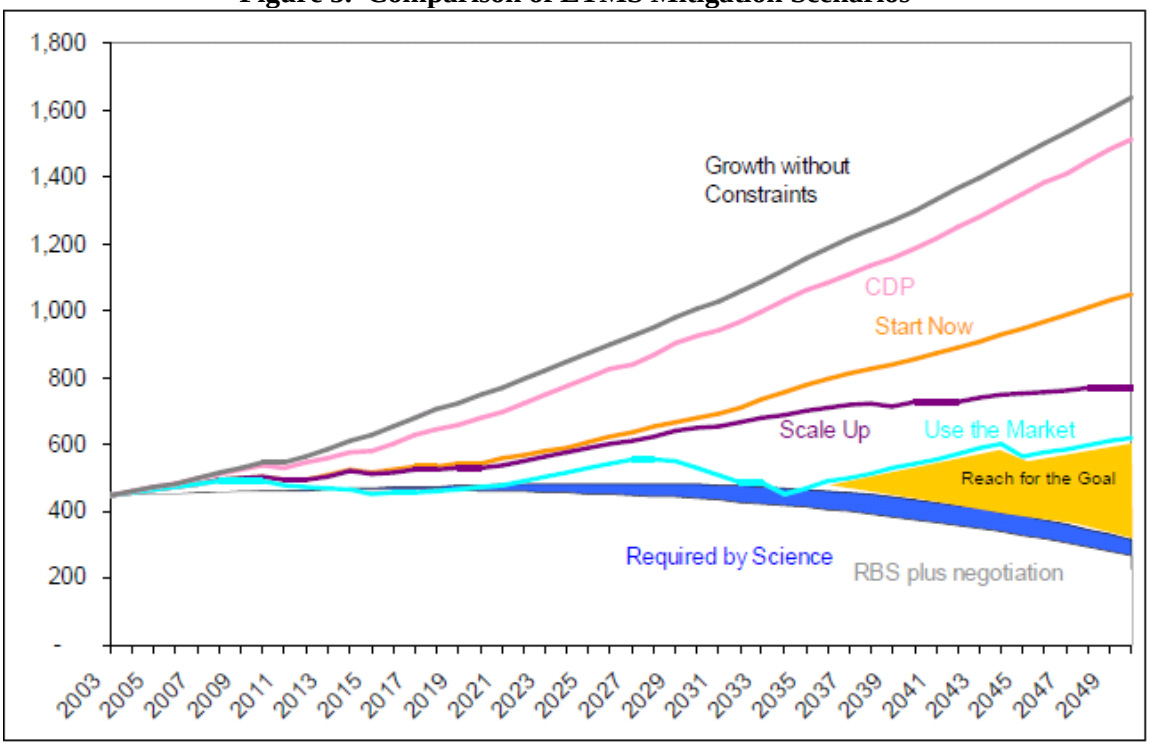
- Adopted a *White Paper on Renewable Energy* in 2005, setting a target of 4 percent of electricity supply (equivalent to 10,000 GWh) from renewable energy sources by 2013;
- Adopted a *National Energy Efficiency Strategy* in 2006 (updated in 2009), setting ambitious national targets for energy efficiency improvement (12 percent by the year 2015). A National Energy Efficiency Agency was also established to pursue this target through various energy conservation programs;
- Completed a major analytical study in 2008, identifying the priority sectors for carbon mitigation, as part of a pioneering effort among developing countries to combine high-quality research with extensive stakeholder consultations. Based on this process, South Africa has put forward aggressive Long-Term Mitigation Scenarios (LTMS) to address priority climate change issues;
- Implemented the Renewable Energy Feed-In Tariff (REFIT) program in 2009, under which the National Energy Regulator of South Africa (NERSA) provides price incentives for the development of power projects that use renewable energy.

# III. PRIORITY SECTORS FOR GHG ABATEMENT

16. South Africa's Long-Term Mitigation Scenarios have allowed for the development of a national climate policy based on what is required by science to limit temperature increase to 2 degree Celsius above pre-industrial levels. This is a ground-breaking effort to create a model-based linkage between mitigation scenario projections and policy options for the Government. Because of its rigor and utilization of available data, the LTMS provides an ideal underpinning for low-carbon investment planning. The conclusions of the LTMS are that the largest emission reductions will come from three energy pillars – energy efficiency, renewable energy, and nuclear; and two transport pillars – passenger modal shift and vehicle fuel efficiency.

17. The LTMS developed three basic scenarios for South Africa's climate change policy: (a) the Growth Without Constraints, or business as usual scenario, in which $CO_2$ emissions quadruple by 2050; (b) the Current Development Path, which represents the Government's energy and transport polices as currently articulated; and (c) the Required by Science scenario, which yields a CO emissions trajectory that plateaus by 2030 followed by gradual decline (see Figure 5). The gap between these two 2050 outcomes is projected at 1300 MT $CO_{2,}$ or almost three times current levels.

**Figure 5. Comparison of LTMS Mitigation Scenarios**




*Source:* South African Department of Environmental Affairs [2008]

18. The LTMS developed several mitigation scenarios designed to illustrate how the huge gap between the Growth without Constraints and the Required by Science cases could be closed. Policy-relevant mitigation scenarios include: (a) the Start Now scenario; (b) the Scale-Up scenario; (c) the Use the Market option; and finally, (d) the Reach for the Goal scenario, based on the South African contributions needed to limit global temperature increase to 2 degrees C by 2050 (see Table 1).

19. The Start Now scenario reflects immediate implementation of policies already articulated but not yet implemented. The largest components of this scenario are efficiency in industry and transport (greater vehicle efficiency and shifts from private to public transport), as well as more renewable sources and nuclear sources for electricity. The Start Now scenario significantly reduces the growth in $CO_2$ emissions compared to the Growth without Constraints case, but cannot stop the absolute growth in emissions.

20. The Scale-Up scenario is much more aggressive than the Start Now scenario and can yield a leveling-off in $CO_2$ emissions, but only by mid-century. It accomplishes this mainly through a transition to zero-carbon electricity, with nuclear power and renewable energy expanding to 50 percent of electricity generated by 2050. This scenario relies significantly on mature carbon capture and storage technologies. Other important components of this scenario include biofuels and electric vehicles, in addition to all previous transport modes, plus the full portfolio of energy efficiency technologies.

**Table 1. Summary of Key LTM Scenarios**

| | *Structural Shift* | *Efficiency* | *Investment* | *Impact on GDP* | *Employment / job impact* | *Poverty / welfare* |
|---|---|---|---|---|---|---|
| | Description of inputs to economic model | | | Results | | |
| Start Now / combined initial wedges | Moderate shift towards renewables, e.g., electricity supply from coal declines to 46 %, with nuclear and renewables each contributing around 27 % in 2050 (9% renewables and 5% nuclear by 2015)<br>Also: changes in transport to more efficient vehicles and shifting to public transport | Net-negative cost wedges, esp energy efficiency, implemented esp in industry | Relatively little additional investment required, few positive cost mitigation options added. | Small / negligible (+0.2% GDP in 2015) | Small and ambivalent - positive for unskilled (1%), skilled (1.2%) and highly-skilled (1.7%) in 2015, but negative for semi-skilled (-2% in 2015, -2.5% in 2010) – which is of concern. Only short-term costs of mitigation are considered and not the longer-term productivity gains. | Household welfare increases relative to reference case for all household groups.<br>High income HH benefit as high skilled labour gains and low skilled labour loses. Savings reduce investment requirements also avoid negative consumption effects of higher savings |
| Scale Up /combined extended wedges | Transition to zero-carbon electricity by mid-century. Significant shift towards renewables and nuclear, e.g., output share of coal-fired electricity plants declining to 2 %. Add carbon capture and storage, extend biofuels as far as possible, introduce electric vehicles | Mitigation extended, adding more efficiency and further positive cost wedges | Significant investment required, between 5 and 10% above the reference case | Initially higher (+1% in 2015) | Increase: +1% in 2015<br>Semi-skilled jobs peak at 3% in 2015 | Generally negative with positive impacts for low skill labour if biofuels is pushed hard<br>High income HH lose (opposite of above) |
| Use the Market / $CO_2$ tax | Uses economic instruments. Key driver is a CO2 tax, starting at current carbon prices and escalating. Tax quickly reduces coal in electricity and synfuel sectors and shifts in fuel and towards efficiency.<br>[Incentives included in energy modeling for SWH, biofuels and renewable electricity not assessed in CGE modeling] | Driven by tax, but efficiency allows (limited) response on energy demand side. Plus fuel switching to gas | High investment required initially, 20% above reference case | Negative (-2% in 2015) as taxes result in energy price increases unless countered by fiscal policies. Recycling revenue can off-set economic impact at lower tax levels. | Jobs *increase* for lower-skilled (+3% semi-skilled, 0% for unskilled in 2015)<br>*Decrease* for higher-skilled workers (-2% for skilled and -4% for highly skilled) | Negative for all households, except poorer households who gain initially from food subsidy; impact depends on fiscal options, low income households can be targeted directly |

*Source:* South African Department of Environmental Affairs, 2008

21. The Use the Market scenario relies on carbon taxes, which are phased in beginning with the already-announced levy on fossil fuel electricity. This case assumes that subsidies are provided via the REFIT tariff, standard offer, or other mechanisms to increase energy efficiency. It also assumes the use of solar water heating (SWH), renewable energy, and bio-fuels. This scenario, focused on economic instruments, including taxes and subsidies, has a very large impact on GHG emissions and demonstrates the importance of enabling frameworks and policies.

22. Although the Scale-Up scenario closes the gap between the Required by Science and Growth without Constraints scenarios by about two-thirds, and the Use the Market scenario achieves almost three-quarters of the reductions needed to limit global temperature increase to 2 degrees C by 2050, some residual emissions reductions remain. The Reach for the Goal scenario fills the remaining gap to achieve the Required by Science trajectory. Additional actions needed include investment in new low-carbon technologies, changes in consumer behavior, importation of low-carbon energy resources, and restructuring of the economy away from coal and towards more climate-friendly energy sources.

23. In response to the LTMS and parallel stakeholder consultations, the Cabinet has adopted the following mitigation strategies:

- Implement the Start Now strategic option, focusing on accelerated energy efficiency and conservation across all sectors, especially industrial, commercial, transport, and residential;
- Invest in the Reach for the Goal strategy, including ambitious carbon-friendly technology research and development, new clean energy resources, and behavioral change;
- Pursue regulatory mechanisms contained in the Scale-Up scenario, together with economic instruments from the Use the Market scenario (e.g., taxes and incentives).

24. Specific Government policies stemming from the Cabinet decision include: (a) ambitious, mandatory targets for energy efficiency; (b) adopting levies on $CO_2$, beginning with a levy on coal-fired power production; (c) introducing more stringent thermal efficiency and emissions standards for coal fired power stations; (d) providing incentives for private sector-led renewable energy development via feed-in tariffs; (e) developing carbon capture and storage (CCS) for coal-fired power stations and coal-to-liquid (CTL) plants; and (f) reducing transport emissions through fuel efficiency standards, modal shifts towards public transport, and promotion of hybrid and electric vehicles. Table 2 summarizes the LTMS marginal abatement cost for South Africa, with passenger modal shift as the most money-saving cost option (i.e., Rand -1131/t $C0_2$).

**Table 2. LTMS Marginal Abatement Cost**

| | Mitigation potential 2003-2050 ($MTCO_2$) | Mitigation cost (R/t $CO_2$) |
|---|---|---|
| ***Energy Sector*** | | |
| Industrial energy efficiency | 4572 | -34 |
| Renewable energy extended | 3990 | 3 |
| Nuclear extended | 3467 | 20 |
| Solar water heaters | 307 | -208 |
| ***Transport Sector*** | | |
| Passenger modal shift | 469 | -1131 |
| Improved vehicle efficiency | 758 | -269 |
| Synfuels CCS | 851 | 105 |

*Source: South African Department of Environmental Affairs, 2008*

# IV. RATIONALE FOR SELECTED SECTORS

25. Under the Investment Plan, Clean Technology Fund (CTF) funds would be used to support the Government's specific goals of (a) generating 4 percent of the country's electricity requirements (about 10,000 GWh) from renewable energy by 2013; (b) improving energy efficiency by 12 percent by 2015; and (c) modal and technology shifts in transport, including shifts from private to public modes for passengers, shifts from road to rail for freight, and introduction of clean passenger vehicles such as electric vehicles.

26. The Investment Plan would have two phases. Phase 1 would include projects in the energy sector that are ready for multilateral development bank (MDB) and CTF-supported implementation within the next 12 to 18 months. The notional CTF allocation for Phase 1 is US$500 million. Priority areas for investment include public and private sector-led, grid-connected solar, thermal, and large wind power projects; as well as private sector and municipality-led solar water heating and energy efficiency, including demand-side management.

27. Other eligible projects that may not be ready for MDB support at this time would be slated for Phase 2 of the Investment Plan, subject to the availability of additional CTF funds. Phase 2 is expected to include substantial investments in low-carbon transport, which is a significant piece of South Africa's LTMS. The Government is currently undertaking a greenhouse gas inventory for the transport sector, which will provide the basis for policy direction and program priorities for modal shifts for passenger and freight transport, and particularly for a modal shift from road to rail. Transport interventions with strong potential for Phase 2 include:

- *Electric vehicles.* The Government is supporting a research and development program on an electric vehicle (EV), with a view to towards mass production by 2012. The EV is currently approaching the concept stage, which will be followed by design, build and test phase that is expected to last about 30 months. Once the EV has reached the commercial deployment stage, MDB/CTF financing could be utilized to support a broader

government initiative for market development, through necessary policy measures, financial incentives and risk mitigation for scale-up for EVs.

- *Bus rapid transit*. Government is launching a national BRT program for a number of cities. Such systems, when appropriately integrated with other transport modes, could be transformational in the urban space.

## 4.1 Grid-Connected Solar Thermal Power (STP)

28. At the present time, almost all of the power requirements for Eskom are provided by large coal-fired power stations. These power stations operate in conjunction with gas-fired peaking turbines and pumped storage facilities to provide the power needs of the country. As noted above, the energy sector accounts for more than 70 percent of South Africa's $CO_2$ emissions. To reduce emissions, the Government has set a goal of generating 4 percent of electricity consumption from renewable energy by 2013.

29. A particularly promising renewable energy resource for South Africa is solar thermal power. Eskom has designed the first-ever commercial-scale Concentrating Solar Power (CSP) plant in southern Africa. Depending on how it is configured, grid-connected solar thermal power (STP) can provide large volumes of firm generation capacity, comparable to what is currently provided by coal-fired power plants.

30. This CSP facility, known as the Upington Concentrating Solar Power plant, is a 540 $MW_t$ tower and mirror design configured to operate as a base load unit. The design utilizes molten salt as a thermal circulating fluid and storage medium, which will allow the plant to achieve a 60-65 percent annual load factor, with a rated capacity of 100$MW_e$.

31. The estimated *cumulative emissions savings* resulting from a projected annual energy production of 516 GWh is 9 million tons of $CO_2$ over a projected 20-year plant life. This facility, when constructed, would be the largest CSP facility in the world. Successful construction and operation of a commercial utility-scale base load solar power unit is a priority for Eskom and the Government.

32. The *replication and scalability potential* of STP plants in southern Africa is vast. Eskom has estimated that there is about 40 GW of commercially viable STP in the Northern Cape and Western Cape provinces alone. Replication elsewhere in the region (Namibia, Botswana) would double or treble this potential. Since most of the component value of these power plants can be sourced locally, the *economic and social co-benefits* of STP would include industrial development and jobs creation. *Environmental co-benefits* would include reduced $NO_X$, $SO_X$, and particulates emissions from avoided coal-fired base load power plants

33. *Priority activities* for the STP subsector include final design and risk mitigation review, followed by construction and operation of the Upington CSP facility in Northern Cape Province.

34. The cost of this facility, including site preparation and interconnection, is estimated at 6.5 billion Rand, or $8,000/kW. This compares to 96 billion Rand, or $2.400/kW, for the Medupi

supercritical coal-fired power plant. Factoring in lower fuel costs for a solar thermal power plant, partially offset by higher operation and maintenance (O&M) costs, the difference in production costs for a new super-critical coal-fired power plant and a solar thermal power plant is more than 1 Rand/kWh. In addition to being more costly, the initial CSP plants will have higher commercial and performance risks than a state-of-the-art coal-fired power plant. Eskom intends to obtain warranties from each of the major component suppliers; however, as a first-of-its-kind facility in Sub-Saharan Africa, there remains substantial uncertainty regarding capital cost (variability estimated as ±25 percent), performance as measured by annual kWh output (variability estimated at ± 20 percent), construction schedule, and operating and maintenance costs (variability estimated at ± 25 percent). For these reasons, the Eskom Board has requested a design and risk mitigation review before approving the project. The high capital cost and high risk involved in constructing and operating this CSP power plant, as well as the transformational nature of the base load power plant technology, make the project a strong candidate for CTF concessional lending. The CTF would be used to reduce the high capital costs and/or to mitigate potential specific risks, such as cost overruns and/or performance risks, through contingent financing.

35. The specific results of CTF support in the STP subsector, in terms of GHG emission reduction and replication potential, are summarized in Table 2.

**Table 2. Results Indicators for the CSP Subsector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Grid-Connected Solar Thermal Power Capacity in South Africa | 0 (2009) | 100 $MW_e$ of new solar capacity |
| Estimated annual GHG emission reductions | 0 (2009) | 0.45 MT $CO_{2e}$/year |
| Rapid replication potential towards Govt's goal of 4 % renewable energy power production by 2013 | 0 (2009) | 100MW new STP plants per year for four years yields 2,064 GWh annual production by 2013 |

*Source:* Eskom and Clean Investment Planning Team, 2009

36. The *additionalities* of the STP component, compared to business as usual, are (a) the start-up of a pipeline of large-scale renewable power generation facilities; and (b) the development of a realistic alternative to coal power plants for base load capacity. Once the STP technology has been proven in actual operation and benchmarks for cost and performance have been established, the new technology learning curve together with appropriate policies and enabling frameworks should result in rapid scale-up. This is in contrast to the business-as-usual scenario, where the obstacles of high first cost and perceived risk act together to delay development of this renewable power technology.

37. The STP component will also stimulate private sector development. The recent establishment of renewable energy feed-in tariffs (REFIT) by NERSA has generated significant interest from the private sector for grid-tied solar independent power production in South Africa. NERSA's initial set of tariffs includes a tariff specifically for concentrating solar power with storage capacity. The regulator is also developing suitable tariffs for a wider range of solar technologies (photovoltaic and thermal, concentrating and non-concentrating and with/without

storage). Both international and domestic solar power developers are targeting this opportunity, with plans to develop projects using a range of technologies including power tower, trough, concentrating photovoltaic (PV), and tracking PV.

## 4.2 Utility-Scale Wind Power Development

38. Despite a slow beginning, wind power development in South Africa is entering a period of potentially rapid growth. Although current wind capacity consists of only a few small facilities (e.g., Darling Wind Power Project at 5.2 MW and the Eskom Klipheuwel test station at 3.1 MW), NERSA's recent establishment of the REFIT has generated a surge of interest by both public and private entities. The allowable feed-in tariff for wind power of 1.25 Rand/kWh is expected to be a sufficient incentive to attract private sector investment. As a result, a number of potential wind power developers have been re-evaluating old sites and developing new sites. However, considerable obstacles remain for public and private sector-led wind power development. The major constraints are include: (a) financing of project developments costs (e.g., site prospecting, wind studies, site acquisition, environmental assessments, and approvals); (b) agreement on bankable off-taker arrangements; (c) grid connection; and (d) financing of the network infrastructure needed to connect remote wind power sites to the grid.

39. The major barriers to scaling-up utility-scale wind power in South Africa include: (a) high costs relative to coal-fired production; (b) the inability to provide base load power due to output intermittency; and (c) incremental transmission costs to connect isolated wind power sites to the grid. Taking into account the lower fuel costs for wind power, the production cost gap between a new super-critical coal-fired power plant and a typical wind farm is still about 0.7 Rand/kWh.

40. The Government's near-term goals for renewable energy (e.g., 10,000 GWh by 2013) can only be met through accelerated renewable energy project development by both the public and private sector. In the public sector, Eskom has for many years been a leader in wind power development for South Africa, through its Klipheuwel test station and, more recently, its proposed Western Cape Province Wind Energy Facility. This facility, located 160 km north of Cape Town, near the town of Skaapvlei, has the potential to accommodate up to 200 MW of wind capacity.

41. A *priority activity* for this subsector is development of Phase 1 of the Western Cape Province Wind Energy Facility, consisting of a 100 MW wind farm comprising 40 2.5 MW (Class 2A) wind turbines. The project is fully scoped and specified, and an environmental impact assessment (EIA) has already been completed and provincial approvals issued. The site has a "moderate" wind resource, which means a load factor of 25-31 percent is likely. The site is near a 66 kV sub-transmission line with sufficient capacity to evacuate the power. Cumulative emissions savings from Phase 1 of the Western Cape Wind Energy Facility, based on an annual output of 271 GWh, would be 5 million tons of $CO_2$ over the 20-year life of the plant.

42. The Western Cape facility, together with new transmission capacity to export power from this and other locations, would act as a flagship to the sector and make it a good candidate for

CTF concessional lending. Eskom investments in expanding transmission capacity to the key regions of potential wind power development would catalyze substantial private sector investment under the REFIT program, making this also a good target for CTF support. The CTF funds could be used to partially finance the Western Cape project, thus reducing the production cost differential compared to coal; to provide contingent financing in the form of a performance guarantee; and to finance transmission additions dedicated to serving wind power development.

43. In the private sector, NERSA's establishment of the REFIT has generated significant interest, and at least 1000 MW of capacity are currently under varying stages of development. The pioneer projects will, however, face significant challenges in (a) negotiating bankable power purchase agreements with a designated single buyer; (b) ensuring grid connection and sufficient transmission capacity provision by Eskom; and (c) the learning processes involved in local lenders and contractors engaging in wind development for the first time. In addition to the public sector application of CTF funds to ensure Eskom's provision of sufficient transmission capacity, there will be a need for private sector a funding support through the International Finance Corporation (IFC) and the African Development Bank (AfDB), to overcome the additional costs faced by the pioneer projects and ensure sufficient returns for the additional risks taken by the developers of these projects.

44. The *replication and scalability* potential for wind power in South Africa is considerable. Although estimates of the economic wind power potential vary, a consensus value seems to be 10,000 GW. Considering that only 20 MW of utility-scale wind power is installed at present, the replication and scalability potential is very large.

45. The *environmental, social, and economic co-benefits of* wind power parallel those of grid-connected solar thermal power. First, the substitution of wind electricity for coal- fired electricity will reduce the $NO_X$, $SO_X$ and particulates emission of coal-fired power production. Social and economic co-benefits go hand-in-hand with wind power development, as fabrication of components and construction of wind projects will create jobs and promote local development, especially in isolated areas where the wind power regime is favorable and job opportunities are limited. As a national wind power industry develops, there will also be economic benefits and jobs creation for small and medium wind power enterprises and associated suppliers and manufacturers.

46. The expected results from CTF-supported wind power development, in terms of GHG reductions and replication potential, are summarized in Table 3.

**Table 3. Results Indicators for the Wind Power Sub-sector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Wind Power Capacity in South Africa | 20 MW (2009) | 200 MW of new wind power capacity (100MW public, 100MW private) |
| Estimated annual GHG emissions reductions | 0.04 Mt $CO2_e$ (2009 est.) | 0.50 MT $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 4% renewable energy power production (e.g., 10,000 GWh) by | 44 GWh (2009 est.) | 10 total new 100 MW wind farms would produce 2,700 GWh annual output |

| | | |
|---|---|---|
| 2013 | | |

*Source:* Eskom and Clean Investment Planning team, 2009

47. The *additionality* of Phase 1 investment in Eskom's Western Cape Wind Energy is two-fold: (a) a pipeline of large-scale wind power projects is created, based on proven construction and performance experience in the South African context; and (b) private sector-led wind power development is accelerated because needed transmission infrastructure has been created without excessive delays. This is in contrast to the business-as-usual scenario, where Eskom has not made significant investments in higher-cost wind power development and transmission infrastructure needed only for accommodating wind power site development. Another additionality would be the stimulation of pioneer private sector wind power developments.

## 4.3 Solar Water Heaters (SWH)

48. The potential for solar energy to mitigate the GHG emissions of household and business water heating demand was a key conclusion of the LTMS. The LTMS identified SWH as a negative-cost mitigation option, with important development and financial co-benefits. In response to both the LTMS and the Power Conservation Program, Eskom and the Department of Energy have adopted a goal of converting 1 million households from electric to solar water heating over the next five years. Such a program would reduce peak demand by 600 MW, save 3,600 GWh per year, and reduce the electricity bills of participating households by up to 50 percent. The *cumulative emissions savings* of this conversion program would be 65 million tons of $CO_2$, assuming a 20-year SWH life.

49. Although Eskom has established a subsidy program, and multiple entities are addressing the technical and market barriers to SWH, market penetration remains at a very low level. Only 10,000 solar water heaters were installed in 2008 compared with 720,000 electric water heaters, and only 1,000 households have taken advantage of Eskom's 25 percent subsidy offer. Obstacles to widespread SWH deployment in South Africa include:

- High installed cost of residential SWHs – about 10,000-15,000 Rand – due to the small number sold, the lack of competition, and extra SWH design features required for the South African operating environment;
- Low electricity prices, resulting in a long (8-10 year) payback period;
- Limited customer awareness;
- Lack of local manufacturing industry and limited installation capacity;
- A fragmented and diffuse market;
- Insufficient incentives for participants in the electricity sector (Eskom and the municipal power distributors) to support the widespread adoption of SWHs.

50. CTF could be used to support engagement with municipalities, private sector actors, and public sector champions in a comprehensive effort to overcome the barriers to SWH conversion. *Priority activities* include: (a) technical assistance to promote, coordinate, finance, and execute a commercial roll-out of SWHs; (b) bulk procurement to bring down SWH costs and ensure the quality of equipment; (c) financial remediation to address the affordability issue faced by

consumers, especially low-income households; (d) technical assistance to catalyze a domestic SWH industry, including manufacturing, distribution, and after-sales service; (e) technical assistance to develop business models that address the needs and opportunities of different water heater markets, including the new build and insurance replacement markets; and (f) increasing consumer awareness through promotional campaigns, consumer education, and marketing by real estate agents.

51. Municipal power distributors (MPDs) will play a vital role in developing the market for household SWH. By aggregating supply and billing access to large pools of residential and commercial customers, they have the potential to buy SWHs in bulk at low cost, and provide them to their customers via a leasing model that utilizes the current billing system. Under the current regulatory model, these MPDs are reliant on electricity sales to finance their operations; therefore, it is vital that MPD's share in the benefits of the SWH market or they may obstruct expansion of the market.

52. CTF funding could be used to support initial, large-scale engagement in the SWH market by pioneering MPDs that will provide a strong demonstration to others. CTF funding could be used to provide a guarantee against the perceived risk of customer payment under SWH leasing contracts, and to provide long-term concessionary loans for bulk-purchase of SWHs at low cost. The CTF funds could be supported by other sources of donor funds that could be used for capacity building, including (a) technical assistance to support regulatory reform to enable such models; (b) development of the legal framework for the leasing contracts; (c) support for adjustments to the billing systems; and (d) training of installers and service providers.

53. Local manufacturers hoping to expand their production capacity in response to bulk procurement requests from MPDs may require access to long-term concessionary funding from CTF. Similarly, installation and service providers hoping to support MPDs may need CTF-subordinated equity financing to enter the market.

54. The *replication and scalability potential* of CTF-supported interventions in the household water heater market is very large. South Africa has 13 million households, of which more than half have water heaters. Engagement with pioneering MPDs will demonstrate the suitability of a SWH conversion business model reflective of South African conditions and markets, leading to a scale-up to achieve the national target of one million SWHs. A 50 percent market penetration for all South African households with water heaters would treble the one million SWH target, in line with the LTMS estimate of 307 Mt $CO_2$ reduction by SWHs over 40 years.

55. SWHs have tremendous environmental, economic, and social co-benefits. *Environmental co-benefits* are in line with other renewable energy sources, and include reduced $NO_X$, $SO_X$, and particulates emissions from coal-fired power production. *Economic and social co-benefits* include lower energy consumption and concomitant pressure on electricity supply; lower consumer electricity bills; increased jobs as a result of a domestic SWH manufacturing industry; and opportunities for small and medium enterprises specializing in SWH installation and after-sales service. Government policies that may contribute to SWH market penetration include requiring SWH in new residential buildings, SWH demonstrations for government buildings,

taxing electric water heaters, and providing rebates or tax credits as financial incentives to adopt SWH.

56. The expected results from CTF financing for the SWH subsector are summarized in Table 5.

**Table 5. Results Indicators for SWH Subsector**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Commercial and Household SWHs | 25,000 SWH installations (2009) | 500,000 SWH installations |
| Estimated annual GHG emissions reductions | 0.081 Mt $CO2_e$ | 1.62 Mt $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 4% renewable energy power production (e.g., 10,000 GWh) by 2013 | 90 GWh | 1 million SWH installations would reduce electricity production needs by 3600 GWh/year |

*Source:* Eskom and Clean Investment Planning Team, 2009

57. The *additionality* of CTF-supported intervention in SWH market development could be considerable. Without a concerted and coordinated intervention targeting a national implementing agency, the MPDs, and the private sector, there is likely to be continued slow market penetration and delays in the development of a domestic industry for manufacturing and distribution of SWH systems. With the support of CTF, it may be possible to rapidly accelerate SWH adoption to approach the one million SWH target within five years.

## 4.4 Energy Efficiency

58. Energy efficiency is another top-priority pillar for South Africa's climate change mitigation strategy. According to the LTMS, annual GHG savings from energy efficiency improvements throughout the South African economy could reach 15-20 Mt $CO_{2e}$ by 2012, with a potential of more than 5,000 Mt $CO_{2e}$ through mid-century. The recently revised National Energy Efficiency Strategy calls for a 12 percent energy efficiency improvement over projected primary energy consumption by 2015 – equivalent to 400 Petajoules (400 x $10^{15}$J) or 120 Mt $CO_{2e}$. The largest energy efficiency opportunities are in the following four consuming sectors:

- Reducing commercial energy consumption, by investing in high-efficiency heating, ventilation, and air conditioning (HVAC) systems, motors and drives, boilers, and lighting;
- Reducing industrial energy consumption, by investing in improved lighting, compressors, motors and drives, cogeneration, boilers, and HVAC;
- Reducing household energy consumption, through Compact Fluorescent Lamp (CFL) replacement, efficient appliances, and improvement in the thermal efficiency of homes and residential buildings;

- Improving the throughput and operational efficiency of refineries and synfuel processes, through combined heat and power schemes and process efficiency improvements.

59. Energy efficiency investment has important environmental, economic, and social co-benefits. The *environmental co-benefits* of energy efficiency are similar to those of renewable energy – reduced $NO_X$, $SO_X$, and particulates emissions from avoided coal-fired generation. *Social and economic co-benefits* include (a) contributions to the Power Conservation Program from reduced electricity demand; (b) potential for SME development and jobs creation through the development of local energy efficiency manufacturing and service industries; and (c) lower electricity bills for consumers. CFL bulk purchase and deployment efforts in South Africa have had particular social co-benefits, as they have reduced both the electricity bills of low-income customers and the fiscal outflows to serve these subsidized customers.

60. Noteworthy energy efficiency initiatives in South Africa to date include (a) adoption of the 2006 National Energy Efficiency Strategy, which included a 12 percent energy efficiency improvement target by 2015; (b) creation of an Energy Efficiency Accord between the Government and the large industries sector, with the goal of a 15 percent reduction in large customer energy use; (c) establishment of a National Energy Efficiency Agency, now located within the Central Energy Fund (CEF); (d) regulatory approval of a Demand Side Management (DSM) Fund, including significant capital subsidies for approved DSM and energy efficiency projects, to be implemented by Eskom; (e) recent allocation by the Treasury of additional funding for energy efficiency improvements by the Department of Public Enterprises (DPE) and municipalities; and (f) successful roll-outs of regional and national CFL replacement programs by Eskom, resulting in some 35 million CFL installations over the past decade and 14 million in 2008 alone.

61. Despite these accomplishments, further adoption of energy efficiency measures has been limited by a number of barriers, including:

- Low electricity prices, resulting in long payback periods for investments in long-lived energy efficient equipment (e.g., HVAC systems, appliances, motors and drives);
- Limited consumer awareness of the opportunities for or benefits of energy efficiency;
- Lack of implementation efforts to follow through on policy pronouncements and target setting;
- Reluctance of Eskom and municipal distributors to undertake programs that reduce power sales and revenues, without some offsetting or decoupling mechanism (similar to the situation with SWHs);
- Shortfalls in administration and regulatory review of the existing DSM Fund resulting in very long lag times for project approval, and creating a lack of confidence on the part of end-users and energy services companies;
- Slow development of private sector capacity for energy efficiency project identification and investment.

62. South Africa's historically low-cost energy has not provided sufficient incentive to ensure efficient consumption of energy in its residential, commercial, and industrial sectors.

This is reflected by South Africa's global ranking in energy intensity (South Africa ranks 42nd in GDP, but 21st in energy consumption).[2] Although recent and projected further tariff increases will enhance the financial attractiveness of energy efficiency investments, a number of barriers remain still prevent the expansion of private sector-led energy efficiency investment. These barriers to private sector development include: (a) lack of awareness by commercial and industrial players of energy efficiency investment opportunities; (b) organizational biases against investing in cost reduction (vs. production expansion) projects; (c) perceived risk of energy efficiency projects on the part of commercial lenders; and (d) high preparation and other transaction costs.

63. A CTF-supported intervention could play a transformational role in scaling up energy efficiency investment, by catalyzing the expansion of bank lending to commercial and industrial players. *Priority activities* would include: (a) creating lines of credit with concessional terms to commercial banks, with that credit on-lent to commercial and industrial end-users, as well as to energy services companies (ESCOs), for energy efficiency and renewable energy investment; (b) providing contingent financing, such as first-loss guarantees on lines of credit offered by commercial banks where risk perception is high, to foster the establishment and early commercial operations of ESCOs that provide energy performance contracts containing savings guarantees; (c) providing financial incentives or risk products to market leaders such as large industrial customers, to encourage them to implement new low-carbon technologies and establish new standards and benchmarks for such technologies in their respective industries; and (d) supporting equipment manufacturers or ESCOs that provide electrical solutions for wholesale, industrial (primary market), and commercial clients.

64. In support of these activities, technical assistance would be mobilized to (a) undertake regulatory reforms aimed at reducing the revenue penalties that energy providers (Eskom, MPDs) might incur for supporting energy efficiency investments; (b) develop enabling government policies on labeling and minimum energy performance standards for appliances and commercial equipment; and (c) develop tax and other fiscal incentives to encourage investment in high-efficiency equipment. Support from other donors would also fund technical assistance and capacity building to industrial developers of energy efficiency projects and to the banks that are learning to assess the risks involved in such investments. IFC is already developing such a program with donor funds, the Climate Change Investment Program for Africa (CIPA), which could be coordinated with CTF activities. Finally, efforts would be taken in conjunction with Eskom, the Department of Energy (DoE), and other agencies to increase consumer awareness through promotion campaigns, consumer education, and marketing by real estate agents.

65. It is difficult to project the cumulative emission savings from CTF support to the energy efficiency subsector. One benchmark to consider is Eskom's five-year DSM plan (2006-2011), which includes a target for the industrial, commercial, and household sectors combined of 10,000 GWh per year (3000 MW), at a cost of 20 billion Rand, or about 0.2 R/kWh levelized costs, for long-lived energy-efficiency investments (e.g., motors and HVAC systems). The *cumulative emissions savings* from realizing this goal was estimated at 70 Mt $CO2_e$.

[2] There are structural reasons for this energy intensity as well. South Africa's reliance on extractive industries, which are inherently energy intensive, contributes to its high ranking relative to OECD economies dominated by manufacturing and service industries.

66. The energy efficiency potential in South Africa is vast, and so is the *replication and scalability potential* of energy efficiency subsector interventions. If the interventions described above lead to realization of the national target laid out in the National Energy Efficiency Strategy (e.g., 12 percent reduction in business-as-usual electricity consumption to 2015), this would represent an annual primary energy savings of 400 Petajoules, or an annual electricity savings of 110,000 GWh. If this goal were achieved, it would represent an annual reduction of 30,000 GWh – three times the energy efficiency goal of Eskom's five-year DSM plan. The equivalent lifetime carbon savings would be well over 200 Mt $CO_2$ equivalent.

67. Table 6 presents the expected program results indicators for the energy efficiency subsector.

**Table 6. Energy Efficiency results indicators**

| Indicators | Baseline | Investment Program Results |
|---|---|---|
| Installed Industrial, Commercial and Household EE | 1,000 GWh (2008 Eskom actual results) | 10,000 GWh |
| Estimated annual GHG emissions reductions | 0.9 Mt $CO2_e$ (2008 Eskom actual results) | 9.0 Mt $CO2_e$ per year |
| Rapid replication potential towards Govt's goal of 12% reduction in 2015 projected consumption | 1,000 GWh | 10,000 GWh yields 10 percent of the 110,000 GWh required to meet the 2015 goal |

*Source:* Eskom and Clean Investment Planning Team , 2009

68. The *additionality* of the CTF-supported intervention consists of more rapid and broad-based scaling-up of energy efficiency investment in South Africa. Under the business-as-usual scenario, private sector-led energy efficiency will continue to be hampered by obstacles such as lack of awareness, organizational biases against capital investment in cost reduction (versus production expansion), and the perceived higher risks and transaction costs of energy efficiency projects. By providing easier access to financing where needed, and additional technical assistance, energy efficiency investments will scale up at a much faster pace.

# V. ENABLING POLICY AND REGULATORY ENVIRONMENT

## 5.1 Grid-tied Solar and Wind Power

69. The most significant enabling policy in place for concentrating solar power and other renewable energy sources is the feed-in tariffs recently established by NERSA. The Renewable Energy Feed-in Tariff is 2.1 Rand/kWh for solar thermal power with storage capacity, and 1.25 Rand/kWh for wind power, compared to Eskom's average tariff of 0.4 Rand/kWh. NERSA is currently developing further tariffs for other forms of grid-tied solar power as well as other renewable energy technologies. The REFIT pricing regime is intended to be complemented by a standard, bankable power purchase agreement (PPA) designed to suit developers of independent solar thermal and wind power plants. NERSA's REFIT pricing regime directly supports the South African Government's goal of producing 4 percent of the country's electricity supply (about 10,000 GWh) from renewable energy sources by 2013.

70. NERSA has indicated that, in principle, Eskom could be eligible for the REFIT tariffs, especially once a single buyer model (which is currently under discussion) is established and will process prices and payments for all generators. This is in addition to the standard ratemaking treatment, where Eskom's cost of a new build is included in the rate base and amortized over time. There is also scope for alternative rate treatments specific to individual assets, building on precedent already established for the Cahora Bassa Hydropower plant and the forthcoming Medupi power plant.

71. The DoE has also developed policies and programs in support of renewable energy, including solar and wind power. DoE is committed to building on the foundation laid with

NERSA's REFIT tariffs by encouraging private sector development of renewable energy, especially wind. Among the enabling efforts undertaken by DoE is an update of the national wind energy atlas, an outreach program providing information and assistance to small businesses seeking to enter the wind power business, and further development of the grid code and the single buyer model. As part of project preparation, specific areas of cooperation with DoE would be developed and supported with funding from bilateral donors. With the REFIT in hand, the remaining barriers include finalization of bankable off-take agreements with credit-worthy off-takers, streamlined permitting and approval processes, timely interconnection by Eskom, and suitable transmission capacity expansion to the key areas of solar and wind resources.

## 5.2 Development of Solar Water Heating

72. In contrast with renewable power generation technologies, there are fewer enabling policies or regulatory support mechanisms for the development of solar water heating. DoE has established a target for a national SWH program, and is working with the support of the GEF-financed Renewable Energy Market Transformation project to develop a national strategy for SWH market development. The aim of the project is to build the capacity of the local private sector for SWH provision and servicing, and to provide matching grants and performance grants to the private sector for pre-investment activities.

73. Several pro-SWH policies are under active discussion by DoE and other agencies, including: (a) requiring SWH in new residential buildings; (b) demonstration of SWH in government buildings; (c) fees or other restrictions on installing new or replacement electric water heaters; (d) "feebate" programs, which would combine rebates for SWH installation, financed by fees on electric water heater installations, with other financial incentives such as a tax credit; and (e) providing incentives to municipalities that would offset the administrative costs and revenue losses of undertaking SWH programs

74. In addition to these policy discussions, there are several ongoing SWH programs which could provide a starting point for CTF-financed SWH development. These include:

- Eskom's Solar Water Heating Program, which provides a 25 percent rebate for SWHs supplied by qualified suppliers that meet South African Bureau of Standards (SABS) SWH requirements.
- The Energy Development Corporation within the Central Energy Fund, which is procuring and installing around 60,000 SWHs as part of a contract with the City of Port Elizabeth/Nelson Mandela Bay, in support of the municipality's obligations under the Power Conservation Program;
- A NERSA-funded SWH program to be undertaken by City Power of Johannesburg. City Power has tendered for a third party, Funuder-Arranger, to implement the program, and intends to offset any revenue losses from electric water heater sales through lower on-peak energy purchases under their bulk power tariff.

## 5.3 Energy Efficiency

75. Until recently, the major funder of government-supported energy efficiency was Eskom, through a DSM fund financed by ratepayers with the approval of the regulator. Municipal distribution companies, factory/industrial managers, and third-party Energy Service Companies could apply for subsidies from the DSM fund to finance energy efficiency (50 percent subsidy) and load management (100 percent subsidy) investments. Eskom would disburse about 200 million Rand annually and deliver MW savings of 50-100 MW. However, there have been bottlenecks and long delays in processing the pipeline of projects.

76. With support from World Bank and the ESMAP trust fund, the DSM fund is winding down and will be replaced by an alternative operating protocol – the Standard Offer – which provides a streamlined mechanism for acquiring demand-side resources (energy efficiency and load management). Under this new protocol, a Funds Administrator (utility or public agency) would purchase energy and/or demand savings using a pre-determined and pre-published rate, called the Standard Offer. Any energy user or energy service company that can deliver those energy and demand savings is would be paid the fixed amounts per kWh and kW upon completion of the project and certification of the savings. The Standard Offer mechanism has been proposed to NERSA, and the regulator intends to conduct a pilot project for commercial and industrial lighting projects using this mechanism. This new mechanism could provide a favorable basis for private sector-led energy efficiency project development.

77. Eskom maintains a significant DSM program although it is not as active as in years past. Most of its current DSM activities are focused on industrial lighting and motor replacement for large, direct-serve customers.

78. The Government agencies responsible for energy efficiency policy and programs include the DoE and the National Energy Efficiency Agency (NEEA) within the South African Energy Research Institute (SANERI). Both entities are under-resourced and understaffed; yet despite these limitations, they have produced several new policy proposals for supporting energy efficiency. DoE is proposing a variant of the Standard Offer mechanism described above, with the total subsidy tied to the amounts available for renewable energy projects through NERSA's REFIT pricing regime. NEEA and National Treasury's Tax Policy Unit have proposed a tax credit scheme that would provide a one-time credit of up to 90 South African cents per kWh for verified first-year electricity savings, against a metered baseline. The tax rebate would be guaranteed to be available for ten years. Treasury and NEEA are developing the systems and protocols needed to implement the tax credit scheme, set to begin in 2010. Whichever subsidy or tax incentive scheme goes forward should provide an important inducement to energy efficiency project developers.

79. In 2009, several government entities and state-owned enterprises received funding from National Treasury for purposes of energy efficiency. The Department of Public Works is to receive 250 million Rand over four years for implementation of efficiency improvements in state-owned buildings and facilities. Eskom received a 302 million Rand infusion from National Treasury for smart metering/advanced metering efforts. A total of 19 large and small municipalities, including all of the cities hosting World Cup venues, received a total of 675 million Rand, subject to approval of business plans by DoE. All of these infusions should create

early opportunities for private companies seeking to develop and implement energy efficiency projects.

80. The Government of South Africa, through the Department of Transport, is supporting a major transformation of public transport, creating systems in cities and metropolitan areas with a lower carbon footprint in preparation for the World Cup 2010. This comprehensive program aims to significantly improve the quality of life of urban dwellers, while at the same time addressing the spatial imbalances inherited from apartheid. This effort includes a series of legislative, regulatory, and investment activities that will ultimately be reflected in the development of: (a) bus rapid transit; (b) improved passenger rail; and (c) upgrading of minibuses and metered taxis. The policy and regulatory framework for BRT envisions a transformational passenger modal shift in support of public transport systems in two phases. The main objective is to have 85 percent of the population of six metropolitan areas (approximately 16 million people) within one kilometer of a public transport network through development of BRT, upgrading rail passenger transport and modernizing mini bus and taxi vehicles.

81. Phase 1 of the BRT is already being implemented in four metropolitan areas – Johannesburg, Thswane (Pretoria), Cape Town, and Nelson Mandela (Port Elizabeth) – for a combined target of about 1 million passenger trips per day by 2010/11. Phase 2 will include the expansion of these four systems, plus an expansion of the BRT concept to the metropolitan areas of Ethekwini (Durban) and Ekurhuleni, and the municipalities of Buffalo City (East London), Mbombela, Mangaung, Polokwane, Rustenburg, and Msunduzi. The combined target would be some 2-3 million passenger trips per day, including about 750,000 passenger trips currently made by private cars. The changes brought about by BRT are expected to introduce changes in behavior, spatial patterns, and personal security, which could help transform key cities and greatly improve the quality of life. The results would include potential GHG emissions savings of about 500,000 tons of $CO_2$ per year during Phase 1, and about 2.5 million tons of $CO_2$ per year during Phase 2. The total emissions savings between 2010-2030 would be on the order of 50 Mt $CO_2$e.

# VI. IMPLEMENTATION POTENTIAL

82. Implementation potential is concerned with the constraints and key risks that could impede implementation of the CTF-financed interventions. A generic risk for all investments designed to reduce the carbon footprint of South Africa is the low cost of electricity pending projected rate increases. Other risks include project risk, the establishment of enabling environments, the funding of subsidy programs, access to affordable financing, foreign exchange risk.

83. Given extensive preparation work on both the initial public projects – the Upington CSP facility and the Western Province wind energy facility– the level of risk for these pioneer projects seems within manageable limits. However, performance risk is a factor with any renewable energy project. Of equal concern is the regulatory regime for both public and private investments in solar thermal power and wind power.

**Table 6. Potential Project-level Risks and Mitigation Measures**

| Risk factors | Description of risk | Rating of risk | Mitigation measures | Rating of residual risk |
|---|---|---|---|---|
| **CSP technology** | | | | |
| Technology and performance risk | The proposed project would be the first-ever commercial scale CSP in Sub-Saharan Africa so it may carry risks related to capital cost, construction schedule, and operating performance of the technology. | High | Eskom Board has requested design and risk mitigation review before final approval.<br><br>Eskom plans to obtain warranties from each of the major component suppliers.<br><br>CTF-financed contingent financing and/or performance guarantee facility. | High |
| **Wind power** | | | | |
| Technology and performance risk | There are performance risks associated with large-scale wind power systems compared with current experience in South Africa. | High | Technical assistance to be provided<br><br>CTF would finance performance guarantee facility. | Moderate |
| Transmission risks | Private sector-led development of wind power may not be able to transmit electricity produced from remote sites to the grid. | High | The CTF would finance network infrastructure necessary to connect wind power sites to the grid. | Low |
| **Solar water heating/Energy efficiency program** | | | | |
| Limited demand for equipment and services.<br><br>Limited installation capacity | There is limited demand because of limited awareness about the benefits and opportunities for energy efficiency.<br><br>There is limited engineering and equipment installation capacity. | Moderate | Project team would work with industry associations and other stakeholders to raise awareness about energy efficiency.<br><br>Capacity building to expand technical capacity. | Low |

*Source:* Eskom and Clean Investment Planning Team, 2009

# VII. FINANCING PLAN AND INSTRUMENTS

## 7.1 World Bank (IBRD)

84. IBRD/CTF will co-finance the low-carbon interventions alongside the proposed Eskom Investment Support Project. These interventions will comprise the following – Upington Concentrating Solar Power (CSP) facility, Western Cape Wind Energy Facility Phase 1, and wind energy-related transmission additions. The interventions related to wind power transmission infrastructure will directly facilitate private sector participation in wind development. Detailed national institutional and project implementation arrangements for CSP, including the role of the private sector, will be developed during further project preparation. In addition, an application is pending for a CTF preparation grant to analyze the cost and risk parameters of the CSP plant.

## 7.2 African Development Bank

85. AfDB/CTF will co-finance, with IBRD/CTF, the Upington CSP facility, Western Cape Wind Energy Facility Phase 1, and wind energy-related transmission additions. It will also co-finance, with CTF, private sector-led renewable energy and energy efficiency projects. Specific details on interventions to be financed by the World Bank and AfDB, respectively, in the Eskom Investment Support Project, will be developed during preparation of that project.

## 7.3 International Finance Corporation

86. IFC/CTF could co-finance, alongside commercial banks, pioneer private sector-led CTF-qualified renewable energy projects. IFC is also considering lines of credit to local banks to support private sector–led small-scale energy efficiency and renewable energy projects, including SWH. In addition, IFC could provide support to sub-sovereign entities to achieve South Africa's solar water heating scale-up objectives.

## 7.4 Bilateral Donors (European Investment Bank, KfW, Agence Francaise de Developpement)

87. Several bilateral donors have expressed interest in co-financing South Africa's CTF Investment Plan. In particular, the European Investment Bank (EIB) has expressed interest in supporting grid-tied solar thermal power and energy-efficient SWH, while KfW has indicated an interest in supporting solar thermal power. The French Development Agency (AFD) previously signed an agreement pledging 100 million Euros to support the Western Province Wind Energy Facility. More recently, AFD has expressed interest in supporting energy efficiency and solar water heating. Pending confirmation, the financing plan shown below includes the amounts provisionally programmed by these bilateral donors.

## 7.5 Financing Plan

88. Table 7 presents a summary of the indicative financing plan for Phase 1 projects, which would be co-financed with CTF[3] and other development partners (notional amounts, to be confirmed).

**Table 7. Indicative Financing Plan for Phase 1 Projects**
**(in US$ millions)**

| **Project** | **CTF** | | | | **ADB** | **IBRD** | **IFC** | **EIB** | **KfW** | **AFD** | **Private Sector** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IBRD | ADB | IFC | ADB (private sector) | | | | | | | | |
| Eskom CSP | 200 | 50 | | - | 50 | 150 | | 50 | 100 | - | | 600 |
| Eskom Wind | 50 | 50 | | - | 50 | 110 | | - | - | 140 | | 400 |
| Private Sector Renewable energy/energy efficiency/SWH | - | - | 75 | 75 | 200 | - | 200 | 50 | - | 210 | 540 | 1,350 |
| **Total** | **250** | **100** | **75** | **75** | **300** | **260** | **200** | **100** | **100** | **350** | **540** | **2,350** |

[3] It is proposed that CTF financing would be on "softer concessional" terms, i.e., 40 years, with 10 years grace on principal repayments, at 0.25 percent interest, with a 0.25 percent front-end fee. CTF terms for private sector projects are determined on a case-by-case basis. Terms for the IBRD and AfDB loans for the Eskom project are under discussion among the Government, Eskom, and the relevant MDB. KfW and AFD financing are expected to be concessional lending.

# ANNEX 1

# Eskom Investment Support Program – Low Carbon Components: Concentrating Solar Power (CSP) and Wind Power

## 1. Problem Statement

1. South Africa's economic success has been supported by a reliable and low-cost supply of electricity, predominantly from locally mined coal, on which the country relies for most of its energy needs. As a result, South Africa is the largest GHG remitter in Africa and the 11$^{th}$ largest in the world, with its 440 M ton of $CO_2$ equivalent accounting for 1.5 percent of global emissions. It also has relatively high emission intensity, although this has increased only marginally over the past two decades. The level of $CO_2$ emissions per capita is also high, at about 9 tonnes, due to the central role of energy-intensive industries in the economy. The electricity sector accounts for about 50 percent of total emissions. As South Africa's economy grows, electricity demand is expected to double from the current 38 TWh over the next 10 years.

2. To sustain South Africa's future economic development, the Government and Eskom have launched a New Build and Major Maintenance Program, which aims to improve generation capacity and reliability of electricity supply. This large-scale investment program includes two coal-fired power plants, 4800 MW each, and a pumped hydropower scheme. The Government has also set the goal of generating 4 percent of electricity supply from renewable energy by 2013. The key challenge for the Government is to ensure that, while the immediate need to bridge the electricity supply-demand gap is met, South Africa is also positioned over the medium term to diversify into clean energy, and Eskom is in a position to support the Government's Long-Term Mitigation Scenario (LTMS) strategies. In particular, it is important to ensure that the current economic crisis and Eskom's financial constraints do not undercut the Government's ambitious low carbon objectives.

## 2. Proposed Transformations

3. CTF co-financing is proposed for Eskom's first large-scale renewable energy investments in concentrating solar power (CSP) and wind power, as described briefly below.

*100 MW Concentrating Solar Power*

4. As part of its New Build and Major Maintenance Program and in response to the Government's climate change policies, Eskom has designed the first-ever commercial- scale CSP in southern Africa. This project, when constructed, will be the largest CSP facility in the world. It is a first-of-its-kind, large-scale base load solar thermal power plant which, if proven to be commercial, could lead to a pipeline of similar projects undertaken by Eskom and independent power producers (IPPs). The estimated *cumulative emissions savings* resulting from a projected

annual energy production of 516 GWh is 9 million tons of $CO_2$ equivalent over a projected twenty-year plant life.

5. In South Africa, the only renewable energy resource that can provide the volumes of firm capacity comparable to what is currently provided by coal-fired power plants is CSP configured with thermal storage. This configuration has a load factor high enough to be considered a base load resource. The Upington Concentrating Solar Power plant is a 540 $MW_t$ tower and mirror design, configured to operate as a base load unit. Utilizing molten salt as a thermal circulating fluid and storage medium allows this design to achieve a 60-65 percent annual load factor with a rated capacity of 100 $MW_e$.

6. Eskom has been working on this design for several years, and it reflects a synthesis of design elements meant to reduce risk, improve performance, maximize local content, and conform to local needs and requirements. For example, a provision patent was registered in 2006 that will allow for the development of a South Africa heliostat, a significant cost component in the proposed plant. Other areas for local content and cost reduction are also being investigated. The project has a huge replication and scalability potential, given the availability of suitable sites and the extensive need for new base load generation. The project also has potential for transformation and replication throughout the SADC region.

7. The CSP configured with molten salt storage does not suffer from a lack of dispatchability, as do many renewable power sources, and therefore can become a significant source of grid support in the country. It is one of the only carbon-free base-load power generation technologies available to South Africa in large volumes

*100 MW Wind Power*

8. The objective of Eskom's wind power program is to scale up the wind power program from the current level of less than 100 MW to 800 MW over the next 5 years, and to 2000 MW by 2020. While the public sector will initiate and continue to participate in the program, in time the private sector is expected to play a leading role. To enable this, the Government is putting in place the needed legal and regulatory framework. The regulatory authority, NERSA, has recently published the feed-in tariff as part of the process, and various regulation are under preparation, after which the Government plans to invite private sector proposals.

9. The aim is to support the public utility, Eskom, in developing the first wind facility in the Western Cape Province, near the town of Skapvlei. This project could serve as a model for future public/private or purely private-only structures. The site will accommodate up to 200 MW, but the first phase consists of a 100 MW facility. An environmental impact assessment (EIA) has already been completed and approved. The site has a "moderate" wind resource, which means a load factor of 25-30 percent is likely, and it is near a 66 kV sub-transmission line.

## 3. Implementation Readiness

*Concentrating Solar Power*

10. This project has been extensively designed over a five-year period. Suppliers for each major component have been identified, and provisional performance warranties are being obtained. The EIA has been conducted and necessary provincial environmental approvals received. The project can commence construction within six months following a final design and risk mitigation review.

*Wind Power*

11. Phase 1 of the Western Province Wind Energy Facility Project is fully prepared, with an approved EIA and permit. More than two years of wind data are available for the site. Wind turbine suppliers have been identified, and performance data are available from Eskom's Klipheuwel test station. Interconnection at 66 kV is possible via a nearby sub-transmission line. The incremental transmission capacity required is contained in Eskom's recent Multi-Year Price Determination filing with NERSA.

## 4. Rationale for CTF Financing

12. The CSP and wind power projects target the crucial early-commercialization/first adopter phase of an entirely new power generation technology. These first-of-a-kind projects would be a challenge for any utility to implement, and Eskom requires the combined support of MDB and CTF lending as it develops these transformation investments.

*Concentrating Solar Power*

13. The total cost of the Upington CSP facility, including site preparation and interconnection, is estimated as 6.5 billion Rand, or $8,000/kWh. This compares to 96 billion Rand for a super-critical coal-fired power plant, or $2400/kW. Factoring in lower fuel costs and accounting for higher O&M costs, the gap between levelized production costs for a new super-critical coal-fired power plant and a solar thermal power plant is more than 1 Rand/kWh. In addition to being more costly, the initial CSP plants will have higher risk than a state-of-the-art coal-fired power plant. Although Eskom is in the process of obtaining warranties from each of the major component suppliers, there remains substantial uncertainty for this prototype facility regarding capital cost (variability estimated as ±25 percent), performance as measured by annual kWh output (variability estimated at ± 20 percent), construction schedule, and operating and maintenance costs (variability estimated at ± 25 percent). This is why the Eskom Board has requested a final design review and risk mitigation exercise before giving the go-ahead to begin construction. The barriers of high capital cost and high risk involved in constructing and operating this prototype commercial power plant, as well as the strong replication potential, make this CSP project a strong candidate for CTF concessional lending. The CTF could be used to buy down the initial cost and/or to mitigate specific risks through a cost over-run or performance guarantee.

*Wind Power*

14. The indicative financing plan for the wind project consists of two parts – $300 million for the Western Province Wind Energy Facility, and $100 million for transmission additions needed to evacuate wind power from sites being developed by IPPs. The major barriers to scaling-up utility-scale wind power in South Africa are high costs relative to coal-fired production, lack of proven performance, and incremental transmission costs required to connect isolated wind power sites to load centers. Although the wind power is not dispatchable, it is possible to compare levelized electricity costs to gauge wind power production costs compared to those of coal-fired power plants. Factoring in lower fuel costs and accounting for higher O&M costs, the gap between levelized production costs for a new super-critical coal-fired power plant and the Western Cape Wind Power Facility is 0.7 R/kWh.

15. Even though wind power technology is well proven and major components are commercially available from multiple suppliers, the lack of proven performance on a large scale creates a perception of high risk. Furthermore, performance risk (e.g., annual output) is real and remains despite intensive wind measurement. Finally, Eskom faces significant investments in transmission infrastructure, driven mostly by the need to evacuate wind power and deliver it to load centers and the main grid.

16. For these reasons, it is a *priority activity* for Eskom and for Government to undertake a large flagship wind power project such as the Western Cape facility, together with new transmission additions, to support wind power site development. These barriers make this initial large-scale wind farm and associated transmission additions good candidates for CTF concessional lending. The CTF finance could be used to partially finance the project, thus reducing the production cost differential compared to coal; to provide contingent financing in the form of a performance guarantee; and to finance transmission additions required to serve wind power site development.

## 5. Financing Plan

17. The indicative costs for the CSP total $250 million, to be financed by the CTF ($200 million through IBRD and $50 million through AfDB); and this amount is expected to leverage about $350 million from IBRD, AfDB, EIB, and KfW. CTF financing for wind power would be $100 million, with a total of $300 million in co-financing from IBRD, ADB, and AFD (see Table A1.1).

**Table A1.1. Financing Plan for the CSP and Wind Power Development**

| **Program Component** | **CTF** | | | | **Co-financing** | | | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | **IBRD** | **ADB** | | | **ADB** | **IBRD** | **EIB** | **KfW** | **AFD** | |
| CSP | 200 | 50 | | | 50 | 150 | 50 | 100 | - | 600 |
| Wind | 50 | 50 | | | 50 | 110 | | | 140 | 400 |
| **Total** | **250** | **100** | | | **100** | **260** | **50** | **100** | **140** | **1,000** |

# ANNEX 2

# PRIVATE SECTOR RENEWABLE ENERGY AND ENERGY EFFICIENCY PROGRAM

## 1. Problem Statement

1. The private sector is generally well developed in South Africa. However, its participation in the energy sector, and in particular in power generation, has been limited by the dominance of the state-owned utility, Eskom, and by a number of other financial, institutional, and technical barriers. The recent approval by the regulator, NERSA, of the REFIT tariff regime, in which a single buyer is required to purchase renewable energy at set prices from independent power producers, has the potential to unlock private sector engagement. Despite the promise of a favorable pricing regime, there remain other impediments to private sector-led clean energy project development that will particularly affect pioneer projects. These include the transaction costs associated with being the first in the sector to have to deal with lack of experience and capacity among developers, contractors, regulators, and lenders; and the higher technology and completion risks, particularly with many of the solar technologies.

2. Sub-sovereign and private sector investment in energy efficiency and small-scale renewable energy has been limited in South Africa because of low power prices; insufficient incentives for distribution companies to encourage distribution of products that would lower their power sales; long payback periods; and, as noted above, lack of sector experience and capacity.

3. The South African CTF Investment Plan identifies several areas where the use of CTF-funded interventions can have a transformational impact on the carbon footprint of the country. Annex 1 discusses specific initiatives to be undertaken by the IBRD and AfDB to reduce GHG emissions in the public sector. This annex outlines areas where IFC and AfDB could leverage their skills, relationships, and financing through direct interventions with private sector stakeholders to fast-track and support these initiatives, in a combined effort to transform South Africa's energy generation and consumption.

4. Consultations with multiple power developers reflect advanced planning with regard to both wind and solar thermal power (both central tower and distributed trough configurations). Some of the wind projects reviewed were at post-feasibility stages, where wind data has been collected over 12 months. Estimates of the potential project pipeline are 400 MW for solar thermal and 700-800 MW for wind power. Developers have responded positively to the recently announced tariffs from NERSA, and believe that the tariffs could be high enough to support the expansion of these sectors. However, developers also expressed concerns regarding: (a) the size of the market and allocation among renewable energy sources; (b) clarity of the selection process (e.g., first come, first served vs. open bid); (c) details of power purchase agreements, especially

tariff escalation structures and the risk of downward revision made possible by the annual revision process; and (d) allocating the costs of high-voltage network additions to accommodate power off-takes.

5. Solar water heating (SWH) and energy efficiency investments are a negative-cost mitigation option (-MW), with important co-benefits, including contributions to the Power Conservation Program; the potential for SME development and jobs creation through local energy efficiency manufacturing and service industries; and lower electricity bills for consumers. Although SWH and energy efficiency have not yet had much traction, both remain national priorities, given the escalating electricity prices and projected supply shortages. The PCP includes goals to curb energy usage from large industry by 10 percent over the 2007 baseline, and to install one million SWHs over five years. The private sector is showing significant interest in the program, but needs to be supported to meet the urgent need for both large industry and mass market customers to adopt energy saving solutions. Market barriers include (a) entry barriers, as new ESCOs are faced with penetrating a complex market while lacking the necessary engineering and installation skills; (b) lack of a proven track record of profitable projects; and (c) high first costs of SWH and energy efficiency equipment relative to current electricity prices.

## 2. Proposed Transformations

6. Several interventions are proposed to meet the needs of different private sector actors. The proposals for private sector interventions in South Africa will retain flexibility to respond to dynamic market conditions and as-yet unidentified market opportunities. Proposed interventions are, therefore, illustrative only and reflect possibilities as currently envisioned rather than certain programmatic engagements.

7. Renewable Energy IPP Support. An effective independent power producer (IPP) sector in South Africa has been slow to develop, with limited success in various competitive tender processes. Although the REFIT tariffs are a positive first step and essential for enabling the long-term viability of renewable energy projects, several other barriers must be addressed in order to catalyze initial market players and ensure successful market transformation. These barriers include:

- *Lack of precedent for bankable PPAs.* There is no precedent in South Africa for bankable PPAs that allocate risk appropriately between the IPP and the off-taker. Further, Eskom is currently the single buyer in the market, and there is no functioning precedent for bilateral sales to industrial users with wheeling provision through Eskom's grid. There is now discussion that a new single buyer will be created. Pioneer renewable energy IPPs would, therefore, face additional delays and costs in negotiating bankable off-take structures that would provide a precedent for followers into the sector. Furthermore, each renewable energy technology has its own commercial and technical peculiarities, which will require refinement of the basic PPA structure.

- *Lack of grid integration*. Optimal solar, wind, and hydro resources may be concentrated in locations that are not currently provided with effective access to, or sufficient capacity

in, the high-voltage grid. Initial renewable energy IPPs may, therefore, face additional delays, costs, and complexities in negotiating with Eskom the appropriate allocation of responsibility for provision of such grid connections, expansions, and investment. In addition, renewable energy technologies often require amendments and adjustments to the grid code, to allow for the quality of power they generate.

- *Technology risk.* Although many renewable energy technologies are now well established (e.g., hydro and wind), other technologies, particularly various concentrating solar power technologies, have little or no commercial track record. Initial investments will likely require nonmarket-based financing to buy down the additional risks of cost overruns and operating performance associated with being the first mover in the market.

8. Thus, even if the tariff approved by NERSA is considered sufficient for the economics of renewable technologies in South Africa, pioneer projects will most certainly face additional costs and risks that make the tariff unworkable. These disincentives create a significant threat to the development of the sector. However, if pioneer projects can successfully overcome these initial barriers, they will create a track record that lowers the real costs and risks for future developers, and enables the rapid expansion of the sector as a whole. Experience in other countries indicates that once a technology has achieved some critical mass of installed capacity, other market players enter at an accelerated rate. Therefore, a CTF intervention that addresses the barriers outlined above could have a transformational impact on the market. CTF interventions would be designed to address the particular hurdles faced by each technology.

9. Commercial Bank Lending for Energy Efficiency Projects. South Africa's traditional provision of low-cost energy has not created sufficient incentive to ensure efficient consumption of energy in its commercial and industrial sectors. The LTMS identifies industrial take-up of energy efficiency as a large, negative-cost mitigation option. However, despite the potential for reasonable financial returns on capital investment in energy efficiency, a number of barriers prevent successful expansion of such activities in the private sector. These barriers include: (a) a lack of awareness by commercial and industrial players of the opportunities to reduce power consumption; (b) organizational biases against capital investment for cost reduction (versus production expansion); and (c) a perception of enhanced risk by commercial lenders, which limits the availability of financing for such projects beyond traditional corporate loans.

10. The CTF could, therefore, catalyze transformation of the market through a programmatic approach that addresses each of these barriers, and encourages energy conservation and efficiency as standard business practice. For example, a collaborative CTF/other agency program that entails working with (a) industry associations and other market players to increase awareness of the benefits and opportunities for energy efficiency; (b) financial institutions (banks and/or leasing companies) to develop additional financial resources for energy efficiency projects (both by building their internal capacity and by mitigating their perceived risks of such projects); and (c) other donor and bilateral organizations, could have a significant market impact in South Africa. At a project level, CTF initiatives would be coordinated with the initiatives of other donor organizations to ensure that the barriers identified above are addressed in aggregate. IFC has successfully implemented similar projects in other emerging market economies and has already conducted a fact-finding mission to South Africa to identify potential financial market

partners and possible energy efficiency investments. IFC is also developing a technical assistance and capacity building program, the Climate Change Investment Program for Africa, with donor funds, which could be coordinated with CTF activities. Agence Francaise de Developpement has also shown interest in this area, and any intervention would be coordinated with that agency.

11. The CTF would also support energy efficiency initiatives targeted towards transforming the highly energy-intensive industrial and mining sectors. The program would provide financial incentives or risk products to market leaders to encourage them to implement new low-carbon technologies, and establish new standards and benchmarks for such technologies in their respective industries. By focusing on companies that have significant market share or market influence, the program would have the largest impact, both by capturing a large share of the industry's emissions reduction potential through one sponsor, and by catalyzing competition and a need for other market players to follow suit. Smaller players would be incentivized indirectly, through programs with financial institutions. To ensure a comprehensive approach to market development, AfDB would, when necessary, also support equipment manufacturers or ESCOs that provide electrical solutions for wholesale, industrial (primary market), and commercial clients.

12. Private Sector and Sub-Sovereign Engagement in Solar Water Heating. As noted above, the SWH market faces numerous barriers, all of which need to be addressed to catalyze, accelerate, and transform the market. To successfully overcome all of these barriers, a CTF intervention will have to engage the sub-sovereign and private sector actors in this market, in addition to public sector support for regulatory reform and an implementing champion.

- *Sub-sovereign lending.* The municipal power distributors (MPDs) could play a vital role in the solar water heating market, since they already aggregate supply and billing access to large pools of residential and commercial customers, and so have the potential to bulk buy SWHs at low cost and provide them to their customers via a leasing model that utilizes the current billing process. However, installation of SWHs directly reduces the power sales of MPDs, so it is vital that they share in the benefits of the SWH market or they may not support its expansion. The CTF intervention could be used to support initial, large-scale engagement in the SWH market by pioneering MPDs that would provide a strong demonstration to others. CTF funding could be used to provide a guarantee against the perceived risk of customer payment under SWH leasing contracts, as well as long-term concessionary loans for bulk purchase of SWHs at low cost. The CTF funds could be supported by other sources of donor funds that could be used for capacity building activities, such as developing the legal structures for the leasing contracts, supporting adjustments to the billing systems, and training installers and service providers.

- *Private sector supply chains.* Local manufacturers hoping to expand their production capacity in response to bulk procurement requests from MPDs may require access to long-term concessionary funding from CTF. Similarly, installation and service providers hoping to support MPDs in their roll-out may need CTF-subordinated equity financing to enter the market.

## 3. Rationale for CTF financing

13. In renewable energy, CTF financing would help to fill financing gaps that may result from liquidity constraints in the current financial crisis. It would also provide concessionary terms that overcome additional first-mover costs, and ensure sufficient returns to pioneer projects. While there is interest in entering the market, private developers would struggle, commercial lenders would be reticent, and progress would be slow without some concessional support.

14. In energy efficiency, CTF funds are needed to overcome the perceived risks of a relatively new market for commercial lenders, and the slow payback periods from energy efficiency projects due to South Africa's low power tariffs.

15. In solar water heating, CTF funds would help to support initial market entry and bulk purchasing by MPDs and private sector participants.

## 4. Implementation Readiness

16. There are currently approximately 1000MW of private sector wind projects and 200MW of solar projects at various stages of development in South Africa. IFC and AfDB are already in dialogue with many of the more serious developers, and at least 200MW of the wind projects would be ready for financing during 2010. IFC and AfDB would hope to support the first one or two pioneer projects in the wind power sector and the first one or two pioneer projects in the solar sector.

17. With the recent power constraints in South Africa and the increasing tariffs, market awareness of energy efficiency opportunities is increasing. IFC and AfDB and their bilateral partner AFD have already been in dialogue with commercial banks and private energy services companies regarding energy efficiency investment opportunities. AFD has established commercial lines of credit for clean energy project lending at several banks, including NedBank, ABSA Bank, and Industrial Development Corporation (IDC). These lines of credit can be quickly expanded and supplemented with CTF support.

## 5. Financing Plan

18. The total indicative costs for SWH and renewable energy/energy efficiency are $1.35 billion, with $150 million from the CTF ($75 million through IFC and $75 million through AfDB). The CTF contribution is expected to leverage about $200 million each from IFC and AfDB, $210 from AFD, and $50 million from the EIB (see Table A2.1), as well as $540 million from the private sector.

**Table A2.1. Indicative Financing for the Solar Water Heater and Renewable Energy/Energy Efficiency Program**

| **Project** | **CTF** | | | | **ADB** | **IFC** | **EIB** | **AFD** | **Private Sector** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| | IBRD | ADB | IFC | ADB (private sector) | | | | | | |
| Renewable energy/energy efficiency/SWH | - | - | 75 | 75 | 200 | 200 | 50 | 210 | 540 | 1,350 |