Climate Investment Funds

CTF/TFC.4/5
October 13, 2009

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

**CLEAN TECHNOLOGY FUND**
**INVESTMENT PLAN FOR UKRAINE**

**Proposed Trust Fund Committee Decision**

The Trust Fund Committee reviewed document CTF/TFC.4/5 *CTF Investment Plan for Ukraine*, endorses the plan and agrees to the further development of the activities foreseen in it. The Trust Fund Committee agrees to an envelope of up to USD350 million in CTF funding to finance the plan.

**Clean Technology Fund Investment Plan for Ukraine**
**Executive Summary**

## Introduction

1. This Clean Technology Fund Investment Plan for Ukraine proposes CTF co-financing of $350 million to support the Government of Ukraine's ambitious goal of keeping emissions 50 percent below 1990 levels, i.e. net zero emissions growth, by 2050. Specifically, the Investment Plan proposes CTF co-financing for reducing risks and overall costs of investing in renewable energy, a first-of-its kind Combined Cycle Combined Heat and Power plant, energy efficiency in residential and government buildings, district heating and industry, introduction of Smart Grid components in the transmission system, and gas network rehabilitation. The CTF investments will mobilize financing of about $3.8 billion from multilateral financiers, Ukrainian counterparts, and private sector financing.

## Country and Sector Context

2. After a decade of steep economic decline, which halved the country's recorded economic output and raised poverty rates to almost a third of the population, economic growth rebounded in 2000 and GDP grew by an annual average of about 7.5 percent until 2007. However, the current global financial crisis has hit Ukraine's industrial sector particularly hard, as a result of which GDP is expected to decline 10 percent. For Ukraine to recover its economic growth, it will need to improve the energy efficiency of the economy and thereby reduce its vulnerability to further import price shocks. Ukraine's energy intensity, although improving in recent years, is still more than two times higher than the EU average. The energy sector is characterized by inefficient utilization of gas (due to historically low prices and an aging asset base) – currently 41 percent of primary energy supply -- and a growing share of coal (due to increasing natural gas prices and the need for security of energy supply) – currently 19 percent of primary energy supply.

3. Reflecting the steep economic decline, greenhouse gas emissions (GHG) decreased between 1990 and 2000 at an average annual rate of 8 percent. With the resumption of growth, emissions increased between 2001 and 2006, but total emissions remained less than half of 1990 levels. Given the high baseline figure, Ukraine's current GHG emissions of about 400 million tons per year means that it remains one of the largest $CO_2$ emitters globally. In 2006, the energy sector was responsible for 69% of emissions and industrial processes 22%. Emissions are expected to grow once the economy recovers; without the crisis impact, Ukraine's emissions were forecast to return to 1990 levels by 2020.

## Priority Sectors for GHG Abatement

4. A Business as Usual scenario was developed on the basis of Ukraine's Energy Strategy. According to the BAU scenario, Ukraine's GHG emissions in 2020 would be 83 percent of its 1990 emissions, based on the following interventions:

(a) Thermal generation would increase in absolute and relative terms – the share of fossil fueled power generation increasing from 45 percent to 51 percent, with coal increasing from 52 percent to 85 percent;
(b) Increase nuclear generation by about 14 percent;
(c) Nearly doubling Ukraine's hydro power generation capacity; and,
(d) Increase non-hydro renewable generation capacity (mostly wind) from about 0.1 MW to 1.6 GW;
(e) Reduce the consumption of energy in existing industries and restructure the economy to make it less energy intensive.

However, implementing a "Business as Usual" program of this size would be challenging for the Government, particularly in the current economic crisis, which threatens to derail implementation of Ukraine's energy strategy.

5. The Government has identified additional measures as part of the Energy Strategy, which could be categorized as a Low Carbon Development (LCD) Case, and which could reduce annual emissions by an additional 134 million tons per year by 2020. If both the BAU and LCD programs are implemented, then the level of GHG emissions will be 18 percent below the BAU case by 2020 and would put Ukraine on track to achieving its ambitious goal of reducing GHG emissions by 50 percent by 2050.

6. In the energy sector, the LCD measures give priority to:

(a) Rehabilitation of fossil fuel power plants, potentially increasing efficiency by about 6 percentage points and reducing CO2 emissions by 18 million tons per year;
(b) Accelerating the construction of new nuclear power plants (6 GW more than BAU), resulting in emissions savings of 53 million tons of CO2 per year;
(c) Switching to high efficiency combined cycle/combined heat power plants; assuming that Ukraine builds five 500 MW CCGT/CHP plants by 2020, total CO2 emissions could be reduced by 14 million tons per year compared to the BAU scenario;
(d) Increasing electricity production from hydro power plants from 12 TWh in 2005 to 17 TWh in 2020, resulting in CO2 emission savings of 5 million tons;
(e) Renovation of the gas transmission network, particularly replacing all outdated and inefficient compressor units could reduce gas consumption by about 30 percent and decrease about five million tons of $CO_2$ emissions annually.
(f) Improving the efficiency of the industrial sector would lead to a savings of 29 TWh of electricity by 2020, which corresponds to 32 million tons of CO2 emissions savings; and,
(g) Improving efficiency in the housing and communal services sector, particularly replacing low-capacity and low-efficiency boilers, refurbishing heat distribution networks, and increasing thermal building insulation, would translate into annual CO2 emissions savings of 8.7 million tons.

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

7. The Government of Ukraine is seeking MDB and CTF support in implementation of its Energy Strategy to both accelerate the low carbon options in the BAU scenario and to facilitate a

move from the BAU case to the Low Carbon Development scenario through a combination of energy efficiency and renewable energy interventions. The priority activities selected for CTF co-financing are:

(a) Direct financing to 100 MW generated from large-scale private sector renewable energy development (particularly wind farms) and funding through financial intermediaries for 80 MW generated from smaller/medium scale projects (such as small hydro and biomass). The CTF program would reduce risk and overall cost of investing in renewable energy in Ukraine by supporting the first commercial-scale projects and addressing barriers such as insufficient access to longer term funding, additional transaction and development costs, and lack of business skills and information.
(b) Commissioning of a modern 450 MW Combined Cycle Combined Heat and Power Plant, the first of its kind in Ukraine, transforming electricity and heat generation by demonstrating the efficiency and cost benefits of introducing this technology in the industrial sector.
(c) An energy efficiency program that implements the Government's ambitious target to reduce energy intensity by 50% by 2030 through reconstruction and refurbishment of municipal and mixed ownership housing stock; upgrading Government-owned buildings, such as schools and hospitals; decreasing losses in district heating supply; and, industrial energy efficiency. The program's transformational effect would result from buying down the cost of energy efficiency projects to address barriers such as perceived technical and financial risk, absence of financing of suitable tenor and cost, and high transaction costs of developing projects.
(d) Design and implementation of the next generation of modern grid management and control systems, which is necessary to support large-scale integration of intermittent renewable energy, thereby catalyzing the Government's strategy for scaling-up of renewable energy capacity from 1.5 GW to 5 GW.
(e) Upgrading 30 percent of all compressors in Ukraine's gas transit system to higher efficiency levels (e.g., from about 25 percent to 35-42 percent), jump-starting a large international collaborative program that would be transformative by reducing the large gas consumption by the network itself and ensuring adequate supply of gas for power plants, thereby avoiding coal-fired power generation. The opportunity of using exhaust gases from the gas compressors to produce electricity from heat recovery boilers will be explored as part of the feasibility study. If feasible, such investments could increase electricity production with no incremental GHG emissions

8. *Potential for GHG reduction:* The proposed investments in renewable energy would result in cumulative $CO_2$ emissions savings of 16 million tons per year by 2020. The CCGT/CHP unit would generate annual emissions savings of between 1.26 and 2.52 million tons of $CO_2$. Efficiency improvements in the industrial and residential sectors are estimated to result in emissions savings of 1.2 and 2 million tons of $CO_2$ annually, respectively. Smart Grids provide more indirect emissions savings by better integrating intermittent renewable energy through improved flexibility of generation and load dispatch. Smart Grids could also support energy efficiency programs by making loads more responsive to price signals. Changing about one-third of the compressors in the gas transit system would reduce gas consumption by 0.8 billion $m^3$, with emissions savings of about 1.5 million tons of $CO_2$ per year.

9. *Demonstration potential:* The renewable energy program will serve as a catalyst in attracting financial institutions to the renewable energy sector and developing a competitive market for these new projects by overcoming the risk perception. Experience from other countries has demonstrated that ignition of a critical mass of privately-financed renewable energy projects has only occurred in markets that rapidly reach a critical threshold in terms of cumulative installed capacity (for wind it is roughly 500 MW). Reaching such a level sends a positive signal to the global industry and also sets in motion a virtuous feedback loop where ancillary economic development begins to also scale.

10. The first state-of-the-art CCGT/CHP plant in Ukraine would establish the cost and performance benchmarks necessary for substituting such efficient, low carbon technologies for coal-fired power plants. With respect to energy efficiency, the investment needs and potential in Ukraine are estimated to exceed $1 billion per year and the International Financial Institutions are establishing an Energy Efficiency Action Plan that would be instrumental in deepening interventions in the industrial sector, district heating, and power and water utilities. Smart Grids are at their early stages of deployment globally, and the CTF investment provides the opportunity to develop implementation experience in emerging economies for more rapid scale-up. Upgrading gas compressors has significant scale-up potential, given the size of Ukraine's has network, and could also have a replication effect in Russia and other countries with large gas transit systems.

11. *Development impact:* The CTF program addresses a top economic priority of the Government – energy security and efficiency – as a result of the global increase in energy prices and the changes in Gazprom's gas pricing formula for Ukraine. This two-punch price impact has created twin priorities for more efficient utilization of gas and fuel switching from gas to alternative fuels. The renewable energy program would have other significant co-benefits, such as business and employment generation in the renewable energy industry (assembly, fabrication, services), as well as reduction in NOx, SOx and particulate emissions from avoided coal-fired power. The CCGT project would support industrial development in a region of Ukraine currently suffering from electricity shortages.

12. *Implementation Potential:* The Government has established a "Green Tariff" for renewable energy, as well as a National Agency for the Effective Use of Energy Resources, whose mandate is to guide Government policy on energy efficiency. Although Ukraine has a proven implementation record of MDB-financed projects in the energy sector, the investment program could be affected by Ukraine's high credit risk arising from its vulnerability to international liquidity problems. The policy framework agreed with the support of the IFIs may serve as an anchor to maintain an appropriate macroeconomic framework that is necessary for Ukraine's economic recovery. The World Bank is also preparing a Development Policy Loan focused on structural reforms to facilitate business entry and exports, to generate fiscal space for needed investments, and to help ensure sustainability in the gas sector.

13. *Additional costs and risk premiums:* One of the key limitations for wider project implementation of renewable energy financing is the lack of financial resources, both direct funding and lending facilities, because private investors and financial institutions view the sector as higher risk due to lack of technical capacity on the part of lenders to evaluate such projects

and potential borrowers to establish the bankability of their projects. Energy efficiency lending has attractive returns, but market penetration has been limited due to similar barriers and experience has shown that subsidies are required to overcome these barriers. Furthermore, the recent economic crisis has made investments difficult due to financial sector constraints, while central and local governments lack the funds to make significant investments. Smart Grids are an innovative and complex concept which requires positive incentives for deployment. Finally, Naftogas' weak financial position limits its ability to invest in standard, low cost technology for gas compressors. Even as gas price reforms are implemented over the next two years, support for initiating the compressor upgrades can accelerate the modernization and reconstruction program.

**Table 1: Results indicators for the Ukraine CTF Investment Plan**

| Project | Primary indicator | Projected $CO_2$ emissions reduction |
|---|---|---|
| Renewable Energy (RE) | Renewable energy supply in the grid | 0.7 mln tons/year |
| Clean Power | Successful connection of the new plant to the grid | 2.5 miln tons/year |
| Energy Efficiency (EE) | 15% improvement in energy intensity by 2015 | 3 mln tons/year |
| Smart Grids | Long term impact: fostering the scale-up of RE after 250MW target is achieved | Indirect; will provide enabling environment for RE and EE. |
| Gas Network Rehabilitation | Replacement of 30% of gas compressors | 1.5 mln tons/year plus the emission reductions from electricity production |

## Table 2: Indicative Financing Plan
## (in US$ millions)

| **Program** | **Ukraine Counterpart** | **MDBs** | | | | **Private Sector** | **CTF** | | | **Total** | **CTF Grant Funds** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stage 1** | | EBRD | IBRD | IFC | Other | | EBRD | IBRD | IFC | | |
| Ukraine Renewable Energy Financing Facility | | 250 | | 50 | | 30 | 50 | | 25 | **405** | 1 |
| Clean Power Generation | | 100 | | | 75 | 225 | 50 | | | **450** | 1 |
| Energy Efficiency | 250 | 75 | 250 | 25 | | 125 | | 50 | 25 | **800** | 1 |
| Smart Grids | 100 | | 300 | | | | | 50 | | **450** | 0.25 |
| Gas Network | 400 | 750 | 750 | | | | 50 | 50 | | **2000** | 1 |
| **Total Stage 1** | **750** | **1175** | **1300** | **75** | **75** | **380** | **150** | **150** | **50** | **4105** | **4.25** |
| | | **2625** | | | | | **350** | | | | |

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## 1. Country and Sector Context

1. **Ukraine is a lower middle income country, with GDP per capita of US$1,940 in 2006**. Located strategically between the east and west, its population of 46 million is the second largest among the successor states of the former Soviet Union.

2. **After a decade of steep economic decline, which halved the country's recorded economic output and raised the poverty rate to almost a third of the population, economic growth rebounded in 2000 and GDP grew by about 7.5% per year on average until 2007.** The robust economic recovery is seriously at risk. Much of this improvement in growth performance was due to the combination of financial stabilization and the introduction of economic reforms. The hardened budget constraints bolstered confidence in the Government's macroeconomic management and in the country's fledgling financial sector as well as created the legal and institutional basis for a market based exchange rate. The recent global financial/economic crisis has, however, hit Ukraine's industrial sector particularly hard: GDP growth dropped to 2.1% in 2008 and is forecasted to decline by about 9% in 2009, followed by a slow recovery in 2010 with an expected GDP growth of 1%.

3. **To recover its economic growth and improve competitiveness, Ukraine will need to address a combination of challenges.** Improving the energy efficiency of the economy and thereby reducing its vulnerability to further import price shocks, as well as modernizing the energy sector itself to make it more efficient, are among those challenges. The Energy Strategy of Ukraine for the Period until 2030 (Energy Strategy), adopted in 2006, provides a platform for addressing these issues over the three distinct phases of development envisaged for the country: Phase I (2006-2010) – focusing on innovation and reconstruction; Phase II (2011-2020) – on accelerated development of the Ukrainian service sector; and Phase III (2021-2030) – on the start of changes in economic structure, moving to a post-industrial society. Phase I, sidelined by recent events, essentially involves technical improvements, rooted in energy efficiency, and strengthened economic reforms (see discussion in Box 1).

**Box 1. From "Business-as-Usual" to "Business-as-Unusual"**
**To a "Low Carbon Development Trajectory**

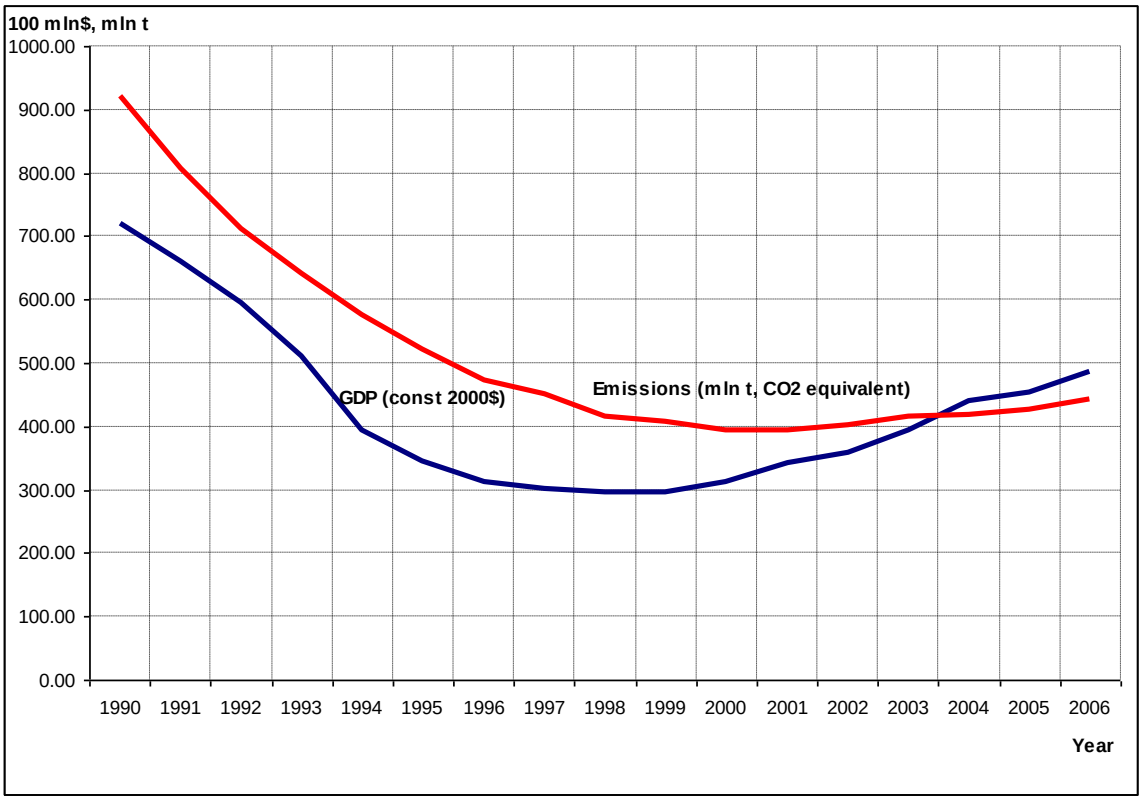
The Government Energy Strategy, outlined in a report in 2006, indicates their desire to normalize the energy supply system, continuing a move towards adopting EU standards. The strategy included only a limited focus on demand-side energy reforms, however. Three events have changed the backdrop considerably: the global increase in energy prices; the change in Gazprom's gas pricing formula for Ukraine; and the financial/economic crisis which saw a collapse of Ukraine's banking sector and a drop in GDP of about 10%. The two-punch energy price impact has ended the Government's complacency towards demand-side energy efficiency; it has now become a top priority. Increased gas prices have also accorded a high priority to switching from gas use towards alternative fuels. While domestic coal has been given a high priority as a part of the fuel switching exercise, there is also an opportunity to increased use Renewable Energy resources if the incentives can be mobilized. All of the above will require not only a change in the focus of energy sector investments, but it will also require an increase in funding, both of which will be a challenge while Ukraine tries to dig itself out of the current financial/economic crisis.

## Ukraine's Greenhouse Gas Emissions

4. **Ukraine signed the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992, which was ratified by Parliament in October 1996**. Ukraine became a Party to the UNFCCC in August 1997. The Kyoto Protocol, signed in 1997, was ratified by Ukrainian Parliament in February 2004 and since then became an integral part of Ukrainian legislation. Under the Kyoto Protocol, Ukraine is committed to ensure that its annual greenhouse gas (GHG) emissions during the period 2008-2012 do not exceed the 1990 level of 922 million tons.

5. **Reflecting the steep economic decline due to the transition, emission decreased between 1990 and 2000** at an average annual rate of 8%. With the resumption of growth, emissions increased between 2001 and 2006, but total emissions remained less than half the 1990 level (see Figure 1.1)

Figure 1.1
GDP and GHG Emissions in Ukraine, 1990-2006



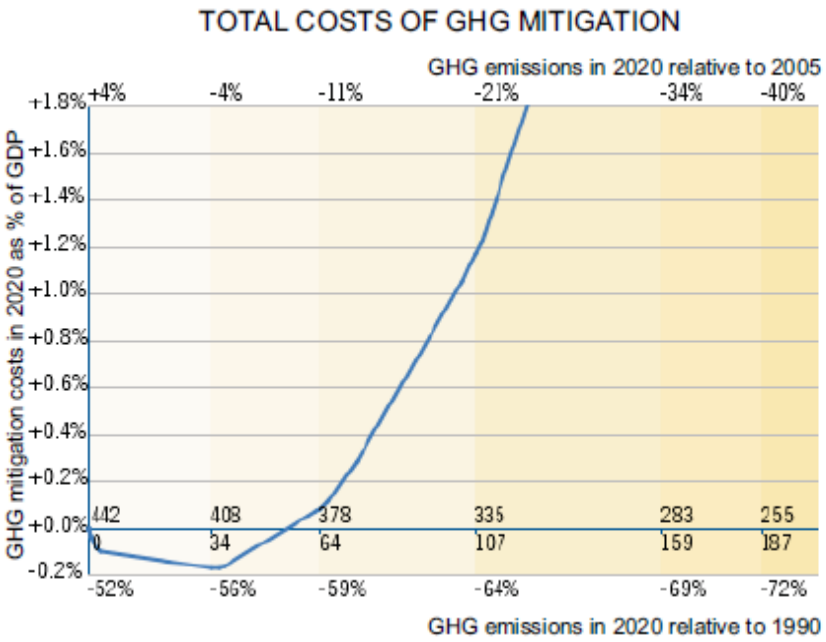

Source: WDI, National GHG Inventory Report, 2008

6. **Total GHG emissions in 2012 and 2020 are forecasted to remain well below the 1990 levels.** In addition to fulfilling its Kyoto commitments, Government of Ukraine (GoU) plans to keep GHG emissions 20% and 50% below 1990 levels by 2020 and 2050, respectively. The latter target would require maintaining the GHG emissions in 2050 to roughly today's levels, implying a net zero growth in emissions between now and 2050 despite an expected strong economic growth.

7. In the Energy Strategy, the GoU proposed low carbon development measures that would help achieve its long term GHG emission reduction goal (the measures are discussed in detail in the next chapter). A study by IIASA[1] has developed a GHG mitigation cost curve for Ukraine (see Figure 1.2) that shows the costs of mitigation options rise steeply and would require considerable external financing. Hence, in order for the GoU to achieve its long term goal of GHG emissions reduction, it needs to mobilize substantial funds.

[1] "Potentials and Costs for Greenhouse Gas Mitigation in Annex 1 Countries – Initial Results" by the International Institute for Applied Systems Analysis, February 2009

Figure 1.2




Source: IIASA, 2009

## Energy Supply Overview and Emissions

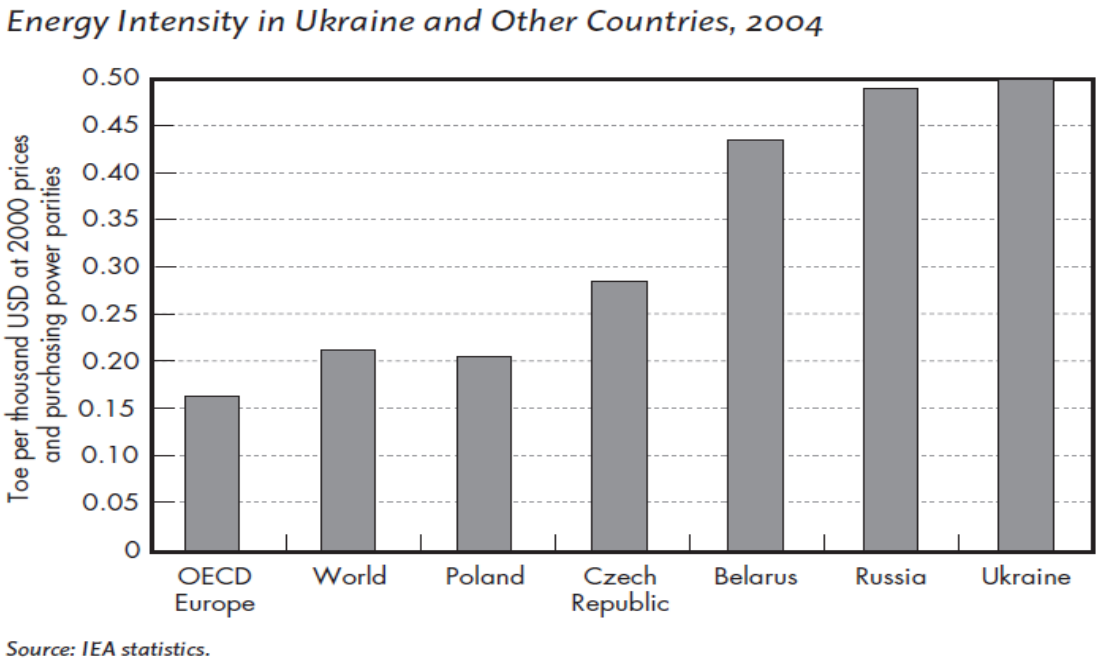
- Energy Supply

8. **Ukraine's high energy intensity is 3 times higher than the EU average and is the key driver of GHG emissions in the country**[2] (see Figure 1.3)**.** For example, Ukraine's energy use per unit of purchasing power parity adjusted GDP exceeds German figures by a factor of 4 (0.5 kg of oil equivalent in Ukraine vs. 0.125 kg in Germany[3]). The energy intensity of Ukraine is higher than that of energy-rich Russia. The only countries with more energy intensive economies are the oil producers of the Middle East. While Ukraine's energy efficiency has improved at a rate of 4-6 percent per year, from 1 kg of oil equivalent per unit of purchasing power parity adjusted GDP in 1999 to 0.5 kg in 2006[4], it remains at a level similar to that of Poland in the early 1990s.

9. Such poor energy intensity is attributable, in part, to historically low energy prices, especially for natural gas, which biased the incentives in favor of inefficient and energy intensive technologies. However, with recent changes in the border price of natural gas from Russia, investments will now need to be evaluated using much higher costs of energy supply. Investing in more efficient technologies could provide a triple dividend in Ukraine: decreasing energy costs, improving energy security and reducing emissions.

[2] The discussion follows IEA's *Ukraine. Energy Policy Review 2006*. Paris: International Energy Agency, 2006
[3] WDI, 2009
[4] Energy Information Administration, http://tonto.eia.doe.gov/country/country_time_series.cfm?fips=UP#prim

Figure 1.3
Energy Intensity Comparisons




10. **Primary energy supply in Ukraine is dominated by natural gas at 41% of the total, though its consumption has been decreasing in recent years** (see Figures 1.4, 1.5). While natural gas emits relatively small amounts of GHGs compared to other fossil fuels, the efficiency with which it is used is well below the industry average. The primary problem is the aging asset base: many of the power and district heating plants are operating beyond their design life. Improving the efficiency of the existing assets will be undertaken with a three-pronged effort: (1) replacing the oldest equipment with new plants; (2) upgrading plants with reasonable continued operating life (typically more than 10 years); and (3) decreasing the energy production by investing in new plants allowing operating hours of existing plants to decrease. Coal accounts for a relatively large share of primary energy (Figures 1.4, 1.5) and its use is expected to grow in response to increasing natural gas prices and/or for reasons of security of energy supply, given that it is the largest domestic source of primary energy. However, Ukraine's increased reliance on nuclear power (two 1,000 MW units were commissioned in 2007 and two more are under construction) could curtail use of coal and reduce GHG emissions. Renewable energy (RE), dominated by hydropower, accounts for about 4% of the country's supply of primary energy, slightly higher than global average. RE's share in the supply of primary energy can be increased through the development of small hydropower, wind power, solar energy and biomass.

Figure 1.4
Ukraine's Primary Energy Sources

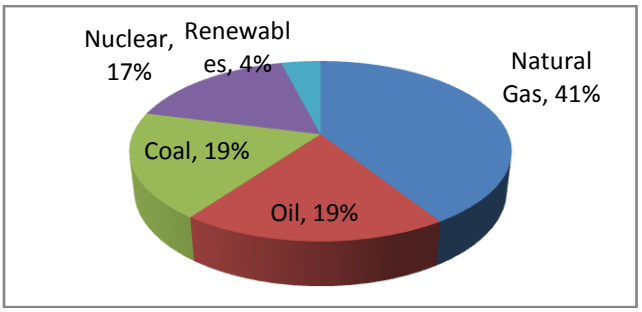
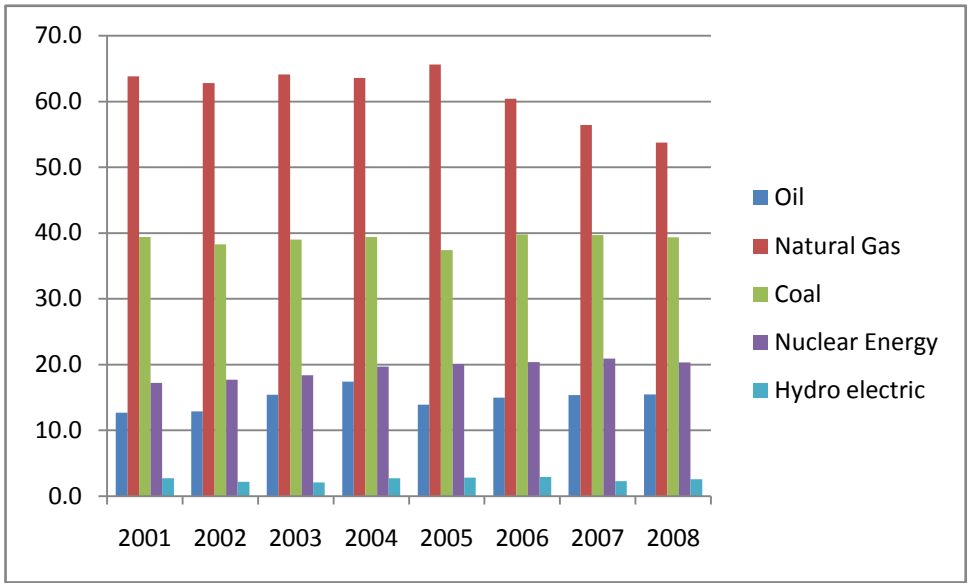



Figure 1.5
Ukraine's Primary Fuel Consumption by Source (million tons of oil equivalent), 2001-2008




Source: BP, 2009

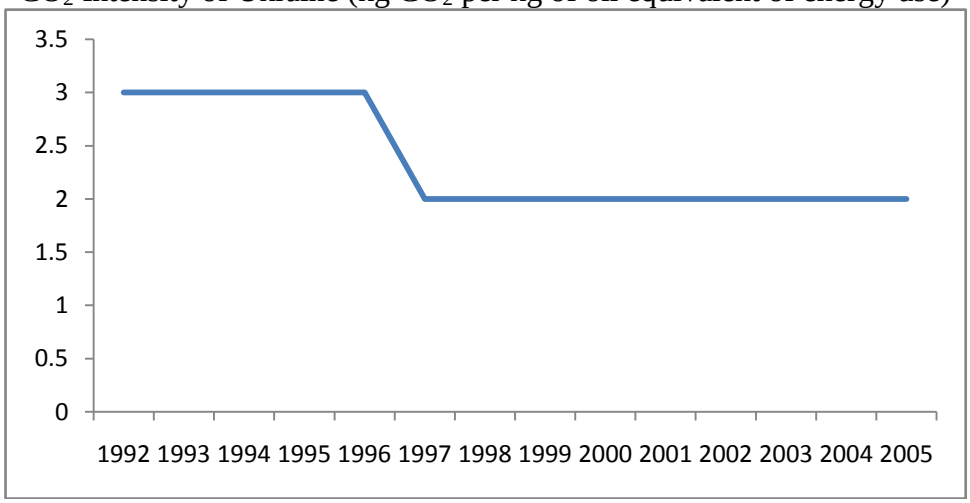
- Emissions

11. In 2006, carbon dioxide accounted for 76% of GHG emissions and methane for another 18%[5], though carbon intensity of the economy has decreased in recent years (Figure 1.6). The energy sector was responsible for 69% of the total emissions. Industrial processes produced another 22% of GHGs (see Table 1.1).

[5] National GHG Inventory Report, 2008

Figure 1.6

$CO_2$ Intensity of Ukraine (kg $CO_2$ per kg of oil equivalent of energy use)

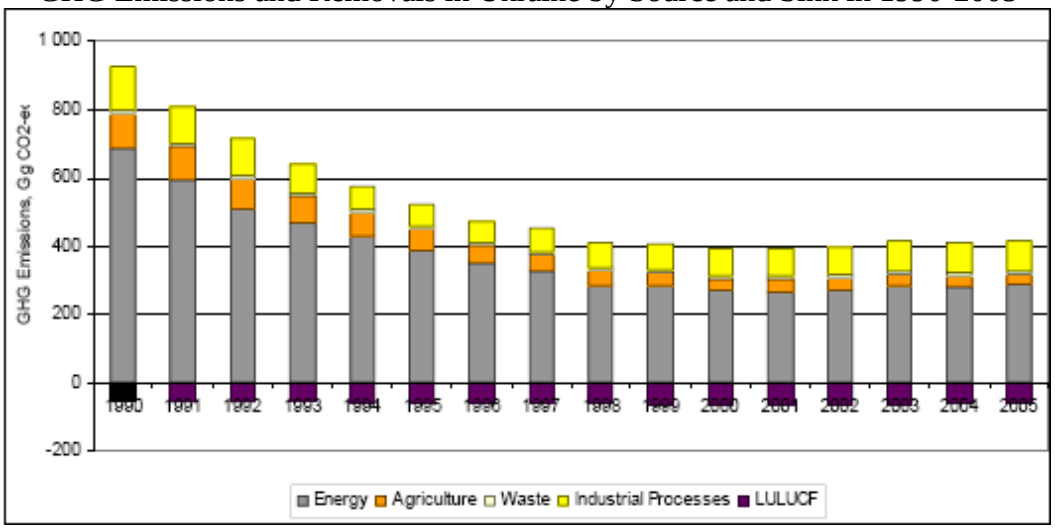



Source: WDI, 2009

12. **Using FPCC[6] standard definitions for GHG emissions, the energy sector accounted for the bulk of the reductions in GHG emissions in absolute terms, followed by agriculture as a distant second** (Figure 1.7). Between 1990 and 2006 GHG emissions from the energy sector fell by 380 million tons of $CO_2$ ($MTCO_2$) and from agriculture by 70 $MTCO_2$. Together, they account for about 94% of the GHG emissions decrease. The recent economic/financial crisis is expected to result in further reductions in GHG emissions in 2009, possibly extending into 2010 as well, with the bulk of the reductions coming from industries.

Figure 1.7

GHG Emissions and Removals in Ukraine by Source and Sink in 1990-2005




Source: National GHG Inventory Report, 2007

[6] Federal Performance Contracting Coalition. As a part of the Business Council for Sustainable Energy, the Federal Performance Contracting Coalition focuses on advancing policies and programs for Federal Energy Savings Performance Contracting (ESPC). (www.bcse.org)

13. **GHG emissions from the energy sector and industrial processes are expected to grow once the economy recovers.** Achieving the Government's 2050 GHG emissions target and the associated net zero growth in emissions will, therefore, depend critically on substantially improving the efficiency with which energy is produced and consumed. This will require broadening and deepening of the structural reforms implemented to date to foster a shift to cleaner fuels and more efficient technologies.

Table 1.1
GHG Emission Trends by Sector

| Sector | 1990 | 1995 | 2000 | 2006 | Change Base Year/2006 | Change 2006/2000 | Share of Sector in 2006 |
|---|---|---|---|---|---|---|---|
| | Mt CO2 | | | | % | | |
| Energy | 685.49 | 387.79 | 271.69 | 305.11 | -55.5 | 12.3 | 68.8 |
| a. Fuel combustion | n/a | 334.04 | 218.37 | 252.32 | n/a | 15.5 | 56.9 |
| Energy industries | n/a | n/a | 98.12 | 110.8 | n/a | 12.9 | 25 |
| Manufacturing industries and construction | n/a | n/a | 42.9 | 49.24 | n/a | 14.8 | 11.1 |
| Transport | n/a | n/a | 34.4 | 43.9 | n/a | 27.6 | 9.9 |
| Other sectors | n/a | n/a | 39.72 | 47.0 | n/a | 18.3 | 10.6 |
| Other | n/a | n/a | 3.23 | 1.38 | n/a | -57.2 | 0.3 |
| b. Fugitive emissions from fuels | n/a | 53.75 | 53.32 | 52.79 | n/a | -0.9 | 11.9 |
| Solid fuels | n/a | 30.13 | 31.38 | 28.98 | n/a | -7.6 | 6.5 |
| Oil and gas | n/a | 23.62 | 21.94 | 23.81 | n/a | 8.5 | 5.4 |
| Industrial Processes | 126.92 | 62.68 | 81.52 | 97.17 | -23.4 | 19.2 | 21.9 |
| Solvents | 0.38 | 0.37 | 0.35 | 0.34 | -10.5 | -2.9 | 0.1 |
| Agriculture | 100.8 | 62.34 | 32.75 | 30.45 | -69.8 | -7.0 | 6.9 |
| LULUCF (net absorption) | -66.94 | -60.33 | -50.91 | -32.63 | -51.3 | -35.9 | -7.4 |
| Waste | 8.43 | 8.55 | 8.68 | 10.12 | 20.0 | 16.6 | 2.3 |
| Total (with LULUCF) | 885.07 | 461.41 | 344.09 | 410.56 | -53.6 | 19.3 | 92.6 |
| **Total (without LULUCF)** | **922.01** | **521.73** | **395** | **443.18** | **-51.9** | **12.2** | **100.0** |

Source: National GHG Inventory Report, 2008

14. **In 2005 and 2006, the production of electricity and heat accounted for over 90% of energy sector emissions[7].** Of the total electricity produced, 45% came from fossil fuel power plants, 48% from nuclear and 6.7% from hydro[8]. Thermal power plants burnt 27,458.3 and 33,422 tons of coal in 2005 and 2006 respectively[9].

[7] National GHG Inventory Report, 2007; National GHG Inventory Report, 2008
[8] Ministry of Fuel and Energy of Ukraine, 2007
http://mpe.kmu.gov.ua/fuel/control/uk/publish/article?art_id=81973&cat_id=35086&search_param=%D0%90%D0

15. Fugitive emissions, primarily caused by methane release from fossil fuel production, processing, transportation and storage, accounted for a relatively significant share of GHG emissions. Venting and flaring of methane are also included in this category. Solid fuels (coal) accounted for 55% of the fugitive emissions and oil and gas for the remaining 45%.

16. Industrial processes are responsible for 22% of GHG emissions in Ukraine. Iron and steel production, cement production, lime production as well as limestone and dolomite use are the most significant sources of $CO_2$. Iron and coke production causes the largest amount of methane emissions. $N_2O$ is emitted mainly from adipic and nitric acid production, and perfluorocarbons – from aluminum production.

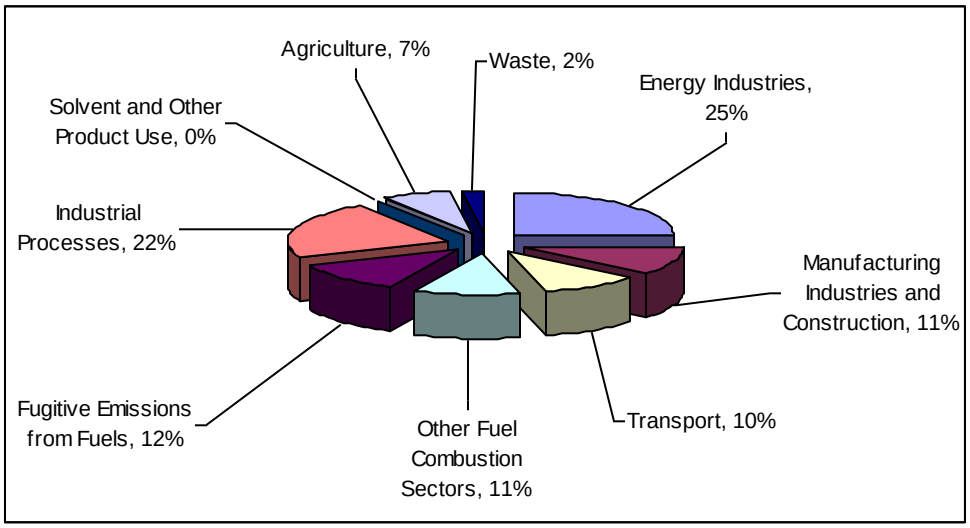
%BD%D0%B0%D0%BB%D1%96%D1%82%D0%B8%D1%87%D0%BD%D0%B0+%D0%B4%D0%BE%D0%B2%D1%96%D0%B4%D0%BA%D0%B0&searchForum=1&searchDocarch=1&searchPublishing=1

[9] Ministry of Fuel and Energy of Ukraine, 2008
http://mpe.kmu.gov.ua/fuel/control/uk/publish/article?art_id=120581&cat_id=35086

## 2. Identification of Priority Sectors for GHG Reduction Interventions

17. **Energy and industry are the priority sectors for intervention as they account for 69% and 22% of country's GHG emissions, respectively** (see Figure 2.1). These sectors are also central to Ukraine's Energy Strategy, which is largely driven by energy security concerns. In the past, low cost natural gas has played an important role in primary energy supply. However, gas has increasingly presented problems in Ukraine because of the increased price and the periodic interruptions in its supply. Therefore, Ukraine plans to reduce its dependence on imported natural gas by increasing use of nuclear power and indigenous coal-based capacity. Increased use of renewable energy resources, particularly hydropower, is also an integral part of the Energy Strategy, but at a much lower level than thermal options. At the same time, the rapid increases in energy prices have facilitated a new outlook on energy efficiency investment potential. The Government is now preparing legislative changes to support increased focus on energy efficiency investment in the residential sector.

Figure 2.1
Emissions by Sector in Ukraine, 2006




Note: Energy Industries, Manufacturing Industries and Construction, Transport, Other Fuel Combustion Sectors and Fugitive Emissions from Fuels are reported under Energy sector emissions

Source: National GHG Inventory Report, 2007

## The Baseline: Business as Usual (BAU) Scenario

18. Considerable analysis by IPCC and others indicates a strong linkage between economic growth and GHG emissions with elasticities typically about 1.1[10] assuming no change in policy drivers – the "Business as Usual" (BAU) case. A BAU scenario for Ukraine was developed on this basis using the Energy Strategy of Ukraine for the Period until 2030 adopted in 2006 as a baseline. Under that scenario, **Ukraine's GHG emissions are expected to decline significantly this year with the economic contraction, followed by gradual increases consistent with a 5% per annum GDP growth after 2011.** This scenario would result in Ukraine's total emissions in 2020 reaching 764 million tons of $CO_2$ equivalent, 83% of its 1990 GHG emissions. **Without the crisis impact, BAU's 2020 emissions would return the 1990 level** (see Figure 2.2)**.**

19. The development trajectory of the BAU Scenario assumes the following:

- **Thermal generation would increase in both absolute and relative terms.** The Government's plan calls for increasing the electricity produced by fossil-fueled power plants from 84 TWh (2005) to 125-130TWh in 2030. The share of fossil-fueled power generation is expected to increase from 45% to about 51%, with coal accounting for 85% of the total in 2030, compared to 52% in 2006.
- **Increase nuclear power generation.** The Energy Strategy includes an optimistic implementation program for installing nuclear power capacity. Nuclear power plant capacity is forecasted to increase from 13.8 GW (in 2005) to 15.8 GW in 2020. The share of nuclear power in total generation is expected to be about 44% in 2020, a modest 4% decrease relative to 2005.
- **Increase Ukraine's hydropower generation capacity**. The Government's target is to increase hydropower capacity from 4.7 GW in 2005 to 7.5 GW in 2020.
- **Increase non-hydro renewable generation capacity (mostly wind)**. The government expects to install 1.6 GW of renewable resource-based generation capacity by 2020, well above the current level of less than 0.1 MW. The Government forecasts that renewable sources will generate 1.5 TWh in 2020, about 0.5% of total generation.
- **Reduce the consumption of energy in existing industries and restructure the economy to make it less energy intensive.** As it has been mentioned above, Ukraine's energy intensity is about 3 times that of EU countries. This is due in part to the legacy of the Soviet era and in part to the delays in implementing the reforms required to restructure the economy to reflect the higher cost of energy supply. The reforms needed include adjusting the price of energy to reflect the cost of supply and improving access to both information and capital as they continue to be a binding constraint.

[10] According to Intergovernmental Panel on Climate Change Working Group III's 2007 Report, the elasticity of GHG emissions with respect to GDP ranges between 0.5 and 1.5, depending on the policy agenda – an estimate supported by other studies. For middle income countries an elasticity of roughly 1.1 has been found to be the norm, which closely corresponds with a rough estimation of the elasticity for Ukraine of 1.16, based on data covering the period between 1990 and 2006. In a paper by Dhanda, Adrangi and Chatrath ( "Linkage between GDP and Emissions: A Global Perspective on Environmental Kuznets Curve" , *Journal of Business & Economics Research*, Vol. 3 #5, pp. 47-56), it is found that in the medium developed countries 1% increase in GDP leads to 1.14% increase in emissions.

20. **Under BAU scenario, it is forecast that GHG emissions in 2020 would be 764 million tons of $CO_2$ equivalent, or 83% of the 1990 level.**

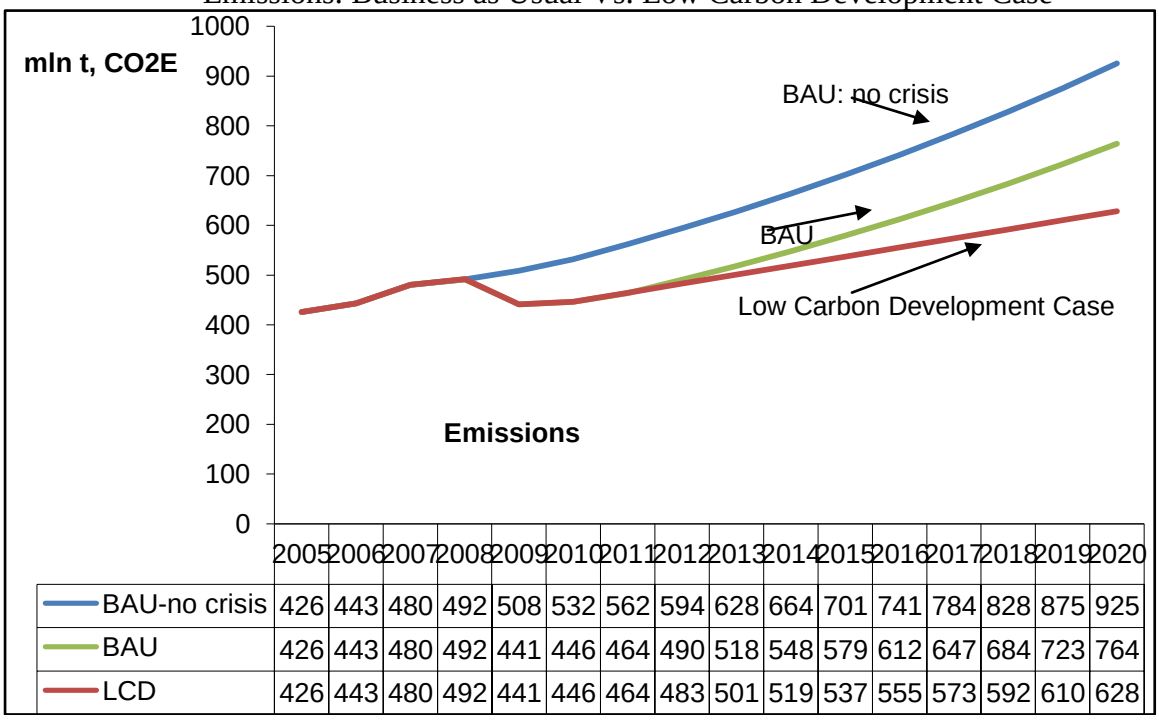
21. However, **implementing a "Business as Usual" program of this size would be challenging for the Government.** In light of the recent financial/economic crisis, the GoU finds itself following not a "Business as Usual", but rather "Business as Unusual" scenario, and measures outlined in Energy Strategy to improve energy efficiency and security require extensive financial and implementation resources. The nuclear program is capital intensive and may stretch the implementation capacity. The renewable energy program is also capital intensive, with limited options for financing it, at least over the short to medium term. Finally, there are questions about the financial and implementation capacity of the Government to address all issues in parallel.

## Low Carbon Development (LCD) Case

22. As it has been mentioned in previous chapter, the GoU has outlined, in broad terms, the measures it plans to implement to reduce GHG emissions in the Energy Strategy of Ukraine for the Period until 2030 (Energy Strategy, 2006; CH 7) as well as in the Report on "Demonstrable Progress under the Kyoto Protocol" (2006). Most of the measures proposed by the Government as part of the Low Carbon Development Case target the energy and industrial sectors and, to a lesser extent, housing and communal services and agriculture. **The implementation of the proposed measures would reduce annual $CO_2$ emissions by 136 million tons[11]. If both BAU and LCD programs are implemented as planned in Energy Strategy, then the level of GHG emissions will be 18% below the BAU case by 2020** (see Figure 2.2). Moreover, the additional importance of implementing LCD scenario is that it would put Ukraine on track to achieving its ambitious goal of reducing GHG emissions by 50% by 2050.

[11] Depends on when/how many combined cycle power plants are assumed to be commissioned.

Figure 2.2
Emissions: Business as Usual Vs. Low Carbon Development Case




| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BAU-no crisis | 426 | 443 | 480 | 492 | 508 | 532 | 562 | 594 | 628 | 664 | 701 | 741 | 784 | 828 | 875 | 925 |
| BAU | 426 | 443 | 480 | 492 | 441 | 446 | 464 | 490 | 518 | 548 | 579 | 612 | 647 | 684 | 723 | 764 |
| LCD | 426 | 443 | 480 | 492 | 441 | 446 | 464 | 483 | 501 | 519 | 537 | 555 | 573 | 592 | 610 | 628 |

23. **In the energy sector, the LCD measures proposed by the Government give priority to rehabilitation of fossil fuel power plants and accelerating the construction of new nuclear power plants.** In addition, the Government proposes to develop renewable energy resources, reduce energy consumption through energy efficiency measures and reduce emissions during production, transportation and in the processing of oil and gas. The forecasted installed capacity and electricity production by source relative to the BAU case is shown in Table 2.1. Under LCD scenario, increased use of new capacity would result in a decrease in the operating hours of the older technology, thus decreasing GHG emissions.

Table 2.1
Electric Power Industry Development:
Business as Usual Vs. Low Carbon Development Case

| | Actual | | BAU | | LCD | |
|---|---|---|---|---|---|---|
| | 2005 | | 2020 | | 2020 | |
| | Installed Capacity (GW) | Power Generation (TWh) | Installed Capacity (GW) | Power Generation (TWh) | Installed Capacity (GW) | Power Generation (TWh) |
| Thermal Power Plants (TPP) | 33.5 | 84.1 | 33.5 | 125.1-135 | 37.6 | 129.9 |
| Nuclear Power Plants (NPP) | 13.8 | 88.8 | 15.8 | 110.5 | 21.8 | 158.9 |
| Hydro Power Plants (HPP) and Hydro Pumped Storage Power Plants (HPSP) | 4.7 | 12.3 | 7.5 | 13 | 9.6 | 16.6 |
| Renewable Energy Sources | 0 (up to 70 MW) | 0 | 1.6 | 1.5 | 1.6 | 1.5 |
| **TOTAL** | **52.0** | **185.2** | **58.4** | **250.1-260*** | **70.6** | **306.9*** |

Source: Energy Strategy, 2006

Notes:

* Increased electricity production under LCD case is due to decreased load shedding and increased electricity exports.

24. In particular:

**(i) Low carbon power generation.** In 2005, 45% of the total electricity was produced by fossil fuel fired power plants[12]. According to the low carbon scenario outlined in the Energy Strategy, the share of fossil fuel electricity production would drop to 42% by 2020 (compared to an increase to 51% in BAU). The GoU is considering the following options that would help to reduce the share of fossil electricity production: (1) accelerating the construction of new nuclear plants; (2) accelerating renewable power development; and (3) switching to high efficiency combined cycle/combined heat power plants..

- **Combined cycle/combined heat and power (CCGT) plants development** would improve efficiency of electricity generation from roughly 30% in older, existing plants to more than 50%. Substituting a 500 MW CCGT power plant for a similarly sized existing low efficiency subcritical coal burning plant[13] is estimated to reduce $CO_2$ emissions by 2.9 million tons/year. *Assuming that by 2020 Ukraine builds five 500 MW CCGT plants, total $CO_2$ emissions would be reduced by over 14 million tons per year compared to BAU scenario*.
- **Renewable power generation**. According to the Energy Strategy of Ukraine, electricity production from hydro power plants is expected to increase from 12TWh to 17TWh. *These actions would reduce $CO_2$ emissions by 5 million tons*.

[12] In 2005, nuclear power plants generated 48% (88.8TWh) of total electricity production; thermal power plants were responsible for 45% of total generation (84.1TWh); hydrogenation contributed 7% (12.3TWh) of total electricity production (Energy Strategy of Ukraine for the Period until 2030, 2006)

[13] We assume that a low (30%) efficiency subcritical coal burning plant emits 1085g of $CO_2$ per kWh.

It is important to note that in its Energy Strategy, the GoU plans to install 1.6GW of renewable energy in both BAU and LCD cases. Also, the GoU is planning to increase renewable energy capacity to as much as 5GW should the initial experience succeed. However, the success of this program is jeopardized by the recent financial crisis and will require nurturing to address the remaining barriers.

- **Nuclear power generation**. By 2020, Ukraine's installed capacity is forecasted to increase by 8 GW[14] in LCD scenario. This would increase nuclear electricity generation from 89TWh in 2005 to 159 TWh in 2020, 48 TWh more than under the BAU case (see Table 2.1, BAU Case). *This would reduce $CO_2$ emissions by 53 million tons a year, assuming the nuclear plant displaces existing coal-fired generation.*

**(ii) Rehabilitation of fossil fuel-fired power plants**. By 2020, the GoU plans to increase the installed TPP capacity by a modest 4.1 GW, from 33.5 GW to 37.6 GW[15]. The GoU also plans to rehabilitate of the existing subcritical coal-fired power plants. A 6 percentage point improvement in efficiency, from 30% to 36%[16], would reduce *$CO_2$ emissions by 18 million tons per year.*

**(iii) Renovation of the gas transmission network.** Most of the gas transmission network in Ukraine is old and in need of renovation or replacement. More than 60% of gas pipelines have been in use for over 10 years (over 30 in some cases). Compressor units are of low efficiency and outdated[17]. As a first step in the renovation of the network, the GoU plans to install high efficiency gas compressor units. Existing compressor units consume about 8 billion $m^3$ (bcm) of natural gas annually. Replacing these with new high efficiency gas compressor units throughout the system would reduce the consumption of gas by 2.5 bcm annually. *Assuming that by 2020 all of the compressors are replaced, $CO_2$ emissions would be reduced by about 5 million ton per year.*

25. The GoU also plans to **improve the efficiency of the industrial sector** through large-scale energy-saving measures. It is planned to introduce a sectoral energy savings system that would:

- introduce new energy saving processes and technology;
- improve existing processes and technologies; and
- reduce energy losses.

26. Sectors targeted for the energy savings are metallurgy, gas, construction, communal services and agriculture. According to the Energy Strategy, implementation of large-scale energy-saving measures would lead to saving of 29TWh of electricity by 2020, which corresponds to **32 million tons of $CO_2$ emissions reduction**.

[14] 2 GW out of 8 GW are a part of BAU case.
[15] Energy Strategy of Ukraine for the Period until 2030, 2006
[16] In this case, $CO_2$ emissions will be reduced from 1085g of $CO_2$ per kWh to about 930 g/kWh.
[17] International Energy Agency, 2006. *Ukraine. Energy Policy Review 2006*. Paris: International Energy Agency

27. In **housing and communal services**, the GoU has given priority to improving the efficiency with which heat is supplied and consumed, involving the use of energy saving materials, technologies and equipment. The estimated energy savings potential in communal heat supply, with a relatively short pay-back period, is 10-15% (such as replacement of burners, introduction of heat recovery, air heaters, and upgraded furnaces). According to Energy Strategy, just replacing and upgrading low-capacity and low-efficiency (about 70%) boilers (NIISTU-5) currently operated in the municipal thermal energy sector with modern 95% efficiency boilers would reduce natural gas consumption by over 200 million cubic meters annually. This would correspond to 0.37 million tons in $CO_2$ emission savings[18]. Additional savings could be achieved by refurbishing heat distribution networks and increasing thermal building insulation. According to IFC estimates, 4 bcm of natural gas reduction can be achieved from residential heating energy efficiency improvements. This would translate into **the annual $CO_2$ emissions reduction of about 8.7 million tons**[19]. However, achieving these additional savings would face significant barriers compared to the industrial sector.

28. **Hence, successful implementation of the measures outlined above would lead to a reduction in $CO_2$ emissions of 136 million tons relative to BAU case, 32% below the 1990 level.**

29. In addition to the LCD case interventions, the following options are also being considered:

- *End-Use Energy Efficiency*. With Ukraine's energy intensity among the highest in the region, there is considerable potential for reducing energy consumption by changing technologies and consumer habits.
- *Supply-Side Energy Efficiency*. The capital stock in the power sector and in district heat supply is old and inefficient. Much of the existing stock is operating beyond its design life and needs to be replaced while other assets should be upgraded.
- *Carbon Capture and Storage (CCS).* CCS options are unlikely to be implemented before 2020 in Ukraine as the technology is still being piloted elsewhere and potential CCS storage sites have not been identified.
- *Use of Coal Bed Methane and Coal Mine Methane*. Coal Bed and Coal Mine Methane projects could support considerable power plant capacity. However, the resource base is reported to be geologically difficult, necessitating piloting before it can be scaled-up.
- *Landfill Gas and Waste as a Fuel*. These resources have not received significant attention as of yet as they are expected to have a minor impact.

[18] We assume 1,860.5 tons of $CO_2$ savings per million $m^3$.

[19] In this case, Intergovernmental Panel on Climate Change emission factor of 56.1 tons $CO_2$/TJ for natural gas combustion was used.

## 3. Rationale for Selected Sectors for CTF Co-Financing

30. Energy Security is a priority for the Government of Ukraine. As seen in the previous chapter, **energy efficiency and renewable energy are among the measures proposed by the GoU to achieve its energy security objective and are fully consistent with the LCD scenario for GHG emissions reduction**.

31. **The GoU is seeking CTF support in implementation of its Energy Strategy to both accelerate the low carbon options in the BAU scenario and to facilitate a move from the Business as Usual (BAU) Scenario to the Low Carbon Development (LCD) Scenario (with GHG emissions levels 18% below BAU)** through a combination of energy efficiency and renewable energy interventions.

32. **The interventions with the highest potential for reducing GHG emissions in Ukraine are: (1) energy efficiency; (2) increased use of nuclear power; (3) implementation of high efficiency combustion technologies and carbon capture and storage (CCS) for new coal-fired plants[20]; and (4) renewable energy**. Nuclear power is not an option for CTF financing; and at this time, no greenfield coal plants would meet the CTF's CCS-readiness requirements. Hence, energy efficiency and renewable energy are left as key candidates for CTF interventions.

33. **The suggested projects would be implemented by the public and private sectors and would leverage the limited resources available through private sector participation**. Public sector interventions would cover areas where the enabling environment needs to be established or reinforced and without which the potential gains are unlikely to be fully realized. Furthermore, some sectors have limited private sector interest due to the current financial/economic crisis.

### Alternative Sources of Low Carbon Financing Options: Carbon Funds, GIS, Swedish/ EU Initiative

34. **JI** - Presently, there are 31 Joint Implementation (JI) projects in the (advanced) project pipeline which, together, are expected to mitigate 12 million tons $CO_2$ equivalent/year. However, as we approach 2012, the application of JI becomes increasingly limited due to implementation constraints.

35. **AAU Trading** - Based on 2006 emissions data, Ukraine has a surplus of emission rights[21] amounting to 2.22 billion AAUs over the Kyoto Protocol commitment period. It is expected that its actual surplus will amount to 1.86 billion AAUs, of which 1 billion would potentially be for sale. The latter figure is, however, unrealistic considering the overall imbalance between supply and demand: e.g., total cumulative demand from Parties that are seriously

[20] It is assumed that adding CCS to existing coal-fired plants would not make economic sense as the assets are old and have limited operating lives left. They are inefficient and efficiencies would be further penalized by CCS.

[21] Emission Rights or AAUs (assigned amount units) are units in which the Kyoto Protocol is measured. Each Annex I country has received emission rights equal to the base year (depending on country and type of GHGs), adjusted by a country-specific factor. In the case of Ukraine, because of the economic collapse that followed the political changes of 1990, the volume of these rights is considerable.

committed to reaching their Kyoto Protocol target might only be 1.5 billion. To date, Ukraine has agreed to sell 30 million AAUs to Japan with further deals in the pipeline. It has also been reported that the GoU plans to sell 100 million AAUs to Dighton Carbon CA (Switzerland), 50 million AAUs to Tawhaki International (New Zealand) and 100-300 million to London branch of Nomura Bank (Japan). If fully realized these deals could amount to US$1.4 –US$6 billion, depending on the price of the AAUs.

36. Assuming that low carbon potential could be realized through trading AAUs, up to 150 million credits (i.e., both ERUs[22] and AAUs through GIS) could actually be traded on a yearly basis. Assuming a price of €10/credit (which is rather high given current market circumstances), and a leverage factor as high as 10 (Carbon Trust, March 2009), annual investments could reach €15 billion as an upper bound. However, based on figures released earlier by Ukraine's National Environmental Investment Agency, a leverage factor of 4 appears more realistic, which is also more in line with international experience. Even with this low leverage factor, overall annual investments could reach €6 billion. These investments are likely to cover the most cost-effective (in terms of $CO_2$ emissions) and low-risk investments in industrial and buildings energy supply efficiency, but would most likely not be available to co-finance more technologically advanced or higher-risk measures. All of the AAUs brought to the table so far are allocated. However, AAUs resources are experiencing problems with project design due to institutional capacity. That can best be addressed by the Bank's presence in EE with CTF supplementing AAUs.

37. **Swedish/EU Initiative on Energy Efficiency and Environment in Eastern Europe/Ukraine Fund.** The Swedish/EU initiative was launched on April 28, 2009, in Stockholm; it was proposed by Sweden in the context of its Presidency of the European Union commencing July 1, 2009. The purpose of the fund is to bring together in common framework finance from Participating Financial Institutions (PFIs) to make a significant contribution to the financing and implementation of concrete projects to improve energy efficiency across all sectors in Ukraine and potentially other Eastern Partnership countries. The list of PFIs includes EBRD, EIB, NIB, NEFCO[23] and the World Bank Group. All beneficiary countries will also be donors. The fund would be managed by EBRD and governed by a steering committee comprised of participating PFIs and donors. The fund would co-invest with PFIs in selected projects under different proportion of donor/PFI funding depending on a project.

38. The fund will initially focus on district heating and then expand the sector focus to other municipal projects (water, solid waste, transport), renewable energy projects, industrial projects and residential energy efficiency. In terms of country coverage, it will start with Ukraine and then expand to other countries in the region. As of June 15th, 2009, the total project pipeline amounted to some €1.2 billion of PFI loans. The funding is largely expected to support projects preparation.

[22] Emission Reduction Units

[23] European Bank of Reconstruction and Development; European Investment Bank; Nordic Investment Bank; Nordic Environment Finance Corporation

## Proposed interventions

### Renewable Energy (RE)

39. The GoU has recently demonstrated its commitment to implementing RE projects by passing a new law introducing green (feed-in) tariffs for renewable energy. The green tariff is differentiated by RE source and is expected to provide a sufficient incentive for low cost RE options. However, experience in other countries has shown that the feed-in tariffs by themselves don't mean an RE program will succeed – it is a necessary but not sufficient condition. Moreover, despite recent progress in the adoption of a modern regulatory framework, Ukraine's renewable energy industry requires support to establish the practical business case and infrastructure for project support. The development of RE projects is stalling due to lack of conventional long-term financing from commercial banks. For example with wind, there are several projects in pre-development by local companies but not a single one has been able to secure commercial debt funding or attract a Western strategic sponsor yet.

40. In addition to facing the implementation risk of being the first to market with an untested framework, these projects are also threatened by the global financial crisis which has led to the unavailability of bank loans. Table 3.1 below outlines the investment requirements to achieve the wind power capacities foreseen in the currently proposed revision of the 2006 strategy.

Table 3.1

***Table: Newly proposed amendments to the Strategy for wind power development***

| Year | 2006 | 2010 | 2015 | 2020 | 2030 |
|---|---|---|---|---|---|
| Installed capacity of WPP, MW | 85 | 285,8 | 2172,8 | 5172,8 | 16002,8 |
| Commissioned during the period, MW | | 200.8 | 1887 | 3000 | 10830 |
| Power generation, GWh /year | 201* | 686 | 6340 | 15327 | 47773 |
| Investment during the period, million € | | 255 | 2399 | 3813 | 13766 |

* Power generated since the beginning of wind power operations up to year 2006

Source: Draft Concept of the Program on Renewable and Alternative Energy Sources Development, Ministry of Fuel and Energy, 2007

41. The availability of CTF resources at this critical time would play a vital role by delivering a substantial part of the funds required for the kick-starting of the sector in Ukraine in the period 2009 to 2011 as well as setting the process of RE projects development onto a rapid and scalable development path. Experience in other markets has demonstrated that ignition of a critical mass of privately-financed renewable energy projects has only occurred in markets that rapidly reach a critical threshold in terms of cumulative installed capacity (for wind it is roughly 500 MW). Reaching such a level sends a positive signal to the global industry including project developers, investors and lenders, and also sets in motion a virtuous feedback loop where more ancillary economic development activity associated with the specific renewable energy industry (e.g., turbine assembly, component fabrication, service organizations, etc.) begins to also scale.

42. Moreover, Ukraine is facing a critical, breakthrough moment for the RE sector: while the regulatory framework has been set up, it remains completely untested as not a single commercial size project has been completed. So there is no precedent to judge whether the framework will succeed. The proposed CTF funding is needed to support the first time private sector players that would take on the implementation risks, discovering the barriers as they go along and hurdling them as an example for others.

43. Hence, the CTF funds would support the new RE framework, accelerate wind and small-scale hydro, and demonstrate the potential for other renewable technologies. Large-scale applications are limited to hydro and large investors. Other barriers that would be addressed by the CTF supported program include high transaction costs, insufficient FRRs[24] for the proposed projects, access to the grid and lack of financing.

44. CTF can be used to justify the difference between short-term quick fixes and the long-term effective solutions for the companies considering RE investments in Ukraine. Through robust evaluations, it can encourage investors to support the highest impact opportunities rather than temporary solutions.

45. CTF support of US$75 million is expected to trigger the deployment of about 100MW of clean energy capacity with direct annual savings of around 0.7 million tons of $CO_2$ per year.

- Emission savings of the proposed interventions

46. As has been mention above, it is expected that the suggested intervention would facilitate savings of 0.7 million tons of $CO_2$ per year. By 2020, total savings through transformation could reach 16 million tons of $CO_2$ per year.

- Demonstration potential

47. Access to financial resources is a key constraint to scaling-up the implementation and replication of RE projects, both large and small. Private investors and financial institutions are reluctant to invest in the RE sector, which is perceived to have a higher risk profile than traditional supply options. The perception stems from lenders and borrowers not having the requisite technical capacity: the former to evaluate such projects and latter to prepare bankable projects. CTF will serve as catalyst in attracting financial institutions to this new field and developing a competitive market for these new projects.

[24] Financial Rate of Return

- Development impact

48. Co-benefits of the intervention include business and employment generation, reduces $SO_x$, $NO_x$ and particulate emissions and energy security. The proposed project would address policy, finance, business, and information barriers to renewable energy market developments in Ukraine.The GOU has established strong support for rationalization of energy use, largely driven by the problems associated with gas imports from Russia. In addition to their energy efficiency program, Ukraine plans to substitute gas use with other fuels, including nuclear power, coal and renewable energy. The renewable energy program, to date, has been weak suffering from low prices for fossil fuels. The Government has announced that they plan to address this through a rationalization of input prices which would favor increased use of renewable energy. However, local coal remains a low-cost option that necessitates low cost financial support for low carbon options to enable them to be implemented and, later on, scaled-up. The Government has demonstrated its support for implementation of renewable energy through the establishment of feed-in tariffs for RE.

- Results indicators

49. The primary indicator of success would be the operation of new renewable energy supply into the grid. The enabling environment is in place while the next steps will test the regulatory regime for practical implementation of RE. It is proposed that the program established targets for renewable energy projects that would be monitored by the Government to ensure that the legal and regulatory framework is effective and the incentives are adequate. An additional $75 million of CTF financing is expected to jump-start the RE program by supporting 100 MW of new RE capacity. These resources are also expected to help identify and resolve the remaining barriers to entry to increased private sector participation in RE. The expected output would reduce $CO_2$ emissions by about 0.7 million tons per year (see Table 3.2 at the end of the Chapter for the summary of the indicators and estimated results).

### Clean Power

50. Ukrainian power supply is primarily based on outdated coal plant and nuclear power. The current plans are to reconstruct older coal-fired plant in the country for public electricity supply. Heat is largely supplied from outdated gas-fired boilers. There are no plans to introduce CCGT/CHP technology into the country at present. The private sector could therefore play a role in the transformation of future electricity and heat generation technologies in Ukraine, by demonstrating the efficiency and cost benefits of introducing this technology into the country.

51. CTF resources are proposed to be blended with an EBRD private-sector loan which will support the construction of a large CCGT-CHP plant associated with a steel work complex and delivering heat to a municipal client. The transformation potential comes from the signal effect this installation of high-efficiency power and heat generation would have in the industrial sector in Ukraine.

- Emission savings of the proposed interventions

52. The emission savings from the new CCGT unit would be around 0.4 tons of $CO_2$ per MWh as compared to a new coal-fired plant and 0.8 tons of $CO_2$ per MWh as compared to a coal fired unit currently in operation. For the proposed 450 MW plant, assuming a load factor of 0.8, annual emissions reductions would be around 1.26 million ton $CO_2$ and 2.52 million ton $CO_2$ respectively.

- Demonstration potential

53. This will be the first state of the art CCGT in the country so the replication potential will be significant because of the demonstration effect of new high technology equipment and services. Combined cycle/combined heat and power (CCGT) plants development would improve efficiency of electricity generation from roughly 30% in older, existing plants to more than 50%, and would be a considerable benefit in emissions terms over new coal stations. Substituting a 500 MW CCGT power plant for a similarly sized existing low efficiency subcritical coal burning plant[25] is estimated to reduce $CO_2$ emissions by 2.9 million tons/year. *Assuming that by 2020 Ukraine builds five 500 MW CCGT plants, total $CO_2$ emissions would be reduced by over 14 million tons per year compared to BAU scenario.*

- Development impact

54. The proposed project would support industrial development in a region of Ukraine currently suffering from electricity shortages. It would also put the industrial development of this region on a low-Carbon growth path.

55. The project is a perfect fit with EBRD's country strategy for Ukraine, and the MoU about a Sustainable Energy Action Plan signed between the EBRD and the GoU.

- Results indicators

56. Successful connection of the new plant to the grid of one high efficiency (>50%) 450 MW CCGT combined heat and power plant. The implementation of this technology would support the introduction of an as-yet untried technology in Ukraine and would support the move away from increased power generation from coal, thus decreasing GHG emissions by roughly 50%. The expected GHG emissions reduction relative to a coal fire plant equivalent is 2.5 million tons of $CO_2$ per year, assuming displacement from existing plants.

## Energy Efficiency (EE)

57. Ukraine has enormous potential for increasing energy efficiency, and good progress has already been made in addressing some sectors of the economy. Drawing on lessons learned in other countries in Eastern Europe and the Former Soviet Union, progress would require access to concessional financing to address the many barriers to energy efficiency investments. GEF's energy efficiency program has demonstrated in many countries that EE investments require relatively modest support to succeed. The proposed CTF EE program would build on these lessons learned and enable the scaling-up required to become transformational.

58. Ukraine's Energy Strategy calls for more than 50% reduction in energy intensity by 2030, corresponding to energy savings of 223 million ton of oil equivalent (MTOE). About 38% of

[25] We assume that a low (30%) efficiency subcritical coal burning plant emits 1,085g of $CO_2$ per kWh.

these savings (85 MTOE) would come from structural changes, as the economy shifts away from heavy industry to more service-oriented sectors, and the rest would come from technical improvements. To achieve this target it is estimated that about US$20 billion needs to be invested in energy efficiency.

59. **Experience with energy efficiency investments in other countries shows that many projects, though financially viable, are not implemented because of the combination of the following six barriers**:

(a) **Inadequate awareness of the benefits of energy efficiency projects and their perceived high technical and financial risks.** Industry, particularly medium and large industries, may in cases perceive energy efficiency projects to be technically risky and not about commensurate financial returns, particularly when compared to the kind of financial returns expected from other investment options. Lack of familiarity with the range of energy efficiency technologies and processes, energy conservation investment best practices as well as the under-appreciation of financial benefits from energy conservation investments are primarily responsible for the high risk perception among industrial enterprises;

(b) **Insufficient capacity for evaluating renewable energy and energy efficiency projects among banks, and their perception of high financial risks of such projects.** There is a lack of adequate debt financing for such projects, primarily because banks are not familiar with such projects in Ukraine. The internal capacity for identification of such projects, their evaluation and further processing is also low as a result. In Ukraine, this is further exacerbated by the absence of financing of suitable tenor and cost – financing available in the Ukrainian market is short-term and high-cost. For industries, banks prefer new investments, or investments that raise productivity or capacity, rather than investments aimed at reducing costs or improving efficiency;

(c) **Insufficient institutional capacity for managing the regulatory framework for energy efficiency.** The capability of the regulatory arrangements to effectively implement the Government's energy efficiency policies and programs needs to be scaled up to meet the new challenges posed by the EE Law and the secondary regulations. This is a significant challenge, as witnessed in other countries that have embarked on the path to scaling up energy efficiency, and need significant capacity building support in initial years;

(d) **High transaction costs in developing renewable energy and energy efficiency investments.** The transaction cost of developing renewable energy (other than large hydro and wind) and energy efficiency investments faced by industry as well as by banks is usually high. Such costs can arise from energy audits, feasibility studies, sometimes the need to shut down processes in order to rehabilitate or replace parts. These costs are further enhanced by the lack of adequate familiarity and experience with identifying and preparing such projects both within industry as well as in banks;

(e) Another of the key limitations for wider project implementation of renewable energy and EE financing is the **lack of financial resources and proper lending facilities**, particularly for small-scale projects and SMEs. Financial institutions view renewable energy and the EE sector as higher risks, due to lack of technical capacity on the part of lenders to evaluate such projects and potential borrowers being unable to establish bankability of their projects. CTF will be instrumental in attracting the attention of the financial institutions to this new field, providing necessary know-how to help develop institutional capacity and developing a competitive market for these products;

(f) The **landlord-tenant problem** which e.g. occurs when the landlord is including the price for heat and power in the rent, thereby removing the incentive on the tenant to use these utilities in an efficient manner, and also the ability of the tenant to control usage through awareness of the meter readings. The reverse would be when the landlord provides energy-using appliances (such as a refrigerator or lighting systems), but the tenant pays the electricity bill. In this situation, there is little incentive for the landlord to choose the most energy-efficient appliance; and

(g) **Additional costs and risk premiums in the sector for buildings** include (i) project preparation/ audits; (ii) monitoring and inspection of results; (iii) knowledge sharing; and (iv) the guarantees needed by banks to enter this market.

60. **CTF investment in energy efficiency is expected to focus on two sectors, the industrial sector and residential sector – both for production and end-use measures[26].** CTF resources would be used to address the need to buy-down the cost of energy efficiency projects to address the barriers identified above.

- Emissions savings potential of the proposed interventions

61. In industrial sector, the proposed EE program would help achieving saving of 1.2 million tons of $CO_2$ emissions annually. Through transformation of the sector, 10 million tons of $CO_2$ emissions would be saved by 2030. Due to intervention in residential sector, the proposed program is expected to facilitate the saving of 2 million tons of $CO_2$ emissions annually which will translate into 20 million tons by 2030, an equivalent of 15% of additional $CO_2$ savings estimated under LCD case.

- Demonstration potential

62. The energy efficiency needs in Ukraine are estimated to exceed $1 billion per year. The Government has agreed to establish a broad-based EE Action Plan, under which the International Financial Institutions (IFI) support would fall. The Action Plan is expected to show scalability of the EE program. The IFI program would be instrumental in deepening EE interventions in the industrial sector, district heating, power and water utilities. It is also proposed that the EE program broaden its effectiveness in sectors where there is little or no support at this time: public and private buildings. The program would be designed to be replicable, particularly in the new markets and sustainable by working through commercial banks.

[26] The needs of the other sectors are modest and thus do not require additional CTF support.

- Development impact

63. Co-benefits of the proposed interventions include enhanced energy security, reduced cost of gas supply to the country as well as business and employment generation, clean air and improved competitiveness. Moreover, the project would allow extension of industrial activity with low $CO_2$ emissions as well as would facilitate growth of key sectors in a region currently suffering from supply shortages.

64. As mentioned above under the RE program, the GoU has accorded a high priority to energy efficiency to help address the problems associated with imported gas. EE has been identified as the highest priority intervention because Ukraine's energy intensity is among the highest in the world. As energy prices are adjusted over the next year, the impact would be felt on all aspects of the economy, requiring fundamental restructuring away from energy use with increased use of labor and capital in its place. Furthermore, the socio-political impact of rising energy prices need to be mitigated with energy efficiency interventions to soften the impact. Improved metering and controls in buildings would facilitate EE investments.

- Results indicators

65. The Government, in its Energy Strategy, set a target of reducing its energy intensity by 50% by 2030. The Government has agreed to complement this target with medium-term targets, possibly 25% improvement by 2020 and a 15% improvement by 2015, so that a targeted Action Plan could be developed to ground-truth these targets. The Government has agreed, as a part of this Action Plan, to establish clear accountability and responsibility for implementation, identification of legal and regulatory impediments as well as provide a program for their mitigation and the capacity-building needs to fulfill the objectives. A broad-based financing program would be developed for support from the donor community and IFIs. The implementation of this program is designed to help the Government achieve its 15% improvement in its energy intensity by 2015. The energy efficiency program is expected to decrease GHG emissions by about 3 million tons of $CO_2$ per year.

### Smart Grids

66. GoU has expressed interest in supporting the implementation of Smart Grids to support both their Renewable Energy and Energy Efficiency programs. Smart grids would be used primarily to enhance the operational capability of the power system network, leading to reduced losses and the ability to support Renewable Energy technologies, recognizing their variable operating regimes. The average technical losses in the electricity transmission and distribution system currently amount to about 15% (8% in 1990) compared to 6% in the OECD, indicating the need for refurbishment and modernization. Concerning support for renewables, one of the biggest technical problems with RE projects is the uncertainty of supply: the relative unpredictability of wind and solar regimes can create system stability issues. Smart Grids can mitigate these problems through better communications and enhanced control systems. Improved coordination betwee$_n$ supply and demand by cycling interruptible loads would decrease the need for redundant supply and decrease the effective total cost of RE. This component would consist of investments into improved communications and controls, possible integration of the power grid and the internet and upgraded "smart" meters.

67. CTF resources are proposed to be blended with the next IBRD transmission loan which would support transmission expansion and strengthening for, among other reasons, support for

RE integration into the grid. CTF resources would be used for assisting in design and implementation of the next generation of modern grid management and control systems which could enable large-scale integration of wind energy resources and improve integration of state-of-the-art demand-side measures.

- Emission savings of the proposed interventions

68. The emission savings from Smart Grids are indirect as they provide an environment that supports RE and EE. Many renewable energy options suffer from being non-dispatchable since they depend on unpredictable inputs from the sun and wind. In a system that is designed to respond to changes in milliseconds, the addition of greater uncertainty comes at a cost, either from energy storage options and/or increased use of spinning reserve to ensure system stability. Smart Grids are designed to mitigate these problems by improving the flexibility of generation and load dispatch. Better market signals of the time dependent nature of electricity use, coupled with improved dispatching of loads that can be easily cycled (such as air conditioners and heat pumps), allow increased use and flexibility in deploying RE and, thus, decrease their cost. As electric cars evolve, they are expected to become an important component of improving the flexibility of grid systems when coupled with Smart Grids. Improved time-of-use pricing and better cycling of equipment will also help support energy efficiency programs by making loads more responsive to price signals.

- Demonstration potential

69. Smart Grids are in their early stage of implementation globally. Standards are evolving regarding interoperability of equipment, with draft standards being implemented in OECD countries and a limited number of middle-income countries. As experience is gained in countries with experience in implementing state-of-the-art technology, it is expected that Smart Grids will later be applied in other middle-income and, eventually, lower income countries.

- Development impact

70. Co-benefits of the proposed interventions include downstream energy efficiency benefits that are expected to accrue as a result of improved pricing communications to consumers which, in turn, is expected to enhance benefits of cycling loads when the system stability is operating at high load and supply costs are high. Decreased emissions and improved energy reliability would also be among secondary benefits. The use of Smart Grids in Ukraine complements the renewable energy and energy efficiency programs outlined above.

- Results indicators

71. Given that Smart Grids are designed to facilitate renewable energy and energy efficiency, the ultimate test of success is in RE and EE programs. However, given that full deployment of Smart Grids is expected to take years to achieve, intermediate targets may also be used. Given the important role of dispatchability of loads to both RE and EE, a key measure of Smart Grids would be the deployment of smart meters. The impact of Smart Grids is expected to have a longer-term impact, fostering the scaling-up of RE after the 250 MW target is achieved in the CTF RE program. It is also expected to facilitate the achievement of the Government's energy efficiency targets (see para 64).

## Gas Network

72. Ukraine's gas transit system (GTS), built between 1950 and 1970, transports around 110-120 bcm or 80% of Russia's gas annually to Europe and is at the centre of the gas supply problem. It is managed by Ukrtransgaz, a subsidiary of a state energy company, Naftogaz. Due to mismanagement and a lack of investment, the GTS is in a poor condition. By 2004, 22% of the Ukrainian pipelines exceeded their originally planned life span of 33 years, and 66% were between 10 and 33 years old. This increases the risk of technical break-downs and jeopardizes the supply of Russian gas to the EU. The efficiency of the gas compressors currently in use is very low. For example, efficiency of existing Compressor Stations at Soyuz pipeline is about 24-25%, compared to the modern ones which efficiency ranges between 35-42%.

73. In 2007 a European Commission study estimated that around €2.5 billion would be needed to rehabilitate Ukraine's GTS but estimates of Ukrainian experts are even higher ranging between US$5 billion to US$10 billion. The lack of capital investments is due to combination of the financial difficulties of Naftogaz Ukrainy which has been, and remains, heavily indebted to Gazprom and risks bankruptcy. The recent financial crisis exacerbated these problems.

74. One of the key limitations for wider project implementation of GTS rehabilitation, apart from political, is the lack of financial resources. Both replacement of compressor stations and small-scale projects such as metering have suffered. Private investors and financial institutions view the Ukraine Gas sector as higher risk, due to the lack of capital investments which in turn is due to the financial difficulties of Naftogaz Ukrainy. IFIs proposed a large international initiative (about US$2 billion, see financing plan in the Appendix 2) to support GTS rehabilitation. CTF will be instrumental in jump-starting the ambitious collaborative program. Assuming US$100 million CTF support, the investment is expected to focus on upgrading gas compressor plants to higher efficiency levels. The project would also explore the possibility of using exhaust gases to produce electricity, thus reducing coal-fired power plant emissions. The project would only fund part of the gas compressor replacement needs of Ukraine but would have considerable GHG emissions reduction potential and provide transformational impacts through its replicability in Ukraine and, possibly, Russia and other major gas transit countries.

- Emission savings of the proposed interventions

75. The primary expectation of emissions savings potential comes from the increased efficiency in using state-of-the-art gas compressors which could reduce gas consumption by about 2.5 bcm per year thus reducing GHG emissions by about 5 million tons of $CO_2$ per year. This project would focus on the first 30% of the gas compressors in Ukraine, improving their efficiency from 24% to 36-37% (50% improvement).This will result in reduction of $CO_2$ emissions by roughly 1.5 million tons per year. The remaining 70% would be undertaken at a later date. The feasibility of further improvements would be explored at the time of project preparation, including the possibility of using waste heat from the gas compressors to produce electricity.

- Demonstration potential

76. In addition to the replication potential in Ukraine outlined above, the potential for replication is also particularly significant in Russia where gas compressor usage is much higher

than that of Ukraine. In addition, these investments could also be considered in countries downstream from Ukraine, as well in other energy transiting countries.

- Development impact

77. Given that current gas demand in Ukraine is about 50 bcm per year, introduction of high efficiency gas compressors to the system will save 5% of total gas consumption in Ukraine. Changing 30% of compressors, thus improving their efficiency from 24% to 36-37%, will lead to direct savings of 0.8 bcm per year. In addition to the direct impacts on energy efficiency, energy security and environmental impacts, the project would help Ukraine address its macroeconomic issues of balance of payments and budget deficit. This project is fully consistent with the Government's energy efficiency strategy as well as its program to decrease the use of Russian gas.

- Results indicators

78. The proposed project would have a significant impact on "own use" of natural gas by Naftogaz. It is proposed that gas use by compressors is monitored so that the impact of the project can be established. Should waste heat be used to produce electricity as well, the electricity output from these compressor stations would be monitored. The implementation of a full replacement of the gas compressors is expected to decrease gas use by nearly 1 BCM/year. This project is designed to meet the first 30% of this target and set the stage for the remaining 70%. In addition, should the feasibility indicate that heat exchangers be added to these gas compressor stations, it would provide an additional source of electricity production with no incremental carbon impact. The size of this impact would be determined by the feasibility study. Total GHG emissions reduced from upgrading 30% of the gas compressor stations would be about 1.5 million tons of $CO_2$ per year plus the emission reductions from electricity production.

Table 3.2 Summary of Proposed Projects' Indicators and Estimated Results

| **Project** | **Primary indicator** | **Projected $CO_2$ emissions reduction** |
|---|---|---|
| Renewable Energy (RE) | Renewable energy supply in the grid | 0.7 mln tons/year |
| Clean Power | Successful connection of the new plant to the grid | 2.5 miln tons/year |
| Energy Efficiency (EE) | 15% improvement in energy intensity by 2015 | 3 mln tons/year |
| Smart Grids | Long term impact: fostering the scale-up of RE after 250MW target is achieved | Indirect; will provide enabling environment for RE and EE. |
| Gas Network Rehabilitation | Replacement of 30% of gas compressors | 1.5 mln tons/year plus the emission reductions from electricity production |

# 4. Enabling Policy and Regulatory Environment

## Energy Sector Policy Agenda

79. **Ukraine's policy agenda focuses on addressing issues of energy security, cost of supply, supply demand imbalance, alignment with EU directives and environmental management**. This policy agenda has been supported by a series of laws and regulations introduced since 2000 to establish the enabling environment for these goals.

80. **The Ministry of Fuel and Energy (MFE) is responsible for energy sector strategy and policy formulation**. The Ministry is supported by the main national regulatory institution for the energy sector - the National Energy Regulatory Commission (NERC). The Government's policy on energy efficiency has been delegated to a specialized agency as specified in the Presidential Decree on Establishment of National Agency of Ukraine for the Effective Use of Energy Resources #1900/2005 dated December 31, 2005. The Ministry of Environmental Protection (MEP) and the National Environmental Investment Agency of Ukraine are the lead authorities on climate change policy.

81. **In March 2006, the Cabinet of Ministers approved the Energy Strategy to 2030, building on work undertaken over the previous decade**. Ukraine first developed its energy strategy in the mid-1990s – the National Energy Program of Ukraine to 2010 – which the Verkhovna Rada (Parliament) adopted in 1996. Ukraine also adopted several comprehensive state programs that outlined the government medium-term policies in various sub-sectors: Creation of a Nuclear Fuel Cycle (1994); Development of Hydrocarbon Resources in the Ukrainian Sector of the Black and Azov Seas (1996); Energy Conservation (1997); Construction of Wind Power Stations (1997); Oil and Gas of Ukraine until 2010 (2001) and Thermal Power Plant Reconstruction (2002). The Energy Strategy of Ukraine to 2030 outlines the strategic objectives for energy sub-sectors with broad objectives that:

- create favorable conditions for meeting energy demand in a sustainable way;
- determine mechanisms for the safe, reliable and stable functioning of the energy system, and for its efficient development; create favorable conditions for implementing these mechanisms;
- increase energy security;
- reduce the impact of the energy sector on the environment;
- reduce the cost per unit of energy production and use via the following measures: assuring efficient energy use, introducing energy-saving technologies, rationalizing the structure of industry and reducing the share of energy-intensive technologies;
- integrate Ukraine's energy system into the European energy system, with gradual growth of electricity exports; and
- strengthen Ukraine's position as an oil and gas transit nation.

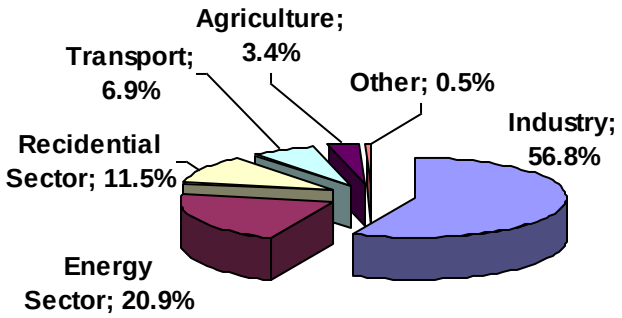
**Box 2. Gas Sector Reform Agenda**

Ukraine enjoys outstanding natural endowments and a key strategic location on the East-West gas transportation corridor. However, it has failed to take full advantage of the opportunity to exploit these assets in order to maximize their contribution to the economic development of the country. Within the context of the current financial and economic crises, the gas sector faces significant financial problems that represent a major threat to the country's economic future. External stakeholders in the sector

82. **The Energy Strategy to 2030 calls for a 50% reduction in energy intensity by 2030** which is estimated to correspond to energy savings of 223 million tons of oil equivalent (MTOE). The Government anticipates that 84 MTOE, or 38%, of these savings would come from structural changes, as the economy shifts away from heavy industry to a more service-oriented GDP (see Figure 4.1). Within industry, the government projects a particularly large decrease in some of the most energy-intensive sectors, such as ferrous metallurgy, energy, and chemicals. The proposed plan satisfactorily identifies the conceptual framework from which a targeted Action Plan would be developed to lay the groundwork for achieving the desired results.

Investments in energy efficiency in these priority sectors are now cost-effective without subsidies, and likely to become more so with increasing prices in the future.

Figure 4.1
Structure of Energy-Efficiency Potential




Source: Cabinet of Ministers, 1997

83. **The Energy Strategy confirms the following steps and targets for the development of its electricity market.** In 2006, MFE prepared the Comprehensive Strategy for Harmonization of the Ukraine Energy Sector with the EU Internal Energy Market and, based on this strategy, proposed an Action Plan for Energy Sector Reform and Development which was adopted by the Cabinet of Ministers on June 13, 2007. During the same period, NERC prepared a detailed program for the implementation of the Wholesale Electricity Market (WEM) concept and drafted the power grid code and market rules.

84. **The transition from the current pool trading arrangement to the future bilateral contract and balancing market (BCBM) will represent a major change for the Ukrainian WEM.** A gradual transition over 5 year period is planned through 4 major steps in market and system operations. The first step envisages initial learning and a small number of bilateral contracts – up to 20% of the market. The second step envisages the start of a balancing mechanism. At the third stage, self scheduling would be started through the Power Exchange (PX). At the last stage there is a full market opening and there is an end of the mandatory trading market. Market design would change fundamentally. The current administrative Single Buyer/Pool market would be replaced gradually with a more modern and competitive BCBM. This provides additional opportunities as well as risks (such as Balancing and Settlement System problems, ancillary system issues and high transaction costs) for renewable energy sources (RES) generation. The current market with its implicit instrument of priority dispatch would not be very suitable to support large volumes of RES. Once RES start to provide medium to large portions of the energy generated (like large wind farms), it would be scheduled as has been done in Spain and Austria. However, it is clear from the past operation of the Pool/Single Buyer that any investments in generation (not only RES, but all generation sources) have been restrictive. It is anticipated that the move to the bilateral contract/balancing market will provide improved investment incentives.

85. **The 1996 National Energy Strategy and the 1997 Cabinet of Ministers' Program for State Support of Non-Traditional and Renewable Energy Sources set a target to meet 10% of domestic energy demand with non-traditional and renewable energy by 2010.** A number of sectoral programs have set targets for specific renewable energy technologies but results are falling short of the target. For example, the Comprehensive Program to Build Windmills to 2010, approved by the government in 1997, has a goal of installing 190 MW of wind capacity by 2010 – only 84 MW have been installed to date. The Energy Strategy estimates that Ukraine would nearly quadruple its use of renewable energy, waste and non-conventional energy sources, from 10.9 MTOE in 2005 to 40.4 MTOE in 2030 requiring investing some UAH60 billion (US$ 12.6 billion) in the sector.

able 4.1
Projected Use of Renewable and Non-Conventional Energy Sources, Optimistic Scenario
(MTOE/year)

| | **2005** | **2010** | **2030** |
|---|---|---|---|
| **Bioenergy** | 0.91 | 1.89 | 6.44 |
| **Solar Energy** | 0.002 | 0.022 | 0.77 |
| **Small Hydropower** | 0.084 | 0.364 | 0.791 |
| **Geothermal Energy** | 0.014 | 0.056 | 0.49 |
| **Wind Energy** | 0.013 | 0.147 | 0.49 |
| **Low Potential Heat** | 0.14 | 0.21 | 15.89 |
| **Total Renewable Energy** | 1.163 | 2.689 | 24.871 |
| **Non-Conventional Energy Sources** | 9.73 | 11.2 | 15.54 |
| **TOTAL** | 10.893 | 13.889 | 40.411 |

Source: Cabinet of Ministers, 2006

## Energy Sector Legal and Regulatory Framework

86. **In December 2005, the President signed a Decree on Establishing the National Agency of Ukraine for the Effective Use of Energy Resources (NAER) whose mandate is to guide Government policy on energy efficiency.** This Agency reports to the Cabinet of Ministers. As a Government body with special status, the Agency is charged with:

- carrying out state policy in the area of energy consumption and energy conservation;
- securing an increase in the share of non-traditional and renewable energy production;
- establishing a state system to monitor energy production, consumption, exports, and imports; improving the system of registering and controlling energy consumption; and

- ensuring the functionality of the system of industrial energy consumption norms.

87. **To date, NAER has actively developed and implemented a range of EE policies**. The Agency also has broader powers; for example, it can participate in designing government tariff policies. Several other government bodies are also particularly important in implementing energy-efficiency policy. The Government created the State Inspection for Energy Conservation in 1999, reporting to NAER, to oversee compliance with energy-efficiency regulations and standards. The Inspection establishes standards for energy use in industry according to product type, and then monitors manufacturers' compliance with these standards. It also conducts technical analyses and monitors compliance with building energy codes. The Ministry of Regional Development and Ministry of Housing and Communal Services are also very active on energy-efficiency issues in district heating and buildings. Many regional governments also have energy-efficiency departments that have been quite active in promoting energy efficiency.

88. **Under an initiative by the State Committee for Energy Conservation, each regional administration established a department for energy saving.** These departments typically focus on:

- managing energy-efficiency activities at the regional and municipal levels by establishing and coordinating the corresponding departments in municipal administrations;
- monitoring energy consumption within the region;
- identifying the top priority energy efficiency measures;
- comparing actual energy consumption with the established norms;
- ensuring realization of energy-saving programs at the regional and municipal levels;
- providing information support for energy efficiency activities; and
- organizing training for local staff who deal with energy efficiency.

89. **The Law on Alternative Energy Sources, adopted in 2003, defines the legislative, economic, ecological and organizational framework for the use of renewable and non-traditional energy**. The earlier drafts of this law proposed mechanisms to provide financial, economic and regulatory support for renewable energy sources. However, following two presidential vetoes, all financial stimuli and support measures were excluded from the final text. Ukraine is in the process of establishing the required procedures and standards for development, permitting, licensing and connection of renewable energy capacity to the Ukrainian electricity grid, which it recognizes should be streamlined. Furthermore, insufficient access to adequate amounts of longer-term funding for renewable energy projects resulting from real and perceived risks is also a constraint to developing RE projects: tenors beyond the banks' current horizons are necessary for financing these types of projects.

90. **The Government has now established a "Green Tariff" to support the implementation of Renewable Energy.** At the beginning of 2006, the Verkhovna Rada approved, in the first reading, the draft law on green tariffs: a premium for power based on renewable energy resources. On 25 September, 2008, the Law "On Amendments to the Laws of Ukraine "On Electricity" and "On Alternative Sources of Energy" was approved by the Verkhovna Rada of Ukraine, removing a major obstacle to the growth of RES in Ukraine. This law is also called "*On Amendments to Some Legislative Acts of Ukraine Concerning the Introduction of a Green Tariff*" (the "**Green Tariff Law**"). Additional amendments to the Green

Tariff Law were adopted in April 2009. The green tariff now is differentiated by RE source and each one has its coefficient which is used to multiply the retail tariff, thereby establishing the green premium. The green tariff for 2009 is approximately €65-133/MWh for wind power, €427-465/MWh for solar power, €124/MWh for biomass and €77.5/MWh for small hydropower plants[27].

[27] The wide range of the green tariff is due to different costs associated with each option and capacity for each proposed installation.

# 5. Implementation Potential, including Risk Assessment

## Country Risk

91. **Ukraine's credit risk is high. Sovereign obligations in foreign currency are rated at B2 by Moody's and thus are considered speculative and are subject to high credit risk.** Macroeconomic risk is rooted in the following: (i) inappropriate implementation of fiscal and monetary responses in the context of upcoming presidential elections; (ii) worse than expected external economic environment and terms of trade deterioration; (iii) further depreciation of the exchange rate with knock-on effects for corporate and banks; and (iv) lower than expected roll-over of private sector external debt. The main mitigant to macroeconomic risk is the framework provided by the IMF program.

92. Political risks are high, due to a recent track record of instability and the upcoming presidential elections, which may delay or derail implementation of the program. However, Ukraine has proven in the past, and yet again with the recent approval of amendments on bank resolution, that it can generate consensus at critical times. While political risks to program implementation are substantial, this operation takes the view that such risks are best managed through continued active engagement and the design of a policy operation, which can serve as a focal point for critical reform steps.

Details on Macro Risks

93. **Moving forward, the most important economic risks lie in: (i) inappropriate fiscal and monetary policy responses through the adjustment process, for example, through incomplete implementation of the IMF-supported government program (and in the context to the run up to the presidential elections); (ii) the size, and duration, of current external shocks (terms of trade and external debt roll-over difficulties); and (iii) further deteriorations in corporate and banking sector balance sheets due to the impact of the economic contraction and a disorderly adjustment process.** Moreover, the macro-financial risks are inter-linked. For example, there is a tangible risk that an additional (significant) fiscal deficit (in 2009 and 2010) driven by pre-electoral policy/legislation – without equivalent corrective measures — could compromise fiscal sustainability and further weaken investors and creditors confidence, leading to a disorderly adjustment with exchange rate and roll-over rates implications in the short term as well as longer term borrowing cost effects. Further, disorderly adjustment of the exchange rate would have serious effects on sectoral balance sheet and their various feedback loops.

94. **The main risk mitigation would come from appropriate macroeconomic and structural policies and, to a large extent, from a higher level of unification and backing for those policies among government authorities (i.e., President, Prime Minister, speaker of the Parliament, and fiscal and monetary authorities) and political parties.** While implementation of adequate policies has been so far uneven, moving forward, consistent signals will need to be sent to markets. The fact that the stakes are high may reduce the risks of inappropriate policies, as key stakeholders among Ukrainian businesses and political fractions in the Government have much to lose from disorderly adjustment. Nonetheless, implementation

risks remain high even after mitigation, and policy uncertainty is significant, particularly in the context of pre-election politics.

95. **In addition, the policy framework agreed with the support of the IFIs may serve as an anchor to maintain an appropriate macro-economic framework during the time of adjustment**. The IMF SBA is based on implementing exchange rate flexibility, reining in the fiscal deficit, and, together with the Bank financed PFRDPL-I, establishing the basis for financial sector stability. The IMF-supported government program would further help to rebalance the economy if implemented thoroughly by the authorities. The EBRD and IFC have supported banks in their recapitalization effort and bilateral donors have been providing technical support to the authorities. The Bank is also preparing the DPL IV focused on structural reforms to facilitate business entry and exports, to generate fiscal space for needed investments and well-targeted programs, and to help ensure sustainability in the gas sector. These structural reforms are critical to underpin a difficult process of recovery.

## Implementation Readiness

96. **Overall implementation risk is assessed to be Moderate[28] (see Table 5.1)**

97. **Ukraine has a proven implementation record of the World Bank and EBRD financed projects in the energy sector – as well as other sectors.** The World Bank financed Hydropower Rehabilitation and System Control project which was implemented by Dniprohydroenergo, closed in June, 2002, with a satisfactory rating and is now under implementation by State Hydropower operator UkrHydroEnergo. The second Hydropower Rehabilitation Project has a highly satisfactory rating. The EBRD UKEEP energy efficiency credit line has run since 2006 and disbursed more than €150 million. In the industrial and district heating sectors, several projects have been undertaken successfully.

98. **Ukraine ranks 145 of 181 economies on the ease of doing business index (*IFC Doing Business 2009*) and 27 of 28 countries in ECA; scores on "paying taxes", "dealing with construction permits", "closing a business" and "protecting investors" lower the ranking.** The key risks relating to the proposals under this investment plan are identified in the risk matrix below.

[28] Rating of 4: High (H), Substantial (S), Moderate (M), Low (L)

Table 5.1
Risks and Mitigation

| Potential Risks | Rating after Mitigation | Description |
|---|---|---|
| Macroeconomic framework | S | Risks are substantial due to vulnerability to international liquidity problems. The high financing needs as well as current account and budget deficits will have an impact on the economic performance. Overall, Ukraine's economic outlook for 2008-09 is thus highly affected by global credit conditions. One of the main mitigation measures on the fiscal side is to link spending to revenues in view of the downside risk to growth and revenue projections.<br><br>Ukraine is expected to return to a high-growth path in the medium to long term. Energy demand, particularly electricity and gas demand, has grown since 2000 and is expected to continue to grow rapidly once the economic crisis has passed. The prospects for CTF projects to be successful are excellent in renewable electricity generation, and energy conservation, particularly electricity and gas conservation and energy efficiency because of their positive impacts on the twin deficits. |
| Country engagement with WB | L | The current Country Partnership Strategy approved in 2007 for next 3-4 years proposes a two-pillar framework of support. The first pillar will aim to improve Ukraine's competitiveness through investments in public sector infrastructure (in particular transport and energy efficiency), advisory services and advocacy work to improve the business climate, technical assistance and access to credit lines to strengthen the financial sector, and global knowledge sharing to promote innovation and technology adoption. The program is designed to also help Ukraine benefit from the framework for international carbon trading and makes a contribution to emission reductions. The second pillar will seek to improve public services by targeting greater efficiency in spending, and using improvements in public sector financial management as an entry point into public sector reforms more generally. With this CPS Bank will maintain a strong dialog on policy and program issues in Energy Sector through Energy Sector Reform & Development Program, Infrastructure Program and Carbon Finance agenda. |
| Country engagement | L | The country is very closely engaged with the EBRD on energy policy and projects, and has entered a |

| Potential Risks | Rating after Mitigation | Description |
|---|---|---|
| with EBRD | | Memorandum of Understanding on a joint Sustainable Energy Action Plan, which outlines actions to be taken by the Government to improve the framework for clean energy investment. |
| Country governance | M | Political risks include: domestic political differences, upcoming presidential elections, and tensions with Russia. |
| Systemic corruption | S | Corruption levels are higher than EU member countries but the situation is improving. Noticeable efforts to reduce corruption include legislation on public procurement which is under review at the moment, civil service ethics, and freedom of information which improved substantially through the past several years, as well as the ratification of a number of conventions related to the fight of corruption. |
| Sector policies and institutions | M | The 2009 gas crisis has reinforced the need for energy supply diversification and increased energy efficiency in Ukraine and has already led to action by the Government, including the recent Joint EU-Ukraine International Investment Conference on the Rehabilitation of Ukraine's Gas Transit System. Ukraine has made efforts to become increasingly integrated into the EU and South-Eastern European energy markets. |
| Implementing agencies | M | Local capacity to build and operate hydro and wind power facilities, and implement industrial projects including building retrofits and construction has been demonstrated. The skills of the domestic financial sector to assess and supervise RE projects through financial assessment of EE activities are emerging. The decentralized nature and smaller size of RE and EE interventions mitigate impacts on power sector performance due to possible delays or failures of individual projects. Technical assistance and external expertise will be sourced to support assessment of EE and RE opportunities, as well as Smart Grid development. Donor interest for this has been established (Chapter 6). |
| Technology | M | CTF will utilize commercially available wind, biomass, and EE technologies that have already been proven in country. CTF will also utilize technologies with a proven track record outside Ukraine, e.g. Smart Grids technologies. |
| Safeguards | M | WB/IFC/EBRD safeguards policies will apply to all interventions. UkrEnergo, Ukrhydroenergo, UkrEximBank and commercial banks working under the |

| Potential Risks | Rating after Mitigation | Description |
|---|---|---|
| | | UKEEP project are already applying these for ongoing projects |
| **Overall Rating** | **M** | |

## Private Sector Risks

99. **Financing wind energy is an important component of IFC and EBRD's commitment to addressing climate change through development finance.** Over the past years, both institutions have accumulated global experience in the direct financing of the wind sector. Wind projects currently in the IFC portfolio and pipeline are based in countries such as India, Mexico, Chile, Turkey, Estonia, Bulgaria and Ukraine. EBRD has financed such projects in Poland, Latvia, Czech Republic, Bulgaria, and Turkey. In late 2008, both IFC and EBRD financed a 156 MW greenfield AES Kavarna windfarm in Bulgaria, and in early 2009 followed this with a joint investment in a 135 MW windfarm in Turkey. The Bulgarian project, the largest in the country, will almost quadruple Bulgaria's share of electricity produced from windpower, propelling it towards the EU commitment of generating 11% of electricity from renewables by 2010. It will also influence the country's ability to attract foreign investment to its nascent renewables sector and position it as an alternative emerging market destination for private sector wind power investments. This and the Turkey investment would be used as a model for financing wind projects in Ukraine.

100. **IFC and EBRD will draw in their experience in financing hydro and biomass projects to mitigate risks of private sector projects in Ukraine.** IFC has undertaken hydro projects in Chile, Columbia, Nepal, Brazil, Albania, Pakistan, and Sri Lanka. Currently, IFC is working with a Brazilian company to finance a portfolio of small hydro plants, wind farms and biomass-fired plants; and with a bank in Sri Lanka to structure a risk sharing facility to assist the local financial sector in increasing exposure to RE projects in the region. EBRD has undertaken biomass and hydro projects in Bulgaria, Russia, Hungary, Slovakia, and Macedonia.

101. **The use of financial intermediaries to finance smaller-scale projects which would not be sufficiently large to warrant direct involvement by the institutions is a successful business model applied by both EBRD and IFC in various regions.** EBRD applies such scheme in some new EU Member States, implementing it most recently in the Western Balkans. IFC has applied successful programs in the ECA region (Hungary, Bosnia, Czech, Baltics, Slovakia, Russia, and regional schemes). The most recent examples include the Russia Sustainable Energy Finance Program to create sustainable capacity in the Russian financial sector to finance EE projects, including RE; and the Eastern Europe Renewable Energy Mezzanine Facility, aimed to catalyze financing, via local banks, for small scale hydro, wind and solar projects. The principal objective in all cases is to create a sustainable commercial lending market which will continue in the absence of IFC/EBRD credit lines. This approach can be used as a model for Ukrainian financial institutions. Electricity and heat produced using small-scale RE sources will be mostly for own consumption by SMEs; export of excess electricity to the grid will be pursued. In addition, the proposed element of a Direct Lending Facility operating with

delegated authority and managed from the local offices, would target private investors interested in financing medium-scale RE sources for sale to the grid.

## 6. Financing Plan and Instruments

102. The primary financial instruments that would be used to support the CTF Investment program for Ukraine would be loans and grants.

103. **Grant funding** would be used to advance project preparatory work for the projects and help identify and resolve potential implementation issues. The funding level that is expected amounts to US$4.25 million (see Table 6.1). US$1 million would support energy efficiency and US$250,000 would support Smart Grids; funding requirements for project preparation of the gas network, renewable as well as clean power facilities projects are equally estimated at US$1 million each, for the preparation of EIAs, feasibility studies, and other associated preparatory work. These funds would be supplemented by funding from ESMAP and PPIAF.

104. **The proposed loan program** would support five projects: Ukraine Renewable Energy Financing Facility, Clean Power Generation (CCGT-CHP), Energy Efficiency, Smart Grids and Gas Network. Ukraine seeks US$350 million of CTF financing, representing about 9% of the US$4,105 million in overall financing needs (Table 6.1). This will leverage US$2,625 million in multilateral support and US$750 million from the Government of Ukraine, and US$380 from the private sector.

Table 6.1
Proposed Loan Program, Stage 1 (million US$)

| **Program** | **Ukraine Counterpart** | **MDBs** | | | | **Private Sector** | **CTF** | | | **Total** | **CTF Grant Funds** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stage 1** | | EBRD | IBRD | IFC | Other | | EBRD | IBRD | IFC | | |
| Ukraine Renewable Energy Financing Facility | | 250 | | 50 | | 30 | 50 | | 25 | **405** | 1 |
| Clean Power Generation | | 100 | | | 75 | 225 | 50 | | | **450** | 1 |
| Energy Efficiency | 250 | 75 | 250 | 25 | | 125 | | 50 | 25 | **800** | 1 |
| Smart Grids | 100 | | 300 | | | | | 50 | | **450** | 0.25 |
| Gas Network | 400 | 750 | 750 | | | | 50 | 50 | | **2000** | 1 |
| **Total Stage 1** | **750** | **1175** | **1300** | **75** | **75** | **380** | **150** | **150** | **50** | **4105** | **4.25** |
| | | **2625** | | | | | **350** | | | | |

105. In addition, carbon financing options may be pursued for Renewable Energy and Energy Efficiency projects should such financing be needed to overcome financing hurdles.

# Annex 1

## The Energy Sector

**Ukraine is a net importer of energy resources with imports representing 62% of primary energy needs (2004)**. In 2005, the shares of domestically produced fuels among supplied fuels were as follows:

- 26.8% of natural gas supply;
- 22.6% of oil supply; and
- 88.1% of coal supply.

***Coal industry***. Total coal reserves of Ukraine are estimated at 117 billion tons, including confirmed reserves of 56.7 billion tons, of which 39.3 billion tons are steam coal reserves. In 2005 the coal industry in Ukraine operated 167 underground and 3 open-cast mines. Difficult geological mining conditions as well as reduced demand resulted in a reduction of coal production from 136 million tons in 1991 to 71 million tons in 1996. Since then Ukraine managed to first stabilize and then slightly increase coal production at about 80 million tons per year. Stabilization of coal production at this level was achieved due to structural reforms in the coal industry, technical retrofits increasing competitiveness of mines, and re-emerging demand due to economic growth, in particular in the steel industry.

The ***Oil and Gas industry*** is of considerable economic importance in Ukraine. The state-owned oil and gas company Naftogaz accounts for almost 13% of GDP, employing 1% of the country's workforce. Ukraine produces 20 billion $m^3$ of natural gas per year, while annual consumption of natural gas is 76 billion $m^3$. Oil production is 4 billion tons per year. Ukraine has important oil and gas transport systems, which not only supply Ukrainian needs but also play a critical role in carrying oil and gas to Central and Eastern Europe. Gas and oil transit to Europe in the recent years has been 110-120 billion $m^3$ and 32-33 million tons per annum, respectively, thus becoming an important source of revenue.

Ukraine's natural gas transportation system is the second largest in Europe. It includes almost 38,000 km of pipelines, 13 underground natural gas storage facilities, and a well-developed system of distribution stations. The system's annual input capacity totals 290 billion $m^3$, while the output capacity stands at 175 billion $m^3$ annually including 140 billion $m^3$ into central and eastern European countries.

**Renewable Energy** supply, other than large hydro, is relatively small in Ukraine, despite a good resource base. The primary problems in increasing the use of renewables relates to a weak support framework as well as relatively high costs compared to thermal power options. Recent changes to the legal framework have made it likely that the supply will now increase from its current low levels.

## Sectoral Overview

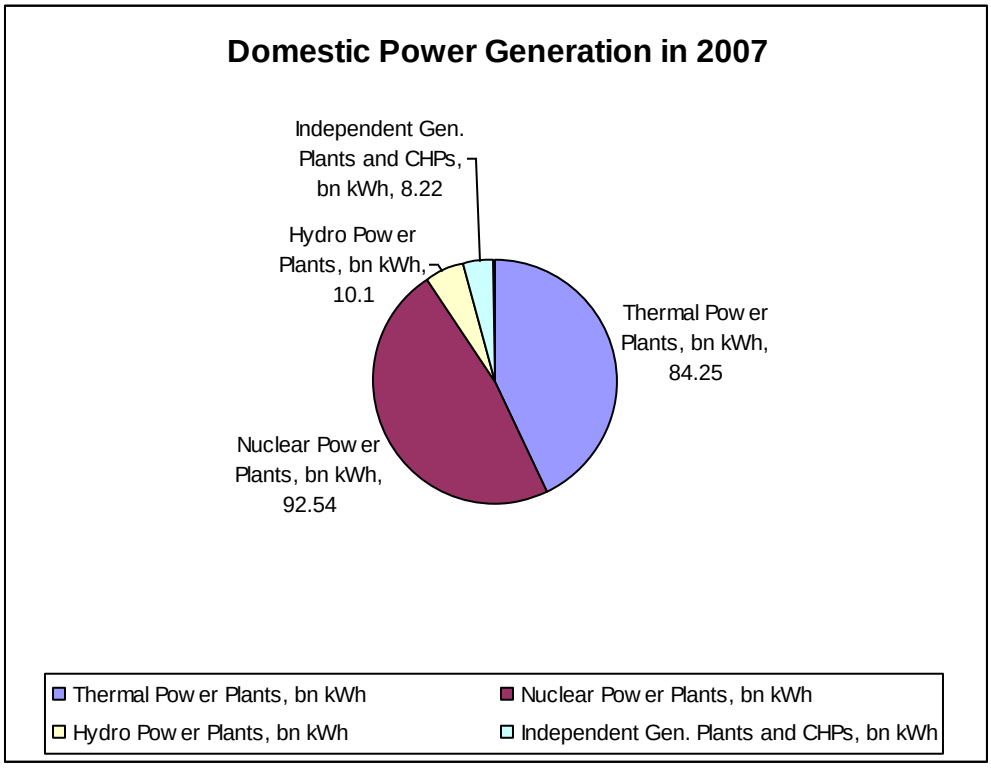
***The Power Sector*** of Ukraine comprises of 14 large thermal power plants (TPPs), 8 large hydropower plants (HPPs) and 4 nuclear power plants (NPPs). As of 2005, total installed capacity was 52 GW of which:

- 57.8% TPPs;
- 26.6% NPPs;
- 9.1% HPPs and pumped storage; and
- 6.5% isolated generating plants (IGPs), combined heat and power plants (CHPs) and other sources.

In terms of generating output, in 2005 the power plants of Ukraine delivered 185 TWh, comprising:

- 40.8% TPPs and CHPs – 75.5 TWh;
- 6.6% HPPs and pumped storage – 12.3 TWh;
- 47.9% NPPs – 88.8 TWh;
- 4.6% IGPs and communal CHPs – 8.6 TWh.

Figure A1.1




Source: Statistics of the Ministry of Fuel and Energy of Ukraine

## Power Market Ownership and Plant Status

The thermal power generation industry consists of 5 generation companies, 4 of which are publicly owned, while one is private. TPPs include a total of 102 power units with a capacity ranging 150-800 MW. Much of the TPP equipment is operating well beyond its normal life-time and urgently requires rehabilitation or replacement. Financing in this area is inadequate, resulting in low reliability and high fuel consumption.

***The Heat Supply System*** in Ukraine is largely based on district heating-utilizing heat-only boilers, with some larger CHP supplying both industrial and residential systems. Currently there are about 250 CHPs under operation. As is the case for power plants, most of the CHPs are outdated, do not meet environmental standards, and thus require urgent retrofitting and modernization. The fuel used in CHP units is as follows:

- 76-80% natural gas;
- 15-18% oil; and
- 5-6% coal.

In addition to CHPs, the heat supply system includes about 100,000 boilers of different specification. The vast majority of these boilers are small industrial or autonomous boilers. Fuel consumption of these boiler houses is:

- 52 – 58% natural gas;
- 12-15% oil;
- 27-36% coal.

Biomass is now emerging as a new source for heating plants, and the first projects are currently reaching financial closure.

# Annex 2

## Program Overview

**Energy Production**

1. EBRD/IFC Ukraine Renewable Energy Finance Facility including:
   - Small Hydropower and Wind projects through credit line or delegated lending facilities
   - Biomass projects financing mechanism through credit line or delegated lending facilities
   - 100 MW Wind Power Project in Crimea

2. EBRD Clean Power Generation
   - Large-scale CCGT Cogeneration Project

**Energy Efficiency**

3. IBRD/IFC Energy Efficiency Program Focusing on Buildings and District Heating

**Support for Renewable Energy and Energy Efficiency**

4. IBRD Smart Grids

**Gas Network**

5. IBRD/EBRD Gas Network Rehabilitation

## 1. Renewable Energy Program (EBRD and IFC)

**Problem Statement**

Although Ukraine has significant potential renewable energy resources, ranging from wind and small hydro sectors to geothermal and biomass, the market for renewable energy and related products and services remains small. Ukraine lacks a clear, long-term, transparent mechanism to develop renewable energy resources, combined with the required procedures and standards for development, permitting, licensing and connection of renewable energy capacity to the Ukrainian electricity grid.

Ukraine has significant RE potential, especially in wind, small hydro and biomass. However, most of this potential remains untapped. The country's RE today is concentrated in large hydro power (75% of total) and biomass-fired heating boilers and stoves. There are also several wind power plants and geothermal heating systems. Currently, RE accounts for only 2.8% of total primary energy supply. The development of renewable energy in the country is not only a priority due to the greenhouse gas reductions which could be realized but also to improve security of supply which has become an increasing concern in Ukraine following the gas crises of January 2006 and 2008.

Under the proposed project, CTF would make funds available to reduce risk and overall cost of investing in renewable energy technologies, which are not currently commercially viable in Ukraine. In particular, IFC and EBRD will seek to provide direct financing to large-scale private sector RE development projects (e.g. windfarms). With respect to smaller-scale projects, especially in the small hydro and biomass sectors, IFC and EBRD will work on mainstreaming funding through financial intermediaries. IFC and EBRD will also seek to provide direct financing to medium-sized project under the newly promoted scheme of a Direct Lending Facility.

**Proposed Transformation**

The Ukrainian government projects significant growth of RE market: Ukraine's "Energy Strategy up to 2030", adopted in 2006, estimates the annual technical potential of renewable and non-conventional energy sources (RES) at about 79 million tons of coal equivalent (MTCE), which translates into RES consumption of 18.3 MTCE by 2030 (6% of total energy consumption). Other estimates put the share of RES at 16.5% of total energy consumption, or 39.2 MTCE, by 2030. The Renewable Energy Agency estimates that annual RE use can grow to about 100 TWh by 2030 and over 200 TWh by 2050, allowing Ukraine to substitute 22 MTCE/year of fossil and nuclear energy in 2030 (7.3% of total energy supply) and up to 42 MTCE/year by 2050.

The main focus of the proposition is to provide funding for both large/mid-scale and small-scale RE projects in order to deliver measurable economic, environmental and social benefits. By doing so, a number of barriers to the development of renewable energy could be addressed by providing CTF financing to this emerging sector. These include:

*Business skills and information*

- There is uncertainty and lack of information about available options, best practice and related financial reward. A portfolio of projects demonstrating technologies and best practice could address this.
- Renewable energy investments are varied in scope and sector, and are difficult to appraise and finance. The establishment of a credit line through local banks could create an effective financing mechanism with good technical support. Technical assistance is required to ensure the pursuit of good lending opportunities that are well assessed.
- Trade and investment promotion has been fragmented in the past by the type of technology being offered (e.g., PV cells or wind turbines). Potential purchasers lack the opportunity to gain an overview of all renewable energy options available. Establishing successful projects would overcome this information gap.
- Few energy-intensive companies consider renewable energy resources as a tool for reducing energy consumption from fossil fuels, even in areas where wind or solar potential is favorable.
- There is also potential, as a follow-on, to explore related schemes to monetize greenhouse gas emission reductions to replace CTF concessional financing, but local capacity to develop such projects is low.

*Finance*

- As a result of lack of experience and uncertainties, renewable energy projects incur additional costs in appraisal, due diligence, and monitoring, making them less attractive to banks. CTF concessional financing can address this.
- There is insufficient access to adequate amounts of longer-term funding for renewable energy projects resulting from real and perceived risks: borrowers' tenors beyond the banks' current horizons are necessary for financing these types of projects. CTF concessional financing in a subordinated role can address this.
- There is no specific marketing for financing renewable projects in the banking sector. The establishment of the facilities will build up this expertise.
- Local banks have limited access to technical expertise for appraisal. There is limited information about various renewable energy resources, and misconceptions exist about their technical risks and financial benefits. Co-financing of the CTF facility could provide this expertise.

Financing wind energy is an important component of IFC and EBRD's commitment to addressing climate change. Over the past years, both institutions have accumulated global experience in direct financing of the wind sector. Wind projects currently in IFC's and EBRD's portfolio and pipeline include India, Latvia, Czech Republic, Chile, Mexico, Turkey, Poland, Estonia and Bulgaria. Most recently, in late 2008, both IFC and EBRD financed a 156 MW greenfield AES Kavarna windfarm in Bulgaria. This project, the largest in the country, will almost quadruple Bulgaria's share of electricity produced from windpower, propelling it towards the EU commitment of generating 11% of electricity from renewables by 2010. It will also influence the country's ability to attract foreign investment to its renewables sector and position it as an alternative emerging market destination for private sector wind power investments. This investment can be used as a model for financing wind projects in Ukraine.

**Implementation Readiness**

EBRD is already active in addressing this through a technical assistance program to assist the GoU in preparing legislation to support renewable energy. Following extensive stakeholder consultations, the first phase was completed in September 2008 with a set of recommendations for the basic structure of legislative framework and required implementation steps. Since September 2008, Rada has passed new primary legislation setting the basis for a regulatory support framework for renewables. Following further enhancements introduced in April 2009, the basic framework now provides for a supportive feed-in tariff up to 2030 based on multiples of the retail electricity price (with different multiples for different renewable technologies). Work is now focused on preparing the enabling legislation of the necessary orders and procedures covering issues such as grid connection and tariff setting. While there is strong support for establishing a comprehensive support framework for renewable energy in Ukraine, this will inevitably take some time and concrete results will probably take at least another 12 to 18 months to be realized. The EBRD is supporting this process through the second phase of its technical assistance program which provides for advisory services to the National Electricity Regulatory Commission in order to develop and implement the secondary legislation for renewables. This assignment commented in April 2009 and will last until the end of the year.

Use of financial intermediaries is a successful business model applied by both EBRD and IFC in various regions. EBRD applies such scheme in some new EU Member States, implementing it most recently in the Western Balkans. IFC has applied successful programs in the ECA region (Hungary, Bosnia, Czech Republic, Baltics, Slovakia, Russia, and regional schemes). Most recent examples include Russia Sustainable Energy Finance Program to create sustainable capacity in the Russian financial sector to finance EE projects, including RE; and Eastern Europe Renewable Energy Mezzanine Facility, to catalyze financing, via local banks, for small scale hydro, wind and solar projects. The principal objective in all cases is to create a sustainable commercial lending market which will continue in the absence of IFC/EBRD credit lines. This approach can be used as a model for Ukrainian financial institutions. Electricity and heat produced using small-scale RE sources will be mostly for own consumption by SMEs and export of excess electricity to the grid. In addition, the Direct Lending Facility would target private investors interested in financing medium-scale RE sources for sale to the grid.

This project will also build on work focusing on "Implementation of the Concept of the Wholesale Electricity Market of Ukraine" supported by the World Bank[29]. This provides for development during 2007-2008 of the comprehensive legal framework of the new model of the electricity market of Ukraine in accordance to the Concept of Operation and Development of the Wholesale Electricity Market of Ukraine approved by the Resolution of the Cabinet of Ministers of Ukraine No. 1789 of 16.11.2002. That includes the preparation of the Balancing and Settlement Code, Grid Code, Distribution Network Code, and Procurement Rules for Ancillary Services. These documents will reflect the provisions related to particular characteristics of operation of electricity generators using renewable and alternative energy sources.

**Rationale for CTF Financing**

One of the key limitations for wider project implementation of RE financing is the lack of financial resources, both direct funding for larger projects and lending facilities for small-scale

[29] Loan Agreement between Ukraine and the World Bank under the hydro power rehabilitation project No. 4795–UA

projects. Private investors and financial institutions view the RE sector as higher risk, due to lack of technical capacity on the part of lenders to evaluate such projects and potential borrowers being unable to establish bankability of their projects. CTF will be instrumental in attracting the attention of the financial institutions to this new field and developing a competitive market for these products.

CTF can be used as a tool to justify the difference between a short-term quick fix and the long-term effective solution for the companies considering the RE investments in Ukraine. CTF can have an impact on their evaluation and encourage them to go for the highest impact opportunities rather than temporary solutions.

While there have been isolated initiatives to promote renewable energy in Ukraine over the past 15 years, energy policy discussion in Ukraine has been dominated largely by the issues of energy efficiency, transit pipelines, and nuclear safety. Renewable energy resources have traditionally meant large hydroelectric facilities, which generate approximately 10% of power but have no potential for expansion. Recently, discussions of pricing reform and steps towards integrating the Ukrainian grid into the European grid have set the stage for more sustained and comprehensive attention to renewable energy resources.

The proposed project will address policy, finance, business, and information barriers to renewable energy market developments in Ukraine resulting in approximately 16 million tons of $CO_2$ equivalent avoided from ca. 80 MW generated from medium-sized renewable sources and 100 MW of large-scale wind power capacity over the life-time of the projects, and significant post-project emission reductions resulting from the adoption and enforcement of supportive policy and regulatory frameworks developed as a component of the project. Because Ukraine is such a large power producer (upwards of 192 TWh annually, with exports of more than 10 TWh), increasing the share of energy from renewable resources could have a significant impact on offsetting greenhouse gas emissions.

**Sub-Facility Description**

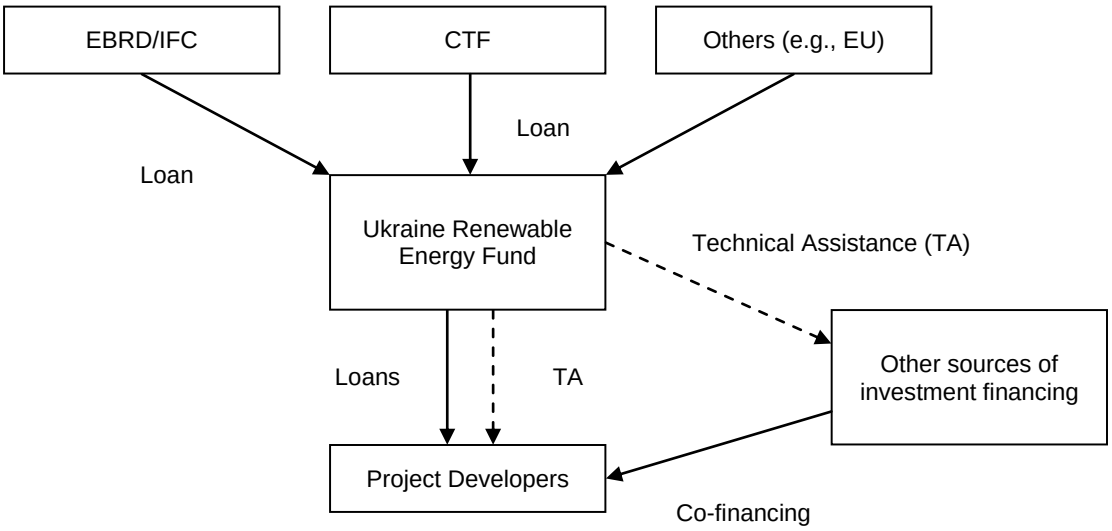
*a. Credit Line for Small-Scale Renewables*

The proposed CTF project is designed to reduce greenhouse gas emissions in Ukraine by supporting the introduction of renewable technologies in the framework of the established UKEEP intermediated finance facility.

UKEEP is a credit facility developed by EBRD and targeting Ukrainian private companies in all sectors looking to invest in energy efficiency or renewable energy projects. EBRD has already dedicated US$150 million to the UKEEP facility for various energy efficiency and renewable energy projects. There are no exact limits on project size, although a typical loan size will range somewhere between US$2-5 million. For larger investments, companies can complement this facility with other forms of financing, e.g. own funds and other commercial credits. Smaller investments may also be eligible.

*b. Delegated Lending Facility for Medium-size RE projects*

The focus of the facility will be on kick-starting the medium-size renewables market through establishment of a dedicated Renewable Energy Fund, capitalized by the EBRD, IFC, CTF, and other sources. The fund will be a source of loans to project developers, and will be supported by technical assistance throughout the supply chain to develop a flow of bankable projects. A possible schematic of the operation of the Ukraine Renewable Energy Fund is shown below. It is planned that up to US$75 million of CTF funding will go towards loans, depending on the market assessment and needs. Other funding – for example from the EU – will be secured to support both loan and TA components:




The EBRD has already initiated a technical assistance program to support development work, which will minimize implementation risks and will aim to provide a regulatory and legal framework for grid-connect renewables.

*c. Large-scale wind energy*

The Project comprises two sites in east and west Crimea. The western site will ultimately have total installed capacity of approximately 214 MW from 102 turbines and will require the construction of a 330kV transmission line to the main grid via the existing interconnection station, which will be partially rehabilitated as part of the Project. The eastern site will ultimately have total installed capacity of 105 MW from 50 turbines and will be connected to the main grid by a 7 km 220kV transmission line via the existing interconnection station which will be partially rehabilitated as part of the Project. The CTF financing would support the establishment of the first phase of the project, with up to 100 MW installed in total.

**Financing Plan for Ukraine Renewable Energy Financing Facility**

It is expected that major share of financing will become available from the EBRD credit line, IFC direct loans, and CTF concessional financing. Other funding sources will be explored before project submission to the CTF, such as carbon financing. Additionally, technical assistance and project preparation grants from other donors will also be separately identified by the time of submission to the CTF committee.

The table below shows tentative financial arrangement for financing renewable energy program.

<table>
<tr><th>EBRD</th><th>IFC</th><th>Private Sector</th><th colspan="2">CTF</th><th>Total RE financing package</th></tr>
<tr><td>62%</td><td>12%</td><td>7%</td><td colspan="2">19%</td><td>100%</td></tr>
<tr><td rowspan="3">USD 250 M</td><td rowspan="3">USD 50 M</td><td rowspan="3">USD 30 M</td><td colspan="2">USD 75 M</td><td rowspan="3">USD 405 M</td></tr>
<tr><td>EBRD</td><td>IFC</td></tr>
<tr><td>USD 50 M</td><td>USD 25 M</td></tr>
</table>

**Project Preparation Timetable**

| Activity | Date |
|---|---|
| Identification Mission / Investment Plan | April 6-10 2009 |
| ROC on CTF Investment Plan | September 2009 |
| Concept Note | September 2009 |
| Proposal Submission to CTF | October 2009 |
| Project Preparation | January – April 2010 |
| Appraisal and Negotiations | May – June 2010 |
| Board Approval | July 2010 |
| Implementation | August 2010 – December 2013 |

## 2. CCGT Cogeneration Project (EBRD)

**Problem Statement**
Power generation in Ukraine is dominated by low-efficiency coal and nuclear power. Modern, high-efficiency gas-fired power generation has until now not been added to the Ukrainian power mix for reasons of unfamiliarity with the technology, and lack of capital on the part of power generators. At the same time, heat production is primarily gas based, but carried out in heat-only boilers.

**Proposed Transformation**
The commissioning of a modern 450 MW Combined Cycle Combined Heat and Power (CHP) Power Plant will substitute electricity currently received from the grid, thus reducing $CO_2$ emissions. The plant will be based on modern Mitsubishi Turbines providing an electrical efficiency of 58%. It will be the first plant of this type in Ukraine, and will considerably improve the efficiency of power and heat generation for industrial processes in the region. By demonstrating the economic benefits of this form of power and heat production, the operator will gain competitive advantages in the industry, which will put pressure on other players to follow suit in improving the efficiency of power and heat supply to their operations.

Furthermore, the plant will add to the available generation in a region that is currently short of electricity, thereby allowing industrial growth to proceed on the basis of a highly-efficient and clean energy supply. This will materially contribute to the Ukrainian government's long term plans for carbon-neutral growth.

**Implementation Readiness**
The project sponsor is a large metallurgy-sector company interested in investing in high-capacity on-site generation of power and heat, with the local city becoming a heat customer of the plant as well. The client is experienced in handling large-scale projects.

**Rationale for CTF financing**
Without an element of concessional finance, the risk of introducing this kind of new technology into Ukraine, most importantly of providing for the highly-efficient heat off-take, would not be taken by the project sponsor. Providing for heat use would be a condition of CTF financing.

**Financing Plan**
Total project cost is around US$450 million. The client expects to provide around 50% equity and requests the EBRD to consider providing up around US$100 million loan. The Project would be implemented via a special purpose vehicle structure, with a potential off-take commitment from a Swiss headquartered resources company with assets in Ukraine as well as some other guaranteed required by the Bank.

| EBRD | Other Co-Lender (JEIC is potentially interested) | Project Sponsor | CTF | Total Financing Package |
|---|---|---|---|---|
| 22% | 17% | 50% | 11% | 100% |
| USD 100 M | USD 75 M | USD 225 M | USD 50 M | USD 450 M |

**Project Preparation Timetable**

| Activity | Date |
|---|---|
| Identification Mission / Investment Plan | April 6-10 2009 |
| ROC on CTF Investment Plan | September 2009 |
| Concept Note | October 2009 |
| Proposal Submission to CTF | November 2009 |
| Project Preparation | November 2009 – March 2010 |
| Appraisal and Negotiations | April – May 2010 |
| Board Approval | June 2010 |
| Implementation | June 2010 to June 2013 |

## 3. Improving Energy Efficiency (IBRD/IFC)

**Problem Statement**

Improving energy efficiency (EE) has been a long-standing problem for Ukraine – a legacy from the period of the former Soviet Union. After the collapse of the Soviet Union, Ukrainian domestic production dropped substantially, causing a decline in energy consumption. However, production output fell at a slower rate in the export-oriented and energy- intensive sectors. As a result, in 1991-95, Ukrainian energy intensity grew by 30%. Energy intensity stabilized from 1996-99, as the economic decline slowed and energy consumption continued to decrease. From 1990-97, electricity and fuel prices rose 40-85% faster than inflation, which tripled the share of energy in total production cost and provided stronger incentives for the private sector to consume energy more efficiently. Not surprisingly, manufacturers began to introduce new technologies. At the same time, the service sector expanded. Since 2000, Ukraine has experienced substantial economic growth while energy consumption has remained relatively stable. In 2000-04, energy intensity in Ukraine dropped by 22%, averaging an improvement of 6.1% per year. However, despite recent improvements, Ukraine remains one of the most energy-intensive countries in Europe. For example, energy use per unit of purchasing power parity adjusted GDP exceeds German figures by a factor of 4 (0.5 kg of oil equivalent in Ukraine vs. 0.125 kg in Germany). The only countries with more energy intensive economies are the oil producers of the Middle East. [30]

Therefore, the challenge is to accelerate the trend of declining energy intensity. The industrial sector is critical for energy efficiency improvements in Ukraine because of its dominance in energy consumption (44 per cent of total final energy) and energy saving potential (estimated by IEA to be 57% of the total energy efficiency potential). Ukraine's industries are among the least energy efficient in the world. As of 2005, about 40% of Ukraine's steel production came from open hearth furnaces, a highly wasteful steel-making technology phased out long ago by all major steel producing countries, except Ukraine and Russia. Tight supply of liquidity in the domestic financial sector means that many urgent industrial energy efficiency needs will not be met in the short to medium term.

As the cost of electricity and gas rises, customers in Ukraine face steadily increasing energy bills for heating and lighting public facilities. The problem is exacerbated because most buildings, Government-owned as well as municipal and mixed ownership, are very inefficient, as much as five times less efficient as the norm in Western Europe. The buildings lack control systems to regulate heat, boilers are old and inefficient, and the building envelopes are poorly insulated. As well as costing a great deal to heat, these buildings provide an uncomfortable environment and may be impossible to keep at a reasonable temperature in the winter. Heat losses from inefficient design are exacerbated by the long heating season. Severe funding shortages over a prolonged period of time have created a housing stock that is energy inefficient and deteriorating at an alarming pace. If adequate action is not taken soon, a significant part of this housing may deteriorate beyond repair and create unacceptable housing conditions. This is a particular problem for vulnerable groups such as the elderly, sick or very young, all of which rely on public institutions to care for them. Unlike electricity, heating costs of the poor are higher than for the

[30] *Ukraine. Energy Policy Review 2006*. Paris: International Energy Agency, 2006; WDI, 2009

wealthy as they are not in a position to upgrade their building envelope. Hence, subsidies for this target group are needed.

District heating (DH) networks in the former Soviet Union were designed for a substantially different market than is the case today. Much of the demand collapsed during the 1990s with only limited recovery post-2000. The collapse in demand was further exacerbated by low prices that enabled only limited replacement and upgrading to the DH networks. As a result, DH networks are over-sized and inefficient with losses well above the norms in the west. In addition, many of the Combined Heat and Power (CHP) plants are old, using outdated technologies. Outdated technologies as well as poor EE negatively affect the levels of GHG emissions in Ukraine.

**Proposed Transformation**

The Program is designed to improve energy efficiency in Ukraine by financing a broad-based EE program that implements the Government's ambitious target to reduce energy intensity of the economy by 50% by 2030. It would include the following components: (1) the reconstruction and refurbishment of municipal & mixed ownership housing stock in order to improve their energy efficiency; (2) upgrading Government-owned buildings such as schools, kindergartens and hospitals; (3) decreasing losses in district heating supply; and (4) support for energy efficiency in industry. In industrial sector, the proposed EE program would help achieving saving of **1.2 million tons of $CO_2$ emissions annually**. Through transformation of the sector, **10 million tons of $CO_2$ emissions would be saved by 2030**. Due to intervention in residential sector, the proposed program is expected to facilitate the saving of **2 million tons of $CO_2$ emissions annually** which will translate into **20 million tons by 2030**, an equivalent of 15% of additional $CO_2$ savings estimated under LCD case.

Based on current operating conditions and the proposed performance of the buildings in the project, the refurbishment of the housing stock within the context of the project would generate an emission reduction of around 30% relative to the situation at the start of the project. Expanding credit support of international financial institutions to industrial energy efficiency investments could help Ukraine reap substantially larger energy-savings benefits in much shorter time than what currently available capital could achieve. However, the EE program would be designed to use CTF resources to expand into markets where commercial financing needs to buy down the costs. The proposed program would be transformational because it would approach the market for public and municipal residential housing at a point where the entire market can develop a lower "carbon trajectory" than it would otherwise, avoiding substantial emissions for a long period in the future. In particular, the program would support the reforms needed, piloting examples and providing institutional capacity building support for commercial banks and ESCOs.

Based on experience of investments from other similar investments in industries and building upgrades an investment of US$150 million may be expected to generate energy savings of 10,500 GWh per year with emission reductions of up to 2.4 million tons of $CO_2$ annually. Detailed estimations of cost effectiveness (and emission reductions per $ spent) will we determined during project preparation.

The project would focus on selected regions and municipalities, and professional organizations to disseminate policies and practices that result in improved buildings efficiency. The regions would be selected based on existing activities projects under development in Ukraine, along with the need/potential for energy saving and replication. By working in conjunction with the EBRD loan that supports the development of a municipal housing authority, the project would strengthen the ability of the participating cities and additional subsequent partners to address both social and environmental issues related to housing.

**Implementation Readiness**

The first steps toward implementation readiness have started to take place as a part of the dialogue with the IMF and World Bank reform program. Gas prices are expected to be adjusted to reflect cost of supply, as well as the impacts on district heating and electricity prices. These reforms alone will create a considerable incentive for changes in attitude to energy efficiency, some of which are already visible. The Government has drafted an Energy Efficiency Law that will help establish the legal framework. Secondary legislation and related regulations are also being drafted with support from donors. Among these regulations will be standards that will apply to appliances and equipment addressing energy efficiency requirements.

An "Association of Energy Efficient Cities" has been established in Ukraine to share lessons learned, drawing largely from EU Directives and practices on energy efficiency. Lviv has taken the lead in implementing this program, having implemented the EU Directive on building energy efficiency through the Certificate Program. Building energy use in Lviv has been estimated and certificates placed on buildings so that people are aware of this characteristic. The program is now being implemented in two more cities and will follow in the remaining seven in the near-term. This program has elicited the public response hoped for as people are now seeking energy efficiency investments as they realize that many buildings are about five times less efficient than buildings in Western Europe. The CTF program would help in implementing the next steps towards improving the existing housing stock.

IFC recently finalized a feasibility study on residential energy efficiency in Ukraine that focused on common area renovations for those multi-unit apartment buildings that are managed by condominium associations (CA). Many of them need to renovate the common areas but cannot do this as CAs are unable to borrow from banks, banks do not know much about CAs, and other related barriers. IFC and EBRD are interested in this particular segment of residential EE sector and will be developing, based on the feasibility study and on a request from the GoU, a technical assistance program to address the legislative/regulatory framework first. IFC is expected to focus on deepening market penetration in the residential sector.

**Rationale for CTF Financing**

Investments in energy efficiency can be financed entirely on the basis of the saved energy, and capital costs can be typically recovered in 5-10 years. Lessons learned from EE lending elsewhere has shown that, despite attractive returns, market penetration has been limited due to barriers. Experience has shown that subsidies are required to overcome these barriers. Furthermore, EE investments are income skewed: high income households adopt these investments while lower income households do not.

Furthermore, the recent economic crisis made investments in improving energy efficiency in industries difficult because of the financial sector constraints. Energy efficiency is not of the highest priority for industries that were looking at rapidly evolving markets. Despite the urgent need for substantial levels of rehabilitation in the residential and public buildings sector, very little progress has been made because central and local governments lack the funds to support a significant renovation program. Local authorities, residents themselves and local banks lack the capacity to finance these measures entirely from their own resources.

It is expected that the primary modality for energy efficiency support would be through commercial banks, drawing on lessons learned from successes in other countries. Using commercial banks has helped ensure that projects are developed on a commercial basis and that the program is sustainable. EBRD and the World Bank have experience working with the banking sector in Ukraine that can be built upon. However, it is expected that CTF resources will also be needed to help banks transition into energy efficiency markets that they are reluctant to enter for a variety of reasons. The possibility of using CTF resources as a guarantee mechanism to facilitate entry into these markets – in particular for public and private buildings -- will also be explored.

**Financing Plan**

It is expected that major share of financing will become available from the World Bank, EBRD, IFC and CTF concessional financing. Other funding sources will be explored before project submission to the CTF, such as carbon financing. Additionally, technical assistance and project preparation grants from other donors will also be separately identified by the time of submission to the CTF committee. In particular, US$1 million of CTF grant funds is expected to finance the project preparatory work.

Additionally, through parallel technical assistance funding, the project would provide support to analyze and disseminate techniques of integrated municipal energy planning, housing planning, and approaches to integrated housing reconstruction programs in Ukraine, and provide the basis for legal frameworks to be applied within the context of the proposed Facility. It would provide capacity building based on practical experience on how municipalities can handle large-scale reconstruction of housing stock – including engagement of private sector developers – in a transparent and efficient manner. The project would provide training in best practices in code enforcement and innovations in building codes such as performance incentives for high-efficiency buildings and build capacity among ESCOs.

The table below shows tentative financial arrangement for financing energy efficiency program.

| **IBRD EE Credit Line** | **EBRD Ukraine Buildings EE Financing Facility** | **IFC** | **CTF** | **Private Sector** | **Ukrainian Counterpart** | **Total Ukraine Energy Efficiency Program** |
|---|---|---|---|---|---|---|
| 31% | 9.5% | 3% | 9.5% | 16% | 31% | 100% |
| USD 250 M | USD 75 M | USD 25 M | USD 75 M | USD 125 M | USD 250 | USD 800 M |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **IBRD** | **IFC** | | | |
| | | | USD 50 M | USD 25 M | | | |

**Project Preparation Timetable**

| Activity | Date |
|---|---|
| Identification Mission / Investment Plan | July, 2009 |
| ROC on CTF Investment Plan | September 2009 |
| Concept Note | September 2009 |
| Proposal Submission to CTF | March 2010 |
| Project Preparation | October 2009 – January 2010 |
| Appraisal and Negotiations | February – May 2010 |
| Board Approval | June/July 2010 |
| Implementation | September 2010 – September 2014 |

## 4. Smart Grids

**Problem Statement**

Electricity demand in Ukraine is expected to return to its rapid rate of increase in the post-2000 period (at about 7-8% per year) after the financial crisis has passed. The transmission and distribution system is witnessing increased strain because of the aging of the assets. Transmission lines were not designed to meet the needs of an economic structure that has changed considerably and is increasingly looking to meet The Union for the Coordination of Transmission of Electricity (UCTE)[31] standards.

At the same time, the Government's strategy calls for rapidly increasing the role of Renewable Energy – this capacity would offset the need for new coal fired power plants. This scale of RE development would create challenges to the power system, in terms of required grid connections, transmission system reinforcement and grid management of large-scale intermittent generation (due to the inevitable variations in wind power generation). Furthermore, as the economy restructures toward one which is more service-based, electricity reliability becomes an increasingly important issue. Similar issues are challenging utilities in Europe and the USA, and significant research is currently ongoing on suitable power grid system controls to ensure efficient integration of intermittent wind generation. In this situation, incremental transmission and distribution investments are essential for system efficiency, reliability, and security.

In addition, Ukraine is planning on moving its electricity system to one which is more market based. The design of the supply-side of the market is consistent with the approach undertaken in many EU countries. However, the demand-side of the market is not fully incorporated into the market design. To ensure better market clearing, price signals need to be effectively delivered to customers so that demand can be price sensitive. Drawing on new technologies, the demand-side can be better integrated into the market design.

**Proposed Transformation**

The Smart Grid investment would support scale-up of RE capacity from 1.5 GW to 5 GW. CTF resources are proposed to be blended with the next IBRD transmission loan which will support transmission expansion and strengthening for, among other reasons, support for wind energy integration into the grid. CTF resources specifically are proposed to be utilized for assisting in design and implementation of the next generation of modern grid management and control systems which can enable large-scale integration of wind energy resources and to improve integration of demand-side measures. IBRD resources would focus on expansion of "conventional" transmission grid and system control reinforcements and interconnections.

In Europe and the USA, the challenges posed by wind generation are sought to be addressed through similar "intelligent" grids, which can respond to the challenges placed by growing intermittent wind generation, increasing demand, and tailoring reliability to customer reliability needs. These systems are currently under development by the European Technology Platform

[31] As of July, 2009, The European Network of Transmission System Operations for Electricity (ENTSO-E)

(SmartGrid) and Electric Power Research Institute (EPRI) in the USA[32] (the IntelliGrid Program).

**Implementation Readiness**

The IBRD transmission project is in the Country Partnership Strategy of Ukraine-IBRD for FY2011. The various investments proposed under this project have been included in the investment plan and have also been approved by the Government. Over the next few months, discussions will continue over provision of budget allocations for these investments, spread over 2011-2015.

Ukraine has capacity in implementing complex transmission projects, including in the areas of load dispatch, system operation and control, and market management. Ukraine also has significant experience with IBRD policies, having implemented several projects (in addition to the two that are currently ongoing) with IBRD financing.

**Rationale for CTF Financing**

In order for wind energy to be implemented and utilized, effort needs to be placed in parallel, in developing and implementing a smart-grid solution in Ukraine. The Smart Grid project would complement the RE and EE programs proposed and would facilitate further scaling-up. Since this is a very innovative and complex concept, which is only now being tried in Europe and the USA, it would be beneficial to utilize CTF financing for this effort, given the concessional nature of CTF. Use of CTF resources in this endeavor would yield very significant results in terms of reduction of GHG emissions.

In addition to GHG reduction benefits, the implementation of the Smart Grid and the development of wind energy have significant national-level benefits. It would help offset increased imports of natural gas, which would save the government important foreign currency, thus freeing up resources for social welfare and economic activities. Wind energy development also entails significant employment benefits, as indigenization levels increase and domestic industry develops to provide supplies and construction support.

**Financing Plan**

| Ukraine | World Bank | CTF | Total Cost |
|---|---|---|---|
| 22% | 67% | 11% | 100% |
| USD 100 M | USD 300 M | USD 50 M | USD 450 M |

[32] The European Technology Platform SmartGrids brings together European utilities, technology providers/manufacturers, regulators and government agencies. EPRI's IntelliGrid Program brings together a large number of US and two European electric utilities, technology providers, and agencies including the US Department of Energy.

**Project Preparation Timetable**

The project is expected to be prepared along the following timeframe:

| | |
|---|---|
| Government Concept Approval/ Bank Concep Review | August 2010 |
| Project Preparation | September – November 2010 |
| Appraisal/ Negotiations | February 2011 |
| Approval | March 2011 |
| Project Implementation | June 2011 – June 2016 |

## 5. Gas Network Rehabilitation

**Problem Statement**

Ukraine's gas transit system (GTS), built between 1950 and 1970 –transports around 110-120 BCM or 80% of Russia's gas annually to Europe. It is managed by Ukrtransgaz, a subsidiary of a state energy company, Naftogaz. Due to under-investing, the GTS is in urgent need of upgrading and rehabilitation. By 2004, 22% of the Ukrainian pipelines exceeded their originally planned life span of 33 years, and 66% were between 10 and 33 years old. This increases the risk of technical break-downs and jeopardizes the supply of Russian gas to Ukraine which would have a devastating impact on heat supply, particularly on the poor. The efficiency of the gas compressors currently in use is very low. For example, efficiency of existing Compressor Stations at Soyuz pipeline is about 24-25%, compared to the modern ones which efficiency ranges between 35-42%.

In 2007 a European Commission study estimated that around €2.5 billion would be needed to rehabilitate Ukraine's GTS but estimates of Ukrainian experts are even higher ranging between US$5 billion to US$10 billion. The lack of investments is due to combination of the financial difficulties of Naftogaz Ukrainy, which remains heavily indebted to Gazprom and risks bankruptcy. The primary cause of the problem is the recent rapid increases of gas prices and the slow rate of change in domestic gas prices. Gas price reforms are scheduled to be implemented over the next two years. The recent worldwide financial crisis further restricted the company's ability to raise capital in domestic and international markets.

**Proposed Transformation**

Naftogas is the largest consumer of natural gas in Ukraine at 8 bcm/year: changing its approach to energy use would have a considerable impact on energy use in Ukraine. It is important that gas remains a component of the energy supply system in Ukraine as gas-fired power plants can operate at efficiencies over 50%, compared to less than 40% efficiency of coal-fired plants. Decreased use of gas will lead to increased use of coal, more than doubling $CO_2$ emissions per unit of energy used. The proposed investments are expected to cover all aspects of gas infrastructure rehabilitation and upgrading, including replacing old and outdated gas compressor stations, replacing high pressure gas pipelines and installation of state of the art metering equipment to measure gas flows and offtake from system. The proposed project would change 30% of all compressors in CTS, improving their efficiency from 24% to 36-37% (50% improvement). Given that current gas demand in Ukraine is about 50 bcm per year, introduction of high efficiency gas compressors to the system will save 5% of total gas consumption in Ukraine. Changing 30% of compressors will lead to direct savings of 0.8 bcm per year.

The project would also explore the possibility of using exhaust heat produced from gas compressing produce electricity and to increase efficiency of gas compressor. The proposed project would only fund part of the overall gas rehabilitation needs of Ukraine gas network but would have considerable GHG emissions reduction potential. The possible addition of waste heat boilers and electricity production from gas compressor stations would provide increased electricity supply with no incremental GHG emissions. The project would also provide transformational impacts through its replicability in Ukraine and, possibly, Russia and other major gas transit countries.

**Implementation Readiness**
The client has identified priority objects for GTS modernization and reconstruction and has completed the feasibility studies for the following pipeline segments, (i) Soyuz, (ii) Urengoy-Pomary-Uzhored and (iii) Progress. However, a full-scale feasibility study would be required to shift the proposed investments to decrease GHG emissions as outlined above. It is important to note that the client is technically capable. Also, gas sector reforms are supported by IMF-WB program.

**Rationale for CTF financing**
Naftogas' weak financial position limits its ability to invest in standard, low cost technology: moving to higher-cost, high efficiency equipment is, therefore, not a priority for Naftogas. However, as new investments are implemented they will change the course for gas use, and GHG emissions, over the next 40 years. Decreasing the carbon footprint of the gas network now will, therefore, have a lasting impact. In addition, the implementation of heat recovery boilers that would recovery heat from the exhaust of the compressor stations would produce electricity with no fuel requirements – a cogeneration source of electricity with no incremental GHG emissions. If this succeeds, it is replicable in the remaining gas compressor plants in Ukraine and elsewhere.

**Financing Plan**
Total project cost is about US$2 billion. Assuming US$100 million CTF support, the client expects to provide around 20% equity and requests the MDBs to consider providing up around US$1.5 billion loan.

| **MDBs** | **Ukrainian Counterpart** | **CTF** | | **Total Financing Package** |
|---|---|---|---|---|
| 75% | 20% | 5% | | 100% |
| USD 1500 M | USD 400 M | USD 100 M | | USD 2000 M |
| | | **IBRD** | **EBRD** | |
| | | USD 50 M | USD 50 M | |

**Project Preparation Timetable**

| **Activity** | **Date** |
|---|---|
| ROC on CTF Investment Plan | September 2009 |
| Board Approval | FY2012 |