UKRAINE: Second Urban Infrastructure Project (UIP2) (P132386)
CTF Submission: Approval by Mail

Comments by CTF Trust Fund Committee members and World Bank Team Response
April 18, 2014

<table>
<tr><th>Comments from United Kingdom</th><th>Response (from World Bank team)</th></tr>
<tr><td>To note, energy savings in the Results Framework and Monitoring are indicated incorrectly, expected energy savings are 434 GWh per year not MWh.</td><td>This was an error in the Results Framework which has been corrected in the updated PAD.</td></tr>
<tr><td>It is unclear what conversion factors IBRD used and based on what assumptions energy savings were converted to GHG savings for the sludge treatment and the solid waste treatment projects. Could IBRD clarify the calculations including project boundaries, baselines, lifetime of technology or investment, type of GHGs included, and emissions conversion factors?</td><td>

Initial savings of GHG emissions were very conservative given that feasibility studies had not been completed and conservative estimates were presented in the document. The team has now received more data which allows for more precise calculations of GHG savings. The final Project Appraisal Document (PAD) will be updated to reflect these changes. Further information about calculations of GHG emission savings achieved from sludge treatment and solid waste sub-projects is provided below:

- **<u>Sludge treatment sub-project:</u>**

This sub-project will achieve GHG savings of 279,337 tCO_2eq per year from two set of interventions, namely by avoiding biogas creation at WWTP site and treating the sludge at the Sludge Treatment Plant (STP). Total GHG savings are 5.587 million tCO_2eq over the lifetime of the project. Due to lack of data at that time, the PAD shared with the CTF Trust Fund Committee only reflected GHG savings from treating the sludge at the STP facility. The latest PAD has been updated to also reflect GHG savings from both interventions as follows:

1) Avoid biogas creation from sludge (170,512 tCO_2eq/yr): Currently, the sludge is stored at the WWTP site and as a result biogas is produced containing 70% CH_4 and 30% CO_2. The construction of the STP will avoid the creation of such biogas, and therefore GHG savings will be achieved. The calculations for GHG emissions savings resulting from this intervention in Kharkiv **sludge treatment sub-project** are based on processing 3000 м3 sludge per day at the biological treatment complexes of Kharkiv vodocanal. The sludge has an average moisture content 96.7% and ash value 27.5%. General amount of organic matter is 72,427.5 kg per day. Correlation content of fat, proteins and carbohydrates in this sludge indicates that catabolism of organic matter is 43%. This would result in 31,143.8 kg biogas per day, where CH_4 consists 70%, which is 21,800.7 kg, and CO_2 9,343.1 kg. Therefore, the amount of GHG savings per year is equivalent to 170,512 tCO_2eq/yr {=9,343.1 +21,800.7 x 21) x 365}. The conversion factor of CH_4 into CO_2 equivalent emissions is 21. Over 20 years of Project lifetime, GHG emissions reduction will be 3.410 million tCO_2eq.

<table>
<tr><td>daily production of sludge</td><td></td><td></td><td>3000</td><td>m3</td></tr>
<tr><td>organic matter</td><td></td><td></td><td>72,427.5</td><td>kg</td></tr>
<tr><td>utilization</td><td></td><td></td><td>43%</td><td>%</td></tr>
<tr><td>biogas produced</td><td></td><td></td><td>31,143.8</td><td>kg</td></tr>
<tr><td>biogas content:</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>CO2</td><td>30%</td><td>9,343.1</td><td>kg</td></tr>
<tr><td></td><td>CH4</td><td>70%</td><td>21,800.7</td><td>kg</td></tr>
<tr><td>CH4 conversion factor to CO2</td><td></td><td>21</td><td>457,814.2</td><td>kg</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2 tons savings per year</td><td></td><td></td><td>170,512</td><td>tons</td></tr>
<tr><td>CO2 tons savings for the project</td><td></td><td></td><td>3,410,249</td><td>tons</td></tr>
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2) Utilization of sludge in WWTP site (108,852 tCO_2eq/yr): In addition to the fact that the sludge will not be disposed at the WWTP site (first CO_2 reduction) it envisaged that it will be utilized by the

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plant. Methane gas is being produced as part of the sludge treatment process (and collected in gas holders to be burned). The burning of dry sludge in the incinerator will achieve GHG savings from the reduction of methane. Further, a portion of the thermal energy and electricity being produced will be utilized by the plant, a portion will be lost during the process, and the remaining balance will be sold to the grid. The table below provides information about electricity and heat production and consumption, as well as GHG savings achieved as part of this intervention. .

electricity production			23	MWh
thermal energy production			84.44	MWh
electricity consumption			8	MWh
thermal energy consumption			53.96	MWh
electricity to the grid			15	MWh
thermal energy/heating to the grid			30.48	MWh
electricity to the grid per year			131,400	MWh
heating to the grid per year			267,005	MWh
		coefficients		
CO2 tons savings per year from electricity		0.419	55,056.6	tons
CO2 tons savings per year from thermal energy		0.201	53,768.6	tons
total CO2 tons savings per year			108,825.2	tons
total CO2 tons savings for the project			***2,176,504.2***	***tons***

- **Solid waste sub-project**

This sub-project will achieve GHG savings of 184,552 tCO2eq from two set of interventions, namely by collecting methane from the landfill and displacing fossil-fueled power with green electricity. Total GHG savings are 3.691 million tCO2eq over the lifetime of the project. Due to lack of data at that time, the PAD shared with the CTF Trust Fund Committee only reflected a more conservative estimate based on GHG savings from the landfill intervention. The final PAD will be updated to also reflect GHG savings from both landfill (3.322 million tCO2eq) and green electricity generation (0.368 million tCO2eq).

Calculations for Kharkiv **solid waste sub-project** GHG emissions reduction were based on the following:
Facilities, where landfill gas is collected
Collection and utilization of landfill gas is planned to implement at 4 landfill sections, which are situated nearby:
Section № 1 – landfill, where waste dumping was during 1999-2005. General amount of waste is 1,46 million tons.
Section № 2 – first phase of current landfill, where waste dumping was during 2006-2011. General amount of waste is 1,2 million tons.
Section № 3 – second phase of current landfill, where waste dumping is since 2012. General amount of waste is 0,65 million tons (status on 01.01.2014).
Section № 4 – landfill, which is planned to build in the framework of UIP2. Annual waste dumping is 0,35 – 0,4 million tons.
Landfill gas volume
Calculation of landfill gas was made according to the international methodology of the Intergovernmental Panel on Climate Change (IPCC, 1996).
Test research demonstrated the following content of landfill gas:
CH4 – 52 % - 64 %;
CO2 – 32 % - 44 %;
O2 – 0,3 % - 2,9 %;
Other – about 3 %.
Efficiency of landfill gas collection
Efficiency of landfill gas collection depends on landfill maintenance conditions. Factors of landfill gas collection's efficiency are the following:
Section № 1 – 0,7;
Section № 2 – 0,47;
Section № 3 – 0,63;
Section № 4 – from 0,4 to 0,8 during a period of landfill operation.
Calculation of GHG emissions reduction
GHG emissions reduction' amount (in CO2eq) was calculated on the base of collection volume and landfill gas utilization in the following way:
MCO2 = VLG * KCH4 * YCH4 * KCF /1000,
where is:

MCO2 - GHG emissions reduction amount (in CO2eq);
VLG - volume of landfill gas collected over the year, м3. It is calculated as multiplication of volume of landfill gas collected over 1 hour and number of hours in year (8760 hours in year);
KCH4 - methane portion in landfill gas, KCH4 = 50%;
YCH4 - specific weight, YCH4 = 0,72 kg/м3;
KCF – conversion factor of CH4 emissions (or global warming potential), KCF = 21.
GHG emissions reduction is presented in the table in the table below, taking into account the factors of landfill gas collection's efficiency.

Year	Section № 1	Section № 2	Section № 3	Section № 4	Volume of gas, $м^3/h$	Electricity amount, kW/h	GHG saved from methane t CO_{2eq}/year	Electricity amount, kW/year	GHG saved from electricity t CO_{2eq}/year	Total GHG saved t CO_{2eq}/year
2016	303	254	213	-	770	1,540	50,994	13,490,400	5,652	56,646
2017	283	233	434	-	950	1,900	62,914	16,644,000	6,974	69,888
2018	265	215	442	449	1,371	2,742	90,795	24,019,920	10,064	100,860
2019	249	199	515	523	1,486	2,972	98,411	26,034,720	10,909	109,320
2020	234	184	471	724	1,613	3,226	106,822	28,259,760	11,841	118,663
2021	220	171	432	929	1,752	3,504	116,027	30,695,040	12,861	128,888
2022	208	159	397	1,135	1,899	3,798	125,762	33,270,480	13,940	139,703
2023	197	148	366	1,344	2,055	4,110	136,094	36,003,600	15,086	151,179
2024	187	139	339	1,552	2,217	4,434	146,822	38,841,840	16,275	163,097
2025	177	130	314	1,763	2,384	4,768	157,882	41,767,680	17,501	175,382
2026	169	122	292	1,973	2,556	5,112	169,273	44,781,120	18,763	188,036
2027	161	115	272	2,185	2,733	5,466	180,995	47,882,160	20,063	201,057
2028	153	109	254	2,397	2,913	5,826	192,915	51,035,760	21,384	214,299
2029	146	103	238	2,609	3,096	6,192	205,034	54,241,920	22,727	227,762
2030	140	98	223	2,820	3,281	6,562	217,286	57,483,120	24,085	241,372
2031	134	93	210	3,032	3,469	6,938	229,737	60,776,880	25,466	255,202
2032	129	88	198	3,245	3,660	7,320	242,386	64,123,200	26,868	269,253
2033	124	84	187	2,968	3,363	6,726	222,717	58,919,760	24,687	247,404
2034	119	80	177	2,722	3,098	6,196	205,167	54,276,960	22,742	227,909
2035	114	76	168	2,501	2,859	5,718	189,339	50,089,680	20,988	210,327
2036	110	73	159	2,306	2,648	5,296	175,365	46,392,960	19,439	194,804
Total	**3,822**	**2,873**	**6,301**	**37,177**	**50,173**	**100,346**	**3,322,737**	**879,030,960**	**368,314**	**3,691,051**

Amount of generated electricity was calculated at calorific value of landfill gas 5 kW/m^3 and efficiency of gas piston generator 40%. 8760 hours in year.
Electricity mix emission factor for Ukraine 419 grams CO2/KWh

With a view to maximizing the impact of the CTF's limited resources the CTF co-financing is ordinarily not available for investments in which the marginal cost of reducing a ton of CO2-equivalent exceeds US$200. Could IBRD provide evidence on the marginal abatement cost of the energy efficient pumping equipment sub-projects? Based on the evidence provided in the proposal the total investment cost per tonne of these sub-projects (excluding Donetsk) at 507$/tonne suggests that they may not be in line with CTF's investment criteria.

Out of the total allocation for the water pumping sub-projects, only between 10-20% of funding will target increases in energy efficiency in the water and sanitation sector. The remaining balance of funding will be used to cover investments not specifically targeting increases in energy efficiency, such as infrastructure, concrete structure, site works, etc. The use of CTF funding has been designed to cover the incremental cost for investments in energy efficiency technologies, which would have not procured in the absence of CTF. Given that information for GHG savings is not yet available for the city of Donetsk, the associated funding for this city has not been considered for estimating the cost-effectiveness ratio for the energy efficiency water pumping sub-projects. Considering that only 10-20% funding will target energy efficiency interventions, and excluding Donetsk from the calculation, the cost effectiveness for this sub-project ranges between 51 and 101 US$ per tCO2eq. This assumes that out of US$112.23 million of total IBRD and CTF funding allocated for the rehabilitation of water pumping stations (see Table A7.2 in PAD, page 83), only between 10-20% is targeting energy efficiency interventions, US$11.22 million and US$22.45 million. The lifetime savings of tCO2eq were extracted from Table A7.3, namely 0.221 million tCO2eq.

According to the CTF committee decision from October 2013 meeting "A threshold for CTF eligibility may be established at the marginal abatement cost of USD 200 per ton of CO2-equivalent reduced. Since the technologies supported by the CTF are typically far below that threshold, it is suggested that instead of requiring every project/program to undertake marginal abatement cost analysis, the country is requested to provide information on the estimated marginal abatement cost only for projects/programs for which the marginal abatement cost is likely to exceed USD 100 per ton of CO2-equivalent. " Since the cost of reducing a tone of CO2eq varies between 51 and 101 US$, one can assume that MAC, which is calculated as net incremental cost of reducing CO2, is far less than US$101 per tCO2.

Further, EBRD report of January 2012 titled "The Demand for Greenhouse Gas Emissions Reduction Investments: An Investors' Marginal Abatement Cost Curve for Ukraine"(see the link below) indicates that there is a significant abatement potential for energy efficient pump technologies in the Ukraine. The report recognizes the existence of several cross-cutting measures and highlights the utilization of more efficient pumps as a major abatement intervention to improve the energy efficiency and the emissions intensity of existing processes. The report indicates that MAC for municipal waste and water related investments is far below $200 per ton.

http://www.ebrd.com/downloads/research/economics/publications/specials/Ukraine_MACC_report_ENG.pdf

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<tr><td></td><td></td></tr>
<tr><td>The proposal has given an estimate of the cost effectiveness based on a CTF Investment cost/per tonne of $8.48/tCO2eq. However, there is no estimate of total project costs (CTF investment plus co-financing) per ton of CO2-equivalent reduced provided as per the requirements of the Oct 2013 TFC decision.</td><td>
Total cost effectiveness for the Project is estimated between 13.79 and 14.98 US$ per ton of CO2eq. This calculation takes into consideration that only a fraction of project funding allocated under the rehabilitation of water pumping stations is targeting energy efficiency interventions. Project funding amounts considered in the table below were extracted from Table A7.2 (see PAD page 83).
<table>
<tr><th>Sub-project</th><th>Case A: Total Project Funding assuming <u>10%</u> of water rehabilitation sub-project targets EE interventions (US$ million)</th><th>Case B: Total Project Funding assuming <u>20%</u> of water rehabilitation sub-project targets EE interventions (US$ million)</th><th>tCO2eq over lifetime of the project</th></tr>
<tr><td>Sludge treatment sub-project</td><td>75.80</td><td>75.80</td><td>5,586,753</td></tr>
<tr><td>Solid waste sub-project</td><td>44.00</td><td>44.00</td><td>3,691,051</td></tr>
<tr><td>Water pumping rehabilitation sub-project</td><td>11.22 [A]</td><td>22.45 [B]</td><td>221,014</td></tr>
<tr><td>Total (US$ million)</td><td>131.02</td><td>142.25</td><td>9,498,818</td></tr>
<tr><td>Cost effectiveness (US$/tCO2eq)</td><td>13.79</td><td>14.98</td><td></td></tr>
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Note:
A) Total allocation for this sub-project is US$112.23 million, of which 10% (US$11.22 million) assumed targeting energy efficiency interventions and 90% (US$101.01 million) cover concrete structure, site works, etc.
B) Total allocation for this sub-project is US$112.23 million, of which 20% (US$22.45 million) assumed targeting energy efficiency interventions and 80% (US$89.78 million) cover concrete structure, site works, etc.
The revised CTF cost effectiveness will be $5.26 ($50 million /9,498, 818 tCO2 eq)
All above estimates will be further refined during the first 12 months of the implementation and will be reflected in the annual reports.
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<tr><td>The review of the project states that the overall implementation risk is substantial. In addition the short-term transformational impact of the project is weak. How can these risks be mitigated adequately.</td><td>The Project Risks have been identified along with defined mitigation measures. These are outlined in the ORAF (Annex 5 of PAD). Regarding the transformational impacts – all investments have been selected towards maximizing the impacts on the quality and efficiency of services in the selected cities (within the approved budget envelopes) in the medium to longer term. These efforts will be supplemented by technical assistance component aimed at strengthening institutions at the utility and central level. We expect that the proposed combination of investments in more energy efficient technologies and technical assistance can help demonstrate the viability and potential of these technologies in the water and sanitation sector in Ukraine. The financial and operational benefits to utilities and municipalities can trigger more of such investments throughout the country, therefore supporting sustainable improvements in municipal service delivery.</td></tr>
<tr><td>What is the project team's assessment of the political risks in the current climate, given that</td><td>The political risk was considered as key element of the Operating Environment Risk (Section 2) of the ORAF (Annex 5 of PAD). The Bank has made significant efforts to ensure a strong relationship with the existing administration and is committed to supporting development efforts in Ukraine (including cities in the eastern part of the Country). In the lead up to negotiations the Government and each of the Utility Companies have reconfirmed their commitment to the project and willingness to proceed.</td></tr>
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many of the projects are in eastern Ukraine?	