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Report No: PAD1093

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$306.50 MILLION

AND A PROPOSED CLEAN TECHNOLOGY FUND LOAN
IN THE AMOUNT OF US$48.425 MILLION

TO

UKRAINE

FOR A

SECOND POWER TRANSMISSION PROJECT

JUNE 30, 2014

Sustainable Development Department
Europe and Central Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 1, 2014)

Currency Unit = UAH
11.60 UAH = US$1

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AIS	air insulated substation	IPS	Interconnected Power System
AMI	advanced metering infrastructure	ISA	International Standards on Auditing
AT	auto-transformers	ISP	Implementation Support Plan
CAS	Country Assistance Strategy	KfW	German Development Bank
CB	circuit breaker	KV	kilo volt
CHP	combined heat and power	MDB	multilateral development bank
CO_2	carbon dioxide	MIS	Management Information System
CPS	Country Partnership Strategy	MoECI	Ministry of Energy and Coal Industry
CTF	Clean Technology Fund	MoF	Ministry of Finance
DA	Designated Account	MVA	megavolt-amperes
DH	district heating	MW	Megawatt
DMS	distribution management system	NERC	National Electricity Regulator Commission
DPL	Development Policy Loan	NO_x	Nitrogen Oxide
EBRD	European Bank for Reconstruction Development	NPP	nuclear power plant
EC	European Commission	NPV	net present value
ECU	Energy Company of Ukraine	O&M	operation and maintenance
ECT	Energy Community Treaty	OHL	overhead line
EIA	environmental impact assessment	ORAF	Operational Risk Assessment Framework
EIB	European Investment Bank	PDO	Project development objective
EIRR	economic internal rate of return	PIU	Project Implementation Unit
EMF	environmental management framework	POM	Project Operations Manual
EMP	environmental management plan	PPP	purchasing power parity
ENPV	economic net present value	PSP	pump storage plant
ENS	Energy Not Served	PTP2	Second Power Transmission Project
ENTSO-E	European Network of Transmission System Operators for Electricity	QCBS	quality-cost based selection
EPCU	Energy Program Coordination Unit	RES	renewable energy source
EU	European Union	SBA	Stand-By Arrangement
FIRR	financial internal rate of return	SCADA	Supervisory Control and Data Acquisition

FM	financial management	SO_2	sulphur dioxide
FNPV	financial net present value	SS	single source
FS	feasibility study	TA	technical assistance
GDP	gross domestic product	TL	transmission line
GHG	greenhouse gas	ToR	terms of reference
GIS	green investment scheme	TPP	thermal power plant
GoU	Government of Ukraine	TWh	terawatt hour
GW	gigawatt	UAH	Ukrainian Hryvnia
GWh	gigawatt-hour	UCTE	Union for the Coordination of the Transmissions of Electricity
HPP	hydropower plant	UE	Ukrenergo
IBRD	International Bank for Reconstruction and Development	UHE	UkrHydroEnergo
ICB	international competitive bidding	UPS	Unified Power System
IFI	international financial institution	USAID	United States Agency for International Development
IFR	Interim Financial Report	VSL	Variable Spread Loan
IFRS	International Financial Reporting Standards	WACC	weighted average cost of capital
IMF	International Monetary Fund	WEM	wholesale electricity market
IPF	Investment Project Financing		

Regional Vice President:	Laura Tuck
Country Director:	Qimiao Fan
Sector Director:	Laszlo Lovei
Sector Manager:	Ranjit Lamech
Task Team Leader:	Dmytro Glazkov

UKRAINE
Second Power Transmission Project

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Ukraine

Second Power Transmission Project (P146788)

PROJECT APPRAISAL DOCUMENT

EUROPE AND CENTRAL ASIA

ECSEG

Report No.: PAD1093

Basic Information			
Project ID P146788	EA Category B - Partial Assessment		Team Leader Dmytro Glazkov
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date 01-Jan-2015	Project Implementation End Date 31-Dec-2019		
Expected Effectiveness Date 28-Oct-2014	Expected Closing Date 30-Jun-2020		
Joint IFC No			
Sector Manager Ranjit J. Lamech	Sector Director Laszlo Lovei	Country Director Qimiao Fan	Regional Vice President Laura Tuck

Borrower: Ukraine			
Responsible Agency: National Power Company Ukrenergo (UE)			
Contact:	Konstantin Ushchapovskiy	Title:	Director
Telephone No.:	380-44-2383015	Email:	kanc@nec.energy.gov.ua
Responsible Agency: Ministry of Energy and Coal Industry of Ukraine			
Contact:	Vadym Ulyda	Title:	Deputy Minister
Telephone No.:	380-44-206385	Email:	vadym.ulyda@mex.en

Project Financing Data(in USD Million)					
[X]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[ ]	Credit	[ ]	Grant	[ ]	Other

Total Project Cost:	354.925	Total Bank Financing:	306.50
Financing Gap:	0.00		

Financing Source	**Amount**
Borrower	0.00
International Bank for Reconstruction and Development	306.50
Clean Technology Fund	48.425
Total	354.925

Expected Disbursements (in USD Million)

Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021	0000
Annual	0.00	15.00	40.00	70.00	100.00	100.00	29.925	0.00	0.00
Cumulative	0.00	15.00	55.00	125.00	225.00	325.00	354.925	0.00	0.00

Proposed Development Objective(s)

The Project Development Objective is to improve the reliability of power transmission system and support implementation of the Wholesale Electricity Market in Ukraine.

Components

Component Name	**Cost (USD Millions)**
Rehabilitation of Transmission Substations	241.50
Electricity Market Enhancement	110.925
Institutional Strengthening of MoECI	2.50

Institutional Data

Sector Board

Energy and Mining

Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and mining	Transmission and Distribution of Electricity	100		
Total		100		

I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

Themes		
Theme (Maximum 5 and total % must equal 100)		
Major theme	Theme	%
Financial and private sector development	Infrastructure services for private sector development	70
Trade and integration	Regional integration	20
Environment and natural resources management	Climate change	10
Total		100

Compliance

Policy

Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]
Does the project require any waivers of Bank policies?	Yes [ ] No [X]
Have these been approved by Bank management?	Yes [ ] No [X]
Is approval for any policy waiver sought from the Board?	Yes [ ] No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X] No [ ]

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	X	
Natural Habitats OP/BP 4.04		X
Forests OP/BP 4.36		X
Pest Management OP 4.09		X
Physical Cultural Resources OP/BP 4.11		X
Indigenous Peoples OP/BP 4.10		X
Involuntary Resettlement OP/BP 4.12		X
Safety of Dams OP/BP 4.37		X
Projects on International Waterways OP/BP 7.50		X
Projects in Disputed Areas OP/BP 7.60		X

Legal Covenants

Name	Recurrent	Due Date	Frequency
LA: Covenant 1	**X**		

Description of Covenant

The Borrower shall through MoECI, carry out Part 3 of the Project in accordance with the procedures set forth in the Project Operations Manual and shall ensure that the Project Operations Manual is not amended, suspended, abrogated, or repealed and that no provision of the Project Operations Manual is

waived without prior approval of the Bank.

Name	Recurrent	Due Date	Frequency
LA: Covenant 2	X		

Description of Covenant

The Borrower shall through MoECI, maintain the EPCU within MoECI, throughout the duration of the Project, in a form and with functions, staffing, (under terms of reference, qualifications and scope of responsibilities) and adequate resources, all satisfactory to the Bank and as further set forth in the POM; the EPCU shall be responsible for implementing Part 3 of the Project, and, for the overall Project, for aggregating data and reports, providing reports to the Bank, and monitoring and evaluation of the Project.

Name	Recurrent	Due Date	Frequency
LA: Covenant 3 (break-even)		01-Jan-2015	

Description of Covenant

The Borrower shall: (a) ensure that, starting from Fiscal Year 2015 and each year thereafter, the NERC shall establish and maintain tariffs sufficient for the Project Implementing Entity to cover its financial needs for operations, Project counterpart financing, and debt service in a timely manner; (b) cause Energomarket to distribute funds due from Energomarket to the Project Implementing Entity in a timely manner; (c) ensure that the NERC introduces by July 1, 2017 a system service charge to be paid to the Project Implementing Entity in accordance with provisions of the Grid Code to be adopted during the implementation of the WEM; and (d) enable the Project Implementing Entity to achieve and maintain selected financial performance indicators, as further set forth in the Project Agreement.

Name	Recurrent	Due Date	Frequency
LA: Covenant 4	X		

Description of Covenant

The Borrower, through MoECI, shall ensure, and shall cause the Project Implementing Entity to ensure, that the Project is carried out in accordance with the EMP, and shall not amend, suspend, abrogate, repeal or waive any provision of the EMP, without prior written approval of the Bank.

Name	Recurrent	Due Date	Frequency
LA: Covenant 5	X		

Description of Covenant

The Borrower shall ensure that the feasibility studies under Part 3 of the Project are prepared in compliance with the procedures set forth in the EMF.

Name	Recurrent	Due Date	Frequency
LA: Covenant 6	X		

Description of Covenant

The Borrower shall ensure that no works under the Project involve the involuntary taking of land resulting in relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, or involving the involuntary restriction of access to legally designated parks and protected areas.

Name	Recurrent	Due Date	Frequency
LA: Covenant 7	X		

Description of Covenant

The Borrower shall: (a) No later than December 31 of every year during the implementation of the Project, beginning on December 31, 2015, prepare and furnish to the Bank a procurement progress report (Procurement Progress Report), in form and substance acceptable to the Bank, which shall include, *inter alia*: (i) a description of issues arising during the full procurement cycle under the Project, from design through planning, bidding, contract implementation and completion; (ii) a list of proposed measures and actions to be taken to resolve the issues identified under (i) above; and (iii) a proposed timeline for the implementation of the said measures and actions; (b) No later than January 31 of every year during the implementation of the Project, beginning on January 31, 2016, exchange views with the Bank on the results of the Procurement Progress Report completed for the Borrower's previous calendar year and thereafter implement such recommended measures, as agreed with the Bank.

Name	Recurrent	Due Date	Frequency
PA: Covenant 1	X		

Description of Covenant

The Project Implementing Entity shall carry out its Respective Part of the Project in accordance with the Project Operations Manual and EMP, and shall maintain its PIU throughout the duration of the Project for this purpose, in a form and with functions, staffing (under terms of reference, qualifications and scope of responsibilities), and adequate resources, all satisfactory to the Bank and as further set forth in the POM. The Project Implementing Entity shall not amend, suspend, abrogate, repeal, or waive any provision of the POM or EMP without prior approval of the Bank.

Name	Recurrent	Due Date	Frequency
PA: Covenant 2	X		

Description of Covenant

The Project Implementing Entity shall exercise its rights under the Subsidiary Agreement in such manner as to protect the interests of the Borrower and the Bank and to accomplish the purposes of the Loan. Except as the Bank shall otherwise agree, the Project Implementing Entity shall not assign, amend, abrogate, or waive the Subsidiary Agreement or any of its provisions.

Name	Recurrent	Due Date	Frequency
PA: Covenant 3	X		

Description of Covenant

The Project Implementing Entity shall carry out its Respective Part of the Project in accordance with the EMP, and shall not amend, suspend, abrogate, repeal, or waive any provision of the EMP, without prior written approval of the Bank.

Name	Recurrent	Due Date	Frequency
PA: Covenant 4	X		

Description of Covenant

The Project Implementing Entity shall ensure that the feasibility studies under Part 3 of the Project are prepared in compliance with the procedures set forth in the EMF.

Name	Recurrent	Due Date	Frequency
PA: Covenant 5	X		

Description of Covenant

The Project Implementing Entity shall ensure that no works under the Project involve the involuntary taking of land resulting in relocation or loss of shelter, loss of assets or access to assets, loss of income

sources or means of livelihood, or involving the involuntary restriction of access to legally designated parks and protected areas.

Name	Recurrent	Due Date	Frequency
PA: Covenant 6 and 7 debt service		01-Jan-2015	

Description of Covenant

The Project Implementing Entity will maintain the following financial covenants: (i) incur any debt, unless the net revenues of the Project Implementing Entity for the Fiscal Year immediately preceding the date of such incurrence or for a later twelve-month period ended prior to the date of such incurrence, whichever is the greater, shall be at least 1.5 times the estimated maximum debt service requirements of the Project Implementing Entity for any succeeding fiscal year on all debt of the Project Implementing Entity, including the debt to be incurred.; and (ii) produce, for each of its fiscal years after its fiscal year ending on Fiscal Year 2015, funds from internal sources equivalent to not less than [25] % of the annual average of the Project Implementing Entity's capital expenditures incurred, or expected to be incurred, for that year, the previous fiscal year and the next five (5) following Fiscal Years.

Name	Recurrent	Due Date	Frequency
PA: Relating to Covenant 7 (self-financing)	**X**		

Description of Covenant

Before December 31 in each of its fiscal years, the Project Implementing Entity shall, on the basis of forecasts prepared by the Project Implementing Entity and satisfactory to the Bank, review whether it would meet the requirements set forth in paragraph (a) in respect of such year and the next following fiscal year and shall furnish to the Bank a copy of such review upon its completion.

Name	Recurrent	Due Date	Frequency
PA: Relating to Covenant 7 (Self-financing)	**X**		

Description of Covenant

If any such review shows that the Project Implementing Entity would not meet the requirements set forth in paragraph (a) for the Fiscal Years covered by such review, the Project Implementing Entity shall promptly take all necessary measures (including, without limitation, adjustments of the structure or levels of its rates) in order to meet such requirements.

Conditions

Source Of Fund	Name	Type
IBRD	Subsidiary Agreement	Effectiveness

Description of Condition

The Subsidiary Agreement has been executed on behalf of the Borrower and the Project Implementing Entity.

Source Of Fund	Name	Type
IBRD	Project Accounting Records	Effectiveness

Description of Condition

The Project Implementing Entity's accounting system has been updated to enable fully automated project accounting and reporting.

Source Of Fund	Name	Type
IBRD	Project Operations Manual	Effectiveness
Description of Condition		
The Project Operations Manuals, in form and substance satisfactory to the Bank, have been finalized and adopted by each of the Borrower and the Project Implementing Entity, respectively.		
Source Of Fund	**Name**	**Type**
IBRD	CTF Loan Agreement	Effectiveness
Description of Condition		
The CTF Loan Agreement has been executed and all conditions precedent to its effectiveness and to the right of the Borrower to make withdrawals under it (other than the effectiveness of this Agreement) have been satisfied or waived.		
Source Of Fund	**Name**	**Type**
CTF	Subsidiary Agreement	Effectiveness
Description of Condition		
The Subsidiary Agreement has been executed on behalf of the Borrower and the Project Implementing Entity.		
Source Of Fund	**Name**	**Type**
CTF	Project Operation Manual	Effectiveness
Description of Condition		
The Project Operations Manuals, in form and substance satisfactory to the World Bank, have been finalized and adopted by each of the Borrower and the Project Implementing Entity, respectively.		
Source Of Fund	**Name**	**Type**
CTF	Project Accounting Records	Effectiveness
Description of Condition The Project Implementing Entity's accounting system has been updated to enable fully automated project accounting and reporting.		
Source Of Fund	**Name**	**Type**
CTF	IBRD Loan Agreement	Effectiveness
Description of Condition		
The IBRD Loan Agreement has been executed and all conditions precedent to its effectiveness and to the right of the Borrower to make withdrawals under it (other than the effectiveness of this Agreement) have been satisfied or waived.		

Team Composition

Bank Staff

Name	Title	Specialization	Unit
Irina Babich	Financial Management Specialist	Financial Management Specialist	ECSO3
Dmytro Glazkov	Operations Officer	Team Lead	ECSEG

Maiada Mahmoud Abdel Fattah Kassem	Finance Officer	Finance Officer	CTRLA
Klavdiya Maksymenko	Social Development Specialist	Social Development Specialist	ECSSO
Julie Rieger	Senior Counsel	Senior Counsel	LEGLE
Pekka Kalevi Salminen	Senior Energy Specialist	Senior Energy Specialist	ECSEG
Julia Samoslied	Team Assistant	Team Assistant	ECCUA
Rozena Serrano	Program Assistant	Program Assistant	ECSSD
Irina Shmeliova	Procurement Specialist	Procurement Specialist	ECSO2
Alexei Slenzak	Senior Environmental Specialist	Senior Environmental Specialist	ECSEN
Tamar Sulukhia	Sector Leader	Sector Leader	ECSSD

Non Bank Staff

Name	Title	City
Kishore Nadkarni	Financial/Economic Specialist	

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Ukraine	National	Khotiv village, Kyiv oblast; Kyiv; Zhytomyr; Cherkasy; Sumy; Kyiashky village, Kremenchuk, Poltava oblast; Novovolynska; Lutsk; Kovel; Shepetivka, Khmelnytsk oblast; Kamenets-Podilsky	Country wide	Ukraine	

UKRAINE
Second Power Transmission Project (PTP2)

I. STRATEGIC CONTEXT

A. Country Context

1. **A weak external environment, delayed structural reforms, and poor macroeconomic management have led to stagnation in Ukraine.** During 2001-2008, real GDP growth averaged 7.5 percent. After a deep contraction in 2009 precipitated by the global economic crisis, Ukraine experienced a modest recovery in 2010-2011. This was followed by economic stagnation in 2012-2013 due to economic mismanagement, declining investment, and weak external demand. In 2013, real GDP remained below its 2007 level. After a peak in 2009, inflation remained close to zero in 2012-2013, mainly because of the lack of utility tariff adjustments and tight monetary policy to support the *de facto* fixed exchange rate.

2. **This economic stagnation was accompanied by an accumulation of unsustainable fiscal and external imbalances.** Weak revenue performance, delayed tariff hikes in the gas and district heating sectors, and increases in wages and pensions led to a growing general government deficit that – including the deficit of the state energy company, Naftogaz – reached 6.7 percent of GDP in 2013. The rising fiscal deficit, in turn, exacerbated pressures on the external current account, which widened to 9.2 percent of GDP in 2013. Balance of payment pressures were amplified by large external debt refinancing needs, limited access to external financing, and political uncertainty. Given the *de facto* exchange rate peg to the US dollar, these growing internal and external imbalances led to depletion of foreign exchange reserves.

3. **The new Government of Ukraine (GoU) started implementation of reforms after a forced macroeconomic adjustment in early 2014.** Faced with economic stagnation, mounting fiscal and external pressures, and a fragile banking system, the authorities undertook urgent measures to stabilize the economy. In late February 2014, to avoid an imminent balance of payment crisis, the authorities switched to a flexible exchange rate regime, resorted to fiscal consolidation, and requested a Stand-by Arrangement (SBA) with the IMF. GDP growth is expected to decline by 5 percent in 2014 in the baseline scenario before recovering to 2 percent in 2015. This scenario takes into account the slower growth of key trading partners, higher gas import prices announced in March 2014, and disruptions of economic activity in eastern Ukraine. The ongoing macroeconomic adjustment is expected to be contractionary in the short term and will negatively affect the purchasing power of households and businesses. Petro Poroshenko was elected President of Ukraine on May 25, 2014. He has signed the Economic Part of the Association Agreement with the EU in Brussels on June 27, 2014.

4. **The political situation in Ukraine remains volatile and there are several substantial risks.** The possiblity of deeper and wider conflict that could affect implementation of the reforms. Possible deterioration of political and economic relations with Russia is a key risk that may impact the external trade and gas sectors. In these circumstances, given the vastness of the reform agenda, questions also remain about the new government's capacity to carry out reforms quickly and comprehensively.

B. Sectoral and Institutional Context

5. **Ukraine's energy demand and supply have been growing rapidly**. Following the collapse of the Soviet Union and the decline in economic activity, Ukraine's power sector output also dramatically dropped, from 296 terawatt hour (TWh) in 1990 to a low 170 TWh in 2000. Output increased to 179 TWh in 2003 and grew to 198 TWh in 2012 as the economy recovered from the global financial crisis. The total installed generating capacity of the Ukrainian power system in 2012 was 53.8 gigawatts (GW). Given a maximum peak load of 31.8 GW (February 2012), there is a surplus of installed capacity of approximately 59 percent. The relatively low increase in installed generating capacity from 52.9 GW in 2000 to 53.7 GW in 2013 compared to the growth in demand, from 123 TWh in 2000 to 147.2 TWh in 2013, reflects the reduction in the present surplus generating capacity to a more prudent level. It should be noted that thermal power plants' (TPPs) capacity is still underutilized, accounting for 44.7 percent of energy generation (whereas the installed capacity share of TPPs is 61 percent), although it is tending to decrease, caused by aging and lack of rehabilitation. Nuclear power plants (NPPs) account for 45.5 percent (25.7 percent of installed capacity) and hydropower plants (HPPs) for 5.5 percent (10 percent of installed capacity).

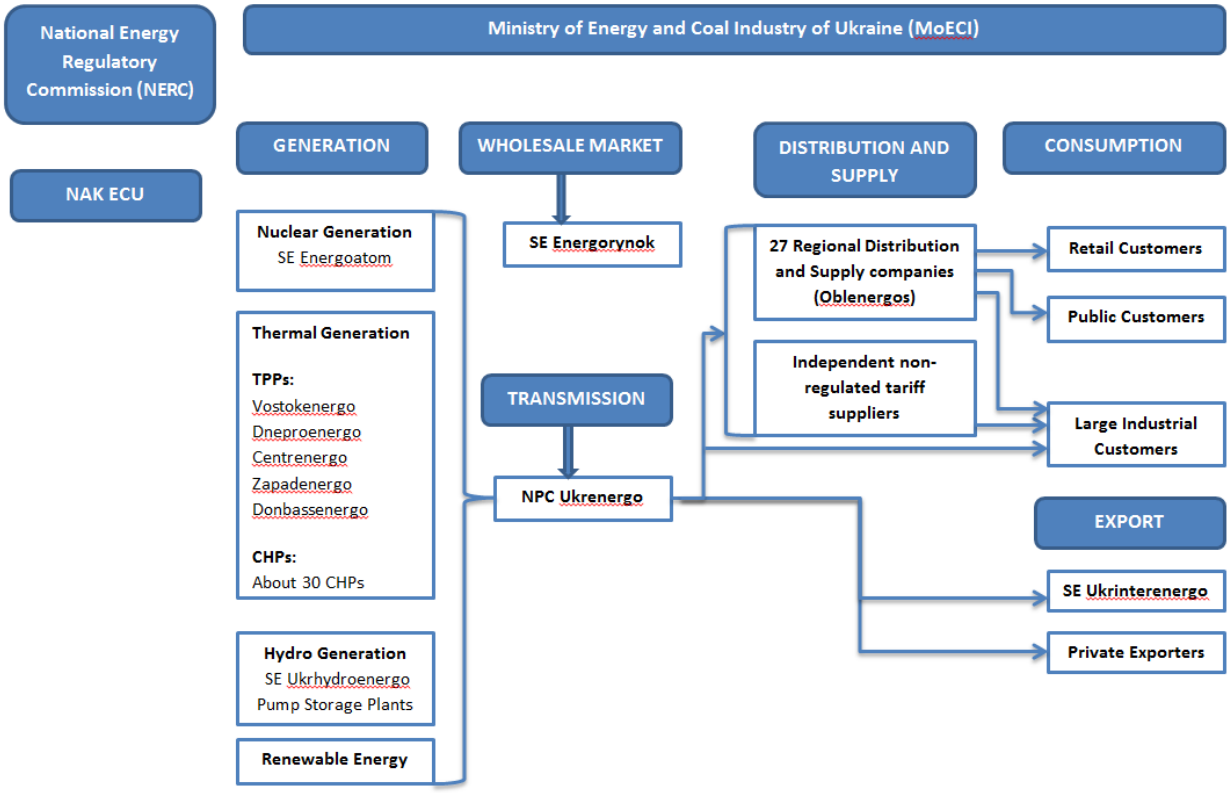
6. **Main characteristics and conditions of Ukraine's transmission network.** At the beginning of 2014, Ukraine's transmission system comprised 136 substations (SS). The total installed capacity of transformers was about 78,900 megavolt-amperes (MVA) (including auxiliary power transformers – 452,781 MVA) and 22,892 km (by circuits) of backbone and overhead transmission lines. A large number of SSs and overhead lines (OHLs) are old and have exhausted their useful life requiring urgent replacement. According to data provided by Ukrenergo (UE), 16,700 km of transmission lines have been in operation for over 30 years (72.8 percent of all lines), of which 10,890 km have been in operation for more than 40 years (47.5 percent of all lines). For reference, the projected useful life of OHLs is 40 years. This suggests further aging and inadequate rates of reconstruction of transmission lines, which has led to complications in their operation. According to UE data, as of December 31, 2012, 229 out of 343 auto-transformers (AT) were over 25 years old (the standard lifespan), which means that 67 percent of ATs have exceeded their projected useful life and should be replaced.

7. In 2011, **the absolute technical losses** in the transmission grid in eight power systems reached 4.1 TWh, or 2.51 percent of the 163.5 TWh gross supply in relative terms. In 2012, this number increased slightly to 4.2 TWh, or 2.53 percent of the 168.8 TWh gross supply in relative terms. At the same time, it should be noted that in 2012 the level of technical failures of main network equipment on OHLs and SSs, the major cause of Energy Not Served (ENS), reached 156.86 MWh. The increase in demand and changes in power flows, coupled with extended periods of insufficient investment, render the network structure unable to support the present load. As currently configured, the transmission network is characterized by high technical losses and poor reliability, instability, and unavailability and low quality of power supply. This is costly, inconvenient, and potentially dangerous to customers. This situation is aggravated by the fact that SS equipment, transmission lines, relay protection, and control systems are outdated or have exhausted their designed operational life. These problems go beyond the sector itself, posing a threat to sustainable economic growth, with adverse effects on products and services in the country, as well as creating barriers to the integration of renewable energy in Ukraine.

8. **Ukraine's power sector and its challenges.** Main players of Ukraine Power Sector are presented in Figure 2 below. The early reforms after Ukraine's independence focused on

increasing competition and fell far short of improving efficiency in the power sector. Despite positive developments in power system reforms over the past 12 years, the sector continues to be plagued by high levels of financial insolvency and operating inefficiencies, and still faces significant challenges. Against this backdrop, for Ukraine's electricity sector to provide a reliable and high-quality electricity supply able to meet growing demand and to take advantage of the proximity to the European Network of Transmission System Operators for Electricity (ENTSO-E), the sector needs to tackle the challenges described below**.**

Figure 1: Players of Ukraine Power Sector



9. **Challenge No. 1: To further improve the functioning of the electricity market through the introduction of reforms** that would gradually replace the single-buyer wholesale electricity market (WEM) with a bilateral contracting market and a balancing mechanism. Although the current model of a single-buyer WEM was introduced before the basic financial, legal, and regulatory conditions were in place, Ukraine has made substantial progress in improving the functioning of the existing market model since 2000. However, the current single-buyer structure of the WEM has enabled government agencies to interfere excessively in the administration of the market, thereby undermining the market's ability to function as an effective price-setting mechanism. On October 24, 2013, the Ukrainian Parliament approved the law "*On Operating Principles of the Electricity Market of Ukraine*," which replaced the single-buyer WEM with a bilateral contracting market and a balancing mechanism. The law was signed by the President on November 26, 2013, and became effective on January 1, 2014. Now Ukraine has three years to prepare for the complete launch of the WEM, starting from July 1, 2017, including implementation of the following elements: (i) a bilateral contract market; (ii) a "day-ahead" (spot) market; (iii) a balancing market; (iv) a market of ancillary services, and (v) a retail

electricity market, as prescribed in the law. EU has provided a grant through EBRD Grant facility to help with the implementation of the WEM law and EBRD is now engaged in selection of consultants who will assist the National Energy Regulatory Comission (NERC) and the Ministry of Energy and Coal Industry of Ukraine (MoECI) in implementation of the law and drafting sub laws, methodologies, procedures needed.

10. **Challenge No. 2: To improve and maintain the financial viability of the power sector.** Despite significant improvement, electricity supplies in Ukraine still include large implicit subsidies which have had severe macroeconomic and structural implications. The three key factors accounting for implicit subsidies are: non-payments; excessive losses; and tariffs below economic costs, which steadily increased since 2000. The following issues will have to be resolved to achieve and sustain financial viability: (i) high inter-enterprise debts; (ii) tariffs below economic cost-recovery levels; and (iii) high transmission and distribution losses. Thus, Ukraine will need to develop and implement a medium-term tariff policy designed to bring electricity tariffs up to economic cost-recovery levels. One of the key challenges of financial viability is to make sure that tariffs are set at sufficiently high levels for the Transmission/Balancing Market Operator to cover capital costs of investments and to ensure that system auxiliary services provided by the Operator are included in tariffs.

11. **Challenge No. 3: To strengthen the institutional capacity and financial and administrative independence of the sector's regulator (National Electricity Regulator Commission – NERC)**. Currently, NERC does not have enough budgetary, financial, and administrative independence to perform its duties in an efficient manner. A draft law in its third iteration is under discussion in the Parliament and represents a major advance in the right direction, but it is not enough. It is necessary to revise the draft law to incorporate suggestions/changes, which are fully in compliance with the EU Third Energy Package, EU Directive for the Power Sector and Energy Community Treaty (ECT) requirements. As part of triggers set by the First Development Policy Loan, approved by the World Bank Board on May 22, 2014, the Bank team will support NERC to update this law. NERC requested Bank's assistance to shape the law to meet the EU Third Energy package and the Bank team hired an expert to provide guidance to NERC.

12. **Challenge No. 4: To improve the efficiency of the operation of energy sector utilities**. Beginning in 1998 and continuing through 2012, the government initiated the privatization of regional electricity distribution companies (*oblenergos*) and thermal generation companies to improve payment discipline, financial solvency of the sector, and its operating performance. . To date, the government has been modestly successful in privatizing *oblenergos* and three generation companies that were state owned. However, questions have been raised as to whether the privatized *oblenergos'* performance has improved with respect to operational and financial efficiency and investments. Private investors should be required to bring the distribution network assets up to internationally accepted technical standards to improve reliability and quality of service to consumers. This would lead to reduction of both technical and commercial losses, and promote efficiency and a viable distribution system. Similarly, private investors in thermal power should be required to bring power plants up to internationally accepted environmental and technical standards to improve the efficiency and reliability of electricity supply. For those utilities under public ownership, such as the power transmission system, including the dispatch center, and HPPs and NPPs, the strategy to improve efficiency could be achieved through tariff surcharges provided by NERC, through borrowing from IFIs, or as part of proper asset revaluation, which is reflected in an increase in tariffs. An additional challenge existing now is the adoption and implementation of the "grid code" and "distribution code" that govern the

technical performance (operation) of grid companies, including transmission operation and distribution companies.

13. **Challenge No. 5: To implement policy and institutional reforms**. After having observer status since November 2006, Ukraine officially became a member of the Energy Community Treaty (ECT) in September 2010 with the signing of the protocol that defined the implementation schedule of the *acquis communautaire*. ECT's goals are to promote energy security, stability, development, and solidarity by integrating the energy market, mutual relations, and harmonization of rules, regulations, and policies with those adopted in the EU, as well as coordination of energy policies. The final purpose of ECT membership is to synchronize the operation of Ukraine's Unified Power System (UPS) with EU power systems. Being part of ECT has a number of requirements, including adaptation of Ukraine's legislation to EU Directives, unbundling of energy assets, and provision of third-party access to the network, to name a few. Energy sector reforms are identified as a priority objective by MoECI and outlined in Annex 8-1. Detailed actionable steps for implementation of the strategy are provided in a separate action plan, developed and introduced in March 2012, and updated annually. The Presidential Administration and MoECI started implementation of the reform program in 2006, when the Energy Strategy until 2030 was approved. This Strategy recently went through a complete revision and was finalized in July 2013, culminating in approval by the Cabinet of Ministers. The focus has mainly been on changing the legislative framework in the sector. A cornerstone of this reform is the implementation of a new model of WEM, and continuation of reforms following ECT requirements.

14. **Development Partners**: Cooperation in the energy sector is high on the agenda of several donors, notably the European Commission, Governments of Japan (JICA), Germany (GiZ), United Kingdom (DfID) and Sweden (Sida). The overall donor support to the sector declined in the last few years after USAID and CIDA reduced their assistance to focus on the Chernobyl sarcophagus project and the nuclear safety and coal sector restructuring. Energy Sector Reforms helps to establish a framework for sector-wide cooperation and partnership, and can link major IFIs including EBRD, EIB, KfW and bilateral donors, in assisting Ukraine to reform and to further develop its large and strategically important energy sector.

15. **The Second Power Transmission Project (PTP2) will address a number of the challenges outlined above**, while providing a strategic framework for the development of Ukraine's power sector in a sustainable manner. In this context, Ukraine, with the support of the World Bank, has been implementing Energy Sector Reforms since 2004. The main objectives of these reforms are to: provide investments for energy infrastructure; improve the safety and reliability of the power supply; contribute to the uninterrupted operation of the Ukrainian energy market; and support Ukraine in its legislative, institutional, and technical harmonization of the energy sector with the European Union's (EU) Internal Energy Market. In support of these reforms, PTP2 (the Project) will focus on the development of comprehensive plans to be prepared taking into consideration strategic directions for Ukraine's power system, including: (i) scale-up of renewable power integration and low carbon development; (ii) plans and requirements for network integration/synchronization with ENTSO-E; and (iii) development of a competitive electricity market. These plans will underpin the selection of, and rationale for, specific investment projects financed by the proposed Project (Annex 8-1). The proposed Project will help UE overcome the challenges of strategic planning, implementation, and finance of transmission system rehabilitation and upgrade in a way that ensures stable operation of the

system. Ukraine's power system comprises eight regional systems, the most challenged of which (as indicated by number of faults, Energy not Served, and technical losses) are: (i) the Central Power System, which includes four regions and one city – Kyiv, Cherkassy, Zhitomir, and Chernigov – and Kyiv city, Ukraine's capital (a total population of 8.4 million people); and (ii) the Northern Power System, which includes three regions – Kharkiv, Poltava, and Sumy (a total population of 5.8 million people). While the Project's institutional reforms and Balancing Market and Smart Grid elements will have a nationwide impact, investments in the rehabilitation of the transmission SSs and integration with ENTSO-E will focus on these two regional power systems, impacting almost one-third of Ukraine's population.

C. Higher Level Objectives to which the Project Contributes

16. **The Project is fully aligned with the GoU's strategic objectives to improve the reliability of Ukraine's power transmission system and to support electricity market reform.** By promoting the security, reliability, efficiency, and quality of power supply through rehabilitation of transmission SSs, the Project also supports the World Bank's twin goals of reducing poverty and increasing shared prosperity. Improved power sector competitiveness will result in greater sector ability to attract investment and generate budget revenues. Secure energy supply will provide a stimulus to local economic development whereas improved quality of energy supply at a reasonable cost will ultimately benefit the end users in particular, households and small businesses. The core objective of the current Country Partnership Strategy (CPS) is to help the government overcome implementation bottlenecks that have affected successive reform programs. Bank-supported activities in the CPS are organized along two main pillars: (i) support for "building relations with citizens"; and (ii) support for "building relations with businesses."

17. **The proposed Project is included in the CPS for Ukraine** for fiscal years 2012-2016 under pillar (i) above under its Outcome 4: "Improved governance in the energy sector," and through Components 2 and 3 to assist the Ministry of Energy and Coal Industry (MoECI) and UE to improve governance in the power sector. Under pillar (ii): "Improving policy effectiveness and economic competitiveness: support to building relations with businesses, Result Area 5: Improving infrastructure for business activities, Outcome 15: Improved performance of power sector," the Bank has been addressing the problems of aging assets, outdated technologies, below-cost-recovery pricing, and non-payments by supporting implementation of the government's Energy Sector Reforms.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

18. The Project Development Objective is to improve the reliability of power transmission system and support implementation of the Wholesale Electricity Market in Ukraine.

B. Project Beneficiaries

19. The main and primary beneficiaries are the national energy company Ukrenergo (UE) and MoECI. UE already has experience implementing Bank-funded projects, as it participated in the first Power Transmission Project (Loan 4868-UA). Established in 1998, UE is a fully state-

owned company. MoECI will benefit from technical assistance (TA) provided for institutional capacity building and reforms carried out as a part of the government's Energy Sector Reforms.

20. The secondary beneficiaries of the project are the power distribution companies in Ukraine, who will benefit from the more reliable, better-quality service provided by UE and the entire population of Ukraine who will benefit from the overall improvement and stability of electricity supply.

C. PDO Level Results Indicators

21. The following key indicators are proposed to assess the PDO's achievement:

a) Number of outages at rehabilitated SSs is reduced (number);
b) Decrease in power usage for own needs of reconstructed SSs (MWh); and
c) Share of electricity traded on bilateral basis in WEM of Ukraine (percentage).

III. PROJECT DESCRIPTION

A. Project Components

22. The proposed Second Power Transmission Project consists of three components: (i) Rehabilitation of Transmission Substations; (ii) Electricity Market Enhancement; and (iii) Institutional Strengthening of MoECI.

23. The description and objectives of each component are summarized below.

24. **Component 1: Rehabilitation of Transmission Substations (US$241.5 million IBRD**). Replacement of outdated high voltage equipment, installation of gas-insulated switchgears, and replacement of auxiliary power equipment, protective layering and substation control and automation systems in selected high voltage transmission substations.

25. Given that the SSs are in residential areas and it is not possible to expand their territory, the component will provide installation of GIS-330 kV (complete gas-insulated switchgears for 330 kV). In addition, the component plans to replace auxiliary power equipment, protective relaying, and SS control systems. Automation of these SSs with the installation of distributed control systems (DCS) is planned, which will allow remote control and automatic operation of transmission SSs. In the Central Power System, the proposed rehabilitation SSs include: 330 kV "Novokyyivska"; 330 kV "October"; 330 kV "Zhytomyrska"; and 330 kV "Cherkaska." In the Northern Power System, the SSs proposed for rehabilitation include: 330 kV "Sumy" and 330 kV "Kremenchug." All of these SSs are over 50 years old.

26. **Component 2: Electricity Market Enhancement (US$110.925 million: US$62.5 IBRD and US$48.425 million CTF)**. This component consists of four subcomponents:

27. **Subcomponent 2.1:** Installation and connection of reactive power compensation devices for selected high voltage transmission substations.

28. This subcomponent supports the implementation of the "Program for Integration of the Ukrainian Power System to ENTSO-E" by financing a requirement of the program for the installation of Variable Shunt Reactor to improve the voltage performance of the transmission network - a mandatory rule for interconnecting the Ukrainian System with the ENTSOE

synchronous. The shunt reactors will be installed in the following high-voltage SSs: 330 kV "Novovolinskaya"; 220 kV "Lutsk Pivdenna"; 330 kV "Kovel"; 330 kV "Shepetivka"; and 330 kV "Kamenets-Podilska".

29. **Subcomponent 2.2:** Smart Grid introduction through purchase and installation of Smart Grid solutions including (a) modernization of the telecommunications network between renewable energy sources, key substations of transmission networks and system operator control centers; and (b) modernization of the regional and national system of load control centers to improve system control and dispatch including more efficient integration renewable energy into the power grid.

30. **Subcomponent 2.3:** Balancing market support through purchase and installation of hardware, software, metering and other related elements needed by the Project Implementing Entity for selected substations and the Project Implementing Entity.

31. This subcomponent will consist of elements for Balancing Market Operator to: determine the transfer capacities that are available for cross-border trading; receive and administer physical notifications; perform system operational scheduling; and procure and utilize ancillary services. Balancing Market settlement and planning system components require substantial metering input. Metering information is furthermore required for forecasting purposes and load profiling and will be installed at SSs.

32. **Subcomponent 2.4:** Support for institutional development of the Project Implementing Entity (UE) by (a) establishing a corporate-wide management information system (MIS) in the Project Implementing Entity; (b) providing technical assistance to the Project Implementing Entity on procurement, financial management and project management; and (c) financing of audits, Training and Incremental Operating Costs.

33. The investment programs will be identified and finalized in feasibility studies financed by the CTF Grant (for Smart Grid) and by the ongoing Power Transmission Project (for the Balancing Market). UE is financing the feasibility study for the MIS from its own funds. All feasibility studies are ongoing and are expected to be completed soon after Board approval.

34. **Component 3: Institutional Strengthening of MoECI (US$2.5 million IBRD).** Technical assistance to MoECI on (a) procurement, financial management and project management; (b) development of feasibility studies for future projects in the energy sector, technical assistance for preparation of analysis, studies and roadmaps related to reforms in the energy sector; and financing of training.

B. Project Financing

Lending Instrument

35. The lending instrument will be an Investment Project Financing (IPF). Ukraine will be the Borrower under the Project. There will be one IBRD loan and one CTF loan. GoU, through the MoF, will on-lend loan amounts needed for implementation of Components 1 and 2 to UE. UE will be responsible for the procurement, financial management (FM), and disbursement aspects of its respective components. MoECI will be responsible for procurement, FM, and disbursements in Component 3.

36. The Borrower has selected a Variable Spread Loan (VSL) to borrow an amount equal to [US$306,500,000] with IBRD terms of [5] years grace and [18] years maturity. The Borrower will be charged a front-end fee of [0.25 percent] of the loan amount to be financed out of loan proceeds (i.e., capitalized).The Borrower shall pay interest on the principal amount of the loan withdrawn and outstanding at a rate for each interest period equal to the reference rate for loan currency plus a variable spread.

37. The CTF loan of [US$48.425] million is extended under the CTF's harder concessional terms. The CTF loan is offered with a service charge of 0.75 percent per annum on the disbursed and outstanding loan balance and a 20-year maturity, including a 10-year grace period, with principal repayments at 10 percent for years 11-20. Principal and service charge payments accrue semi-annually. A management fee equivalent to [0.45] percent of the total loan amount will be charged, to be capitalized from the loan proceeds, following loan effectiveness.

Project Cost and Financing

38. Total Project financing requirements are estimated to be US$354.925 million, including 15 percent for contingences and a front-end fee. Out of the total Project financing, US$306.5 million equivalent will be financed by an IBRD loan and US$48.425 million by a CTF loan. Table 1 provides a breakdown of Project costs and financing by component and financing source.

Table 1: Project Costs and Financing Sources

Project Components	**Project Cost (US$ Mln)**	**IBRD Financing (US$ Mln)**	**CTF Financing (US$ Mln)**	**% of Costs Financed by IBRD (US$ Mln)**
1. Rehabilitation of Transmission SSs	202.9	202.9		100%
2. Electricity Market Enhancement	95.3	53.7	41.6	56%
3. **Institutional Strengthening of MoECI**	2.5	2.5		100%
Total Baseline Costs	**300.7**	**259.1**	**41.6**	**86%**
Contingencies (15%)	53.2	46.6	6.6	88%
Total Project Costs	353.9	305.7	48.2	86%
Front-End Fees	0.98	0.77	0.22	78%
Total Financing Required	**354.925**	**306.5**	**48.425**	**86%**

C. Lessons Learned and Reflected in the Project Design

39. Strong commitment from energy companies, NERC, and the GoU is critical for implementing energy projects. Ownership by the Borrower is important during Project implementation, especially in Ukraine where implementation of energy projects has been slow. The experience of the first Power Transmission Project with UE and the Hydropower Rehabilitation Project with UkrHydroEnergo (UHE) showed that the strong drive and determination of the participating state-owned companies are crucial.

40. Combining capacity building and TA with investment strengthens project implementation and sustainability. As demonstrated in the implementation of the Hydropower Rehabilitation and first Power Transmission Projects, TA that provided capacity-building support to participating companies (UE and UHE) improved their technical competence, institutional capacity, and governance, thus supporting the sustainability of investments. The Project includes a TA and

capacity-building component (in components 2.4 and 3) to ensure knowledge building and sharing.

41. Bidding Documents Readiness. UE will utilize loan savings from the ongoing Power Transmission Project to prepare the technical specifications and bidding documents for the investments under the Project. This approach will enable tendering for the investment packages before loan effectiveness and will facilitate the timely start of Project implementation.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

42. The proposed Project's institutional and implementation arrangements will take advantage of existing institutional systems. The MoECI and UE already have well-functioning Project Implementation Units (PIUs) staffed with technical experts/safeguards specialists, financial management specialists, and procurement specialists. The Bank will provide further training to the PIUs to strengthen their capacity as needed.

43. UE will be the responsible implementing agency for Components 1 and 2. Its PIU will have fiduciary responsibility, including M&E functions related to the Project's key performance indicators. UE's PIU is well staffed and functioning properly, with Project coordinators appointed for each subcomponent and one director. MoECI will be the responsible implementing agency for Component 3 of the proposed Project. MoECI's PIU will have fiduciary responsibility, including monitoring and evaluation (M&E) functions related to the Project's key performance indicators. The Project Operational Manuals (POMs) are being developed and will be adopted by loan effectiveness.

B. Results Monitoring and Evaluation

44. Monitoring of Project implementation progress and results indicators, as well as progress towards achievement of the PDO, will be the responsibility of UE and the MoECI. Their respective PIUs will collect data and reports and will semi-annually present to the Bank data on progress in achieving the key and intermediate indicators. This will be done in conjunction with Bank team's supervision missions.

C. Sustainability

45. The key to sustainability is to ensure that: (i) UE improves the reliability of Ukraine's power transmission system and supports the implementation of Energy Sector Reforms; (ii) investments are viable and that their benefits exceed their costs; and (iii) efficient and reasonable costs are recovered from transmission tariffs. The Bank is closely engaged in high-level policy dialogue in Ukraine concerning gas, electricity, and heating tariffs in coordination with the IMF and other donors, and is supporting the GoU in implementing Energy Sector Reforms and improving the sector's regulatory framework.

46. At the Project level, UE has shown: (i) its determination to improve the security, reliability, efficiency, and quality of power supply by rehabilitating transmission SSs and strengthening the power transmission network; and (ii) its interest and willingness to apply modern efficient technologies, including the Smart Grid and an MIS.

V. KEY RISKS AND MITIGATION MEASURES

A. Risk Ratings Summary Table

Risk Category	Rating
Stakeholder Risk	**Substantial**
Implementing Agency Risk	
- Capacity	Moderate
- Governance	Substantial
Project Risk	
- Design	Substantial
- Social and Environmental	Low
- Program and Donor	Low
- Delivery Monitoring and Sustainability	Moderate
Overall Implementation Risk	**Substantial**

B. Overall Risk Rating Explanation

47. An overall risk rating of "Substantial" reflects elevated country implementing agency, stakeholder and Project design risks (see table above). Apart from the country level risks, the key factors include: (i) possible cost increases between feasibility and contract award stages; (ii) resistance or delays of NERC approval of UE investment plans and tariff adjustments; and (iii) frequent changes in the senior management of government ministries.

48. These risks will be partly mitigated by effective project management, advance preparation, including procurement packages, which will beready for tendering by effectiveness, and a focus on capacity building. The financing agreements include provisions that would allow unilateral cancellation by the Bank in case project implementation goes off track or the implementation timeline is not maintained. The Project builds on the capacity and knowledge developed in UHE during Hydropower Rehabilitation Project and UE during the first Power Transmission Project. The bidding process will be initiated for a number of projects by effectiveness, which should help to manage cost overruns. In addition, the Project will support training for PIU staff during both Project preparation and implementation.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analyses

49. A detailed analysis of the Project's economic and financial viability is provided in Annex 6. The main features and results are summarized below.

Economic Analysis

50. The Project's economic analysis was carried out in accordance with the Bank's Guidelines for Economic Analysis of Investment Projects (April 2013).

51. **Rationale for public sector investment:** Ukrenergo is responsible for operation of Ukraine's national electricity transmission grid, and it is the nation-wide connecting link between producers and consumers of electricity in Ukraine. Consequently, the integrity, efficiency, reliability, and safety of the transmission service are of vital national importance. Since their activities cover and impact the entire electric power sector, transmission companies tend to be natural monopolies. Unlike investments in other areas of the power sector where projects tend to be generally smaller in size, located in one area, and shorter in duration, transmission investments have special risks and challenges since they are more capital-intensive. These investments also cover large geographic areas, and require longer lead times in the planning process. As a natural monopoly, and given the vital nature of its functions, Ukrenergo remains under state ownership since it has a crucial nation-wide role in providing safe and reliable transmission services in Ukraine.

52. The proposed investments under the Project will further strengthen UE's ability to provide quality transmission services. In addition, the option of private sector investment is not feasible as Ukrenergo is a state company which is allowed to finance its investments either from public sources including tariff or to borrow from International Financial Institutions for priority reconstruction as agreed in Cabinet of Ministers Directive # 1027. Presently, UE can borrow from commercial banks but the interest rates are very high which does not allow the company to fulfill its investment plans and do reconstruct/upgrade transmissions lines as it is overseen in Energy Strategy until 2030.

53. **Rationale for Bank involvement**: The Bank has played an important role through policy advice, technical assistance, and financing in the process of design and implementation of Ukraine's Energy Sector Reforms over the last decade. Under the ongoing Power Transmission Project, in addition to investment financing and technical assistance to Ukrenergo, the Bank is supporting the MoECI in carrying out important reforms and improvements with regard to the electricity market. This includes the introduction of a new Electricity Wholesale Market model and a Balancing Market, and the planned establishment of a Smart Grid. The Government is therefore keen to have continuing assistance from the Bank in building on the work done so far and in helping it deepen and strengthen the ongoing reforms, together with further capacity-building in important sector institutions including MoECI, NERC, and DP Energorynok.

54. **Fiscal impact:** UE, the primary beneficiary under the Project, is a substantial net contributor to the state budget through the annual taxes and dividends distributed from its profits.

55. **Economic viability analysis:** Quantifiable economic costs and benefits were estimated for Component 1 (rehabilitation of SSs). All the investments have satisfactory economic viability indicators (economic internal rate of return – EIRR – and economic net present value – ENPV). For Component 1 as a whole, the EIRR is estimated at 24 percent with an ENPV of US$424.6 million. The EIRR is robust to adverse changes in key underlying parameters and remains at satisfactory levels (see details in Annex 6).

Financial Analysis

56. UE's tariffs for transmission and dispatch services are regulated by the National Electricity Regulatory Commission (NERC). Tariffs are set annually to allow UE to cover its operating expenses and debt service obligations and to carry out approved investments from its earnings. This enables UE to realize a net profit after tax each year which is applied mainly to financing investments.

57. UE's financial performance was strong in 2012 and 2013. It has been in compliance with the financial covenants under the ongoing Power Transmission Project. UE's future financial performance is projected to remain satisfactory over the period 2014-2021 (summarized in the following Table 2 with details in Annex 6).

Table 2: UE's Projected Future Financial Performance

Indicator	2012	2013	2014	2015	2017	2019	2021
Net profit after tax/ Revenues (%)	27%	29%	21%	16%	15%	16%	17%
Self-financing ratio (%)	79%	72%	50%	45%	39%	55%	72%
Debt service coverage ratio	15.6	8.4	4.9	3.6	2.1	2.4	2.5

58. The key financial covenants proposed are that UE should annually maintain:

- A self-financing ratio (ratio of net internal cash from operations to the average of investment expenditures in the preceding, current, and succeeding years) of at least 25 percent starting with the year 2016; and
- A debt service coverage ratio (ratio of net income after tax plus depreciation plus interest to debt service – i.e., the sum of interest plus principal repayment) of at least 1.5.

B. Technical

59. The Project's technical design is considered sound. Comprehensive feasibility studies for Component 1 (Rehabilitation of six SSs) and Subcomponent 2.1 (Implementation of the Program for Integration of the Ukrainian Power System to ENTSO-E) were completed and reviewed by the relevant government agencies, NERC, and the Bank team. The individual subprojects meet accepted international standards. Comprehensive feasibility studies are underway for the remaining three subcomponents and the results and proposed solutions will be available for assessment before loan negotiations.

C. Financial Management

60. The FM arrangements for Project implementation will be satisfactory, subject to implementation of the two conditions listed below. UE is currently implementing the first Power Transmission Project and will continue to use similar arrangements, which will be further strengthened to address known weaknesses, as described below. UE will be responsible Components 1 and 2 of the Project, including CTF financing. The second implementing agency, MoECI, is currently involved as an implementing agency in the ongoing Hydropower Rehabilitation Project and will implement Component 3 of the Project (US$2.5 million).

61. The FM assessment has covered both UE and MoECI in their respective FM areas. The overall FM risk rating for this Project is currently "Substantial," and will be reassessed during implementation. The key risks are related to UE's accounting system, which is still not fully automated, and to problems with project funds allocation in the state budget observed during implementation of the ongoing Power Transmission Project. In light of the changes in the government, both UE and MoECI are facing changes in top management, which may impact Project implementation and disbursements, particularly at the early stages. The complexity of the

proposed Project, given two implementing agencies and two sources of Project financing (IBRD and CTF), contribute to the proposed risk rating.

62. UE will continue to use the FM arrangements which are in place in the ongoing Power Transmission Project. Specifically, UE's financial staff is available and has broad experience in project FM. Project records will be maintained by UE in a set of accounts segregated from its other activities. An automated accounting system is available to maintain UE's accounting records in accordance with the National Accounting Standards, and accounting records related to project implementation are not fully automated. UE will update the accounting software to ensure fully automated project accounting and reporting *(condition for effectiveness)*. UE will be responsible for accounting and reporting on the use of its share of IBRD and CTF funds, and quarterly interim financial reports (IFRs) will be submitted separately for IBRD and CTF funding. UE will also be responsible for the annual audit of its share of Project funds as well as its entity financial statements (an entity audit is requested for the financial analysis of UE). A POM will be prepared for this Project and will cover all aspects of FM and disbursement at UE, including use of IBRD and CTF funding, as well as coordination of UE with the MoECI and MoF (*condition of effectiveness*).

63. MoECI will also continue to use the FM arrangements in place in the ongoing Hydropower Rehabilitation Project. MoECI's chief accountant is currently in charge of FM and disbursement in the ongoing project and she will continue in this role until the new financial consultant is hired early during implementation. MoECI will be responsible for quarterly IFRs related to its portion of the Project, and will be responsible for the annual audit of these funds. The Project's accounting records will be maintained in a segregated set of accounts in MoECI's existing system.

D. Procurement

64. The Project's procurement risks are mainly related to the complexity of the procurement packages under the major component: (i) the Procurement Plan includes two major, complex, high-value "Supply and Installation of Plant and Equipment" packages (Component 1 and Subcomponent 2.1), and Supply and Installation of Smart Grid Systems and Balancing Market (Components 2.2 and 2.3); (ii) there are a limited number of qualified potential suppliers/contractors due to the uniqueness of the sector and complexity of the tasks required; (iii) Project implementation delays can occur if the bidding documents are not ready by the effectiveness date; and (iv) insufficient allocation in the state budget may lead to delays in contract implementation, possibly resulting in eventual complaints from contractors.

65. Component 3 (TA to the MoECI) is limited to consultancy assignments; it is assumed that this will be implemented with the help of the MoECI's Energy Program Coordination Unit (EPCU), which is responsible for implementation of similar assignments under two other Bank-financed projects currently under implementation.

66. The risks will be mitigated by: starting preparation of the bidding documents at the stage of Project preparation; hiring an international procurement consultant (firm) to help during implementation; broadly advertising bidding opportunities; and ensuring timely availability of funds. The unmitigated residual risk comprises delays in the selection of a procurement consultant and lack of interest from potential bidders, resulting in a low level of competition.

67. The Project procurement risk is rated "Substantial," while the residual Project risk is rated "Moderate" after the implementation of mitigation measures.

E. Social (including Safeguards).

68. One of the main objectives of the GoU's Energy Sector Reforms is to stimulate sustainable economic growth and investments in Ukraine by: (i) improving the security, reliability, efficiency, and quality of energy supply at reasonable cost; and (ii) supporting the country's aspirations with regard to legal and technical harmonization and increased integration of its energy market with the EU Internal Energy Market. The overall social impacts of the Project are positive in terms of: improving energy supply; mitigating the environmental impacts of the energy sector; supporting growth, investment, and employment; and facilitating the introduction of EU norms and standards. Energy consumers will ultimately benefit from the Project, but the investments will be largely invisible to them.

69. **Involuntary resettlement.** OP 4.12 is not triggered by the Project. The scope of investment is limited to SSs and does not include investment for transmission line (TL) improvement. The direct beneficiary will be UE, which proposed and designed the investments and has full ownership of the facilities and the land on which they are situated. The proposed investments will not cause any permanent or temporary physical or economic displacement.

70. **Gender aspects.** Electricity SSs do not have direct operational impacts on men or women. The Project's footprint as designed will not have a direct impact on the ultimate electricity end users at the household level; therefore, it is not necessary to disaggregate the impacts of the Project's outcomes on men and women. Overall improvement of the stability of electricity supply will benefit the entire population and therefore the gender composition of the beneficiaries will be identical to that of Ukraine's population. Given that direct project beneficiary is the UE, the institutional gender analysis will be conducted in the framework of subcomponent 2.4 Support for Institutional Development and recommendations of the assessment will be incorporated in the development strategy and other relevant institutional development documents.

F. Environment (including Safeguards)

71. Any adverse environmental impacts are site-specific and anticipated to be minimal and to take place mainly during the construction stage. The Project will be implemented within the footprint of existing infrastructure and is not expected to affect the population or to lead to conversion or degradation of natural habitats or forest ecosystems. The proposed mitigation measures will be able to either fully mitigate or significantly reduce any adverse impacts and can be readily designed.

72. The proposed Project is in strict compliance with GoU and World Bank regulations, policies, and procedures for environmental assessment. Under Ukrainian legislation, the Project is not included in the "List of Activity Categories and Installations which are environmentally unsafe or hazardous." In accordance with World Bank environmental safeguards policies (OP/BP/GP 4.01 Environmental Assessment), the Project has been assigned a "Category B" rating.

73. For rehabilitation of SSs (Component 1) and introduction of reactive power compensation devices (Subcomponent 2.1), UE provided the Bank with Environmental Impact Assessments (EIAs) and Environmental Management Plans (EMPs) in English; these were disclosed in the Infoshop prior to appraisal. Ukrainian language versions were disclosed on UE's website (http://www.ukrenergo.energy.gov.ua). The EIAs and EMPs for SSs identified the main issues for construction and operation as: (a) during the construction phase – dust, noise, and disposal of waste and used equipment, and PCB identification and management (if found/ applicable); and (b) during the operation phase – electric/magnetic field and noise. The chief issues identified for operation were noise, electric field, and bird collisions. The EMPs contain standard mitigation measures to minimize negative impacts and highlight specific measures, consistent with applicable international practices, in the event of obsolete PCB-containing equipment or soil contamination by PCBs.

74. For Smart Grid Introduction (Subcomponent 2.2) and Balancing Market (Subcomponent 2.3), no EIAs and EMPS are required under OP 4.01 since these components consist of installation of IT software and hardware (Category C- type activities), however, the TORs for these activities will require complying with basic standards and requirements and as such, the consultants will prepare basic EIA and EMPs.

75. Component 3 will finance TA, possibly including development of feasibility studies for new energy projects. It is not anticipated that any of these new projects will be Category A. An environmental management framework (EMF) was be prepared for Component 3 indicating that the Terms of Reference (ToRs) for feasibility studies need to be consistent with relevant World Bank safeguards policies.

76. The EIA and EMP documents were disclosed by the Client on June 25 and comments were solicited from interested stakeholders, including local NGOs. June 27 was established as a deadline for comments on EIA and EMP and no comments were received. Also, the Client sent written requests for formal comments to local NGOs and representatives of local authorities (e.g. environmental and/or local interest groups, etc.). The documented evidence of disclosure and communication regarding feedback on EIA and EMP documents has been provided by the Client and is on project file.

77. The EMF for Component 3 was disclosed by the Client on June 24 and comments were solicited from interested stakeholders. EMF does not require consultations due to its specific nature, because it governs the preparation of feasibility studies only.

G. Other Safeguards Policies Triggered *(if required)*

78. No other safeguards policies are triggered.

ANNEX 1: RESULTS FRAMEWORK AND MONITORING

UKRAINE: SECOND POWER TRANSMISSION PROJECT (PTP 2)

Project Development Objective

PDO Statement

To improve the reliability of power transmission system and support implementation of the Wholesale Electricity Market in Ukraine.

These results are at the:	Project Level

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values					Frequency	Data Source/ Methodology	Responsibility for Data Collection	Comments
				YR1	YR2	YR3	YR4	YR5				
1) Number of outages at rehabilitated SSs is reduced 1. Novokyyivska 2. October 3. Kremenchug 4. Zhytomyrska 5. Cherkaska 6. Sumy		Number	 35 23 37 28 12 27	 35 23 37 28 12 27	 35 23 37 28 12 27	 35 23 37 28 12 27	 18 12 19 14 6 14	 8 5 9 7 3 7	Semi-annual progress report, Midterm review, and Completion	Semi- annual progress reports of UE	UE PIU	Indicator for Component 1 Annual Values
2) Decrease in power usage for own needs of Substations which were reconstructed: 1. Central Region SS Novokyyivska, October, Kremenchug, Zhytomyrska 2. North Region SS Cherkaska, Sumy		MWh	 3863 3299	 3863 3299	 3863 3299	 3863 3299	 3735 3230	 3546 3091	Semi-annual progress report, Midterm review, and Completion	Semi- annual progress reports of UE	UE PIU	Indicator for Component 1 Annual Values
3) Share of electricity traded on bilateral basis and day ahead market in WEM of Ukraine		%	0	0	0	10	30	50	Semi-annual progress report, Midterm review, and Completion	Semi- annual progress reports of UE	UE PIU	Indicator for Component 2.3 Annual Values

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values					Frequency	Data Source/ Methodology	Responsibility for Data Collection	Comments
				YR1	YR2	YR3	YR4	YR5				
Intermediate Results Indicators												
1) Implementation progress of SS Rehabilitation 1. Novokyyivska 2. October 3. Kremenchug 4. Zhytomyrska 5. Cherkaska 6. Sumy		milestones	0	Bidding Document Ready	Contract Signed	Detailed design by the contractor ready and expertise review approved	Works on High Voltage Unit 110 – 150 kV start	Works continue on High Voltage Units 330 kV/ Contracts Completed	Annual	Semi- annual progress reports of UE	UE PIU	Intermediate Result indicator for Component 1
2) Reduced operating and maintenance costs at the rehabilitated SSs 1. Novokyyivska 2. October 3. Kremenchug 4. Zhytomyrska 5. Cherkaska 6. Sumy		%	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	25 25 25 25 25 25	50 50 50 50 50 50	Annual	Semi- annual progress reports of UE	UE PIU	Intermediate Result indicator for Component 1
3) Electricity losses per year in the project area	x	MWH	0.5	0.5	0.5	0.4	0.3	0.2	Annual	Semi- annual progress reports of UE	UE PIU	Indicator for Component 1 Area - Central and North Region
4) Energy Not Served reduced by 50% 1. Central Region 2. North Region		%	35 7	0 0	0 0	0 0	25 25	50 50	Annual	Semi- annual progress reports of UE	UE PIU	Intermediate Result indicator for Component 1 Baseline is Annual MWh
5) Voltage at bus bars 35kV at the rehabilitated SSs are within operating limits +-5% 1. Novovolynskaya 2. Lutsk Pivdenna 3. Kove 4. Shepetivka		V	40,000 40,000 40,000 41,000	40,000 40,000 40,000 41,000	40,000 40,000 40,000 41,000	39,000 39,000 39,000 40,000	39,000 39,000 39,000 40,000	35,000 35,000 36,000 36,000	Annual	Semi- annual progress reports of UE	UE PIU	Indicator for Component 2.1 Annual Values

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values					Frequency	Data Source/ Methodology	Responsibility for Data Collection	Comments
				YR1	YR2	YR3	YR4	YR5				
5. Kamenets-Podilska			42,000	42,000	42,000	40,000	40,000	36,000				
6) Implementation progress of Smart Grid		milestones	Feasibility Study completed	Bidding Document Ready	Contract Signed	Detailed Design ready	Equipment Supply Starts	System fully Supplied and Tested/ Contract Completed	Annual	Semi- annual progress reports of UE	UE PIU	CTF Indicator
7) Implementation of Balancing Market		milestones	Feasibility Study completed	Contract Signed for hard and software	Hard and software installed	Hard and software Fine-tuned for the launch	Balancing Market is launched	Modifications to BM. Balancing Market Operational / Balancing Market Operational	Annual	Semi- annual progress reports of UE	UE PIU	Intermediate Result indicator for Component 2.3
8) Implementation progress of MIS		milestones	Feasibility Study Completed	Bidding document completed	Contract Signed	Detailed Design Completed	Hardware and Software Supplied	Testing and staff training completed System operational	Annual	Semi- annual progress reports of UE	UE PIU	Intermediate Result indicator for Component 2.4
9) Tons of GHG emissions reduced or avoided based on Electricity Savings		Tons/year	0	344,199	734,427	1,000,464	1,579,257	2,804,407	Annual	Semi- annual progress reports of UE	UE PIU	CTF Indicator
10) Annual energy savings		MWh/year	0	1,500	8,000	47,000	220,000	430,000	Annual	Semi- annual progress reports of UE	UE PIU	CTF Indicator
11) Increased installed RE capacity in Ukraine ES		MW	0	180	395	500	680	1,100	Annual	Semi- annual progress reports of UE	UE PIU	CTF Indicator

Project Development Objective Indicators	
Indicator Name	Description (indicator definition etc.)
Number of outages at rehabilitated SSs is reduced	This indicator measures the improvement in the transmission system reliability by the reduction in the number of equipment outages in the rehabilitated SSs.
Decrease in power usage for own needs of Substations which were reconstructed	This indicator measures reduction in power used for own needs of the Substation. Substation internal power consumption is monitored and recorded by UE
Share of electricity traded on bilateral basis in WEM of Ukraine	This indicator measures the share of the electricity traded on bilateral basis in the Wholesale Electricity Market of Ukraine.

Intermediate Results Indicators	
Indicator Name	Description (indicator definition etc.)
Implementation progress of SS rehabilitation	This indicator monitors progress in SS rehabilitation.
Reduced operating and maintenance costs in the rehabilitated SSs	This indicator reports on reduction in operation and maintenance costs of the rehabilitated SSs.
Energy Not Served reduced by 50%	The reduction in Energy Not Served is measured against the 2013 baseline level which is calculated on the past 5 years of ENS in each of the Power Regions (Central and North Regions).
Electricity losses per year in the project area	This indicator measures the electricity losses in two project areas (Central and North Regions of Ukrainian Power Grid) and is calculated based on the amount of power transited in the Region divided by amount of total loses and represent indirect losses (power used for the own needs of the substations).
Voltage at busbars 35kV at the rehabilitated SSs are within operating limits +-5%	This indicator measures the off peak voltage level at bus bars 35kV within the limits after installation of shunt reactors and is a calculated based off peak load flow modeling.
Implementation progress of Smart Grid technologies	This indicator measures progress in implementation of the Smart Grid program financed by the Project
Implementation progress of Balancing Energy Market System	This indicator monitors progress in implementation of the Balancing Energy Market System.
Implementation progress of MIS	This indicator monitors progress in implementation of installation of the new MIS at UE.
Tons of GHG emissions reduced or avoided	This indicator measures the GHG emissions avoided annually due to increase generation og existing RE and by new RE generation plants due to smart grid investment
Annual energy savings	This indicator measures the annual energy savings from reduced technical losses in transmission grid attributed to the installation of Smart grid elements
Increased installed Renewable Energy capacity in Ukraine Energy System	This indicator measures the deployment of an additional 1,100 MW of wind/solar RE installed capacity in Unified Energy System of Ukraine

ANNEX 2: DETAILED PROJECT DESCRIPTION

UKRAINE: Second Power Transmission Project (PTP2)

1. Ukraine's power transmission system comprises eight regional grids, shown in Table 3. The 750 kV network (comprising about 4,121 km of transmission lines) forms the backbone of the power transmission system. However, the 330 kV network (comprising about 13,346 km of transmission lines) is the main transmission network within the regions and also underpins the 750 kV interconnections between regions and neighboring countries operating in parallel with Ukraine (Russia, Belarus, and Moldova).[1]

Table 3: Regional Power Transmission Grids

Region	Area (km^2)	Main Features of Regional Transmission Grids	
		Transmission Lines (TLs)	Substations (SS)
Central	111,600	2,401 km of 110–330–750 kV TLs	13 SS at 330–750 kV with transformer capacity of 6,097 MVA
Northern	84,000	2,155 km of 110–330–750 kV TLs	14 SS at 330–750 kV with transformer capacity of 7,527.5 MVA
Donbas	53,200	4,041.48 km of 35–800 kV TLs	29 SS at 220–750 kV with transformer capacity of 23,428.1 MVA
Dnieper	83,700	4,036.6 km of 330–750 kV TLs	21 SS at 330–750 kV with transformer capacity of 18,097.1 MVA
Crimea	26,100	1,369.4 km of 220–110–330 kV TLs	17 SS at 110–330 kV with transformer capacity of 3,838.8 MVA
Southern	86,400	2,545.2 km of 35–110–220–750 kV TLs	14 SS at 110–330 kV with transformer capacity of 4,896.5 MVA
South-Western	69,000	2,259.87 km of 330–750 kV TLs	9 SS at 330–750 kV with transformer capacity of 3,900 MVA
Western	88,700	3,678.91 km of 220–750 kV TLs	20 SS 220–750 kV with transformer capacity of 10,800 MVA

2. At the beginning of 2014, Ukraine's transmission system comprised 136 SSs with voltages ranging from 110 to 750 kV, including: 750 kV - 8 SS; 500 kV - 2 SS; 400 kV - 2 SS; 330 kV - 88 SS; 220 kV - 33 SS; and 110 kV - 3 SS. The system had a total installed capacity of transformers and auto-transformers (AT) of 78,884.381 MWs (including auxiliary power transformers – 452,781 MVA) and 22,892 km (by circuits) of backbone and interstate overhead

[1] Ukraine is part of the Interconnected Power System (IPS) of the former Soviet Union, where the 330 kV voltage level was extensively used for power transmission instead of the 400 kV used in the Western and Central European (UCTE) grid.

transmission lines with voltages ranging from 35 to 800 kV, including: 800 kV - 99 km; 750 kV – 4.121 km; 500 kV - 375 km; 400 kV - 339 km; 330 kV – 13.346 km; 220 kV - 3976 km; 110 kV - 538 km (interstate); and 35 kV - 98 km (interstate). A great number of SSs and overhead lines (OHLs) are old and have exhausted their projected service term, so need a replacement. Annex 2-A includes a detailed overview of the Ukrainian transmission system and its performance.

3. The proposed Second Power Transmission Project (PTP2) will focus on three main areas: strengthening the National Transmission System; enhancing the electricity market; and providing Technical Assistance (TA) to Ukrenergo (UE) and the Ministry of Energy and Coal Industry (MoECI). The Project will consist of three components, whose description and objectives are summarized below.

Component 1: Rehabilitation of Transmission Substations (US$241.5 million IBRD).

4. The description of Component 1 and Subcomponent 2.1 is highlighted below. This is an indicative list of the priority investments to be verified by the feasibility study consultants. The final selection and details of the proposed investments will be confirmed as the Project progresses.

5. **Novokyivska SS** envisages the construction of indoor GIS 330kV under the "one-and-a-half-breaker" scheme (330-11) with five fields to enable connection of five 330kV OTLs feeders and installation of three ATs feeders (two existing AT + 1 additional AT-3). Total number of connections is eight, they will be organized into 5 fields, two of which will be incomplete. It requires installation of 13 CB modules. In the incomplete fields a place for two future connections will be envisaged (AT-4 and 1 CL). The project foresees construction of indoor GIS 110kV under “two main sectionalized busbars with two bus couplers without transfer busbar" scheme (110-8). Busbars are segmented with bus tie circuit breakers. GIS includes 22 CB modules to enable connection

6. **October SS** envisages construction of indoor GIS 330kV under the "one-and-a-half-breaker" scheme (330-11). Within the scope of the rehabilitation there will be provided and installed two fields for the existing three connections (two AT and 1 OHL), and there will be spare place for one more diameter (for the future connection of AT-3 and the projected cable line Zakhidna – October) in both the switchgear field and the control room. It is expected that the procurement and implementation of the futures bays becomes part of the contract of each of the additional elements (transformers or lines). The Outdoor Switchyard 110 kV will be will be rehabilitated as GIS-110 k, under «two main busbars segmented with CB without a transfer busbar, and two bus couplers» scheme

7. **Kremenchug SS** envisages reconstruction of the indoor 330kV and 150 kV switchyards A 330kV level switchyard will be transferred to one-and-a-half-breaker scheme, organized in four modules providing eight bays GIS. Future expansion on 330 kV switchyard with space for an arrangement of the fifth diameter (two bays) to accommodate two 330 kV OTL will be envisaged. 150kV switchyard will be reconstructed maintaining the wiring scheme “two main busbars without transfer busbar". The busbars are segmented with bus tie circuit breakers. The total technical solution foresees a switchgear of 25 bays, within the scope of the rehabilitation there will be provided and installed only 21 bays (25 circuit breaker modules), which are enough for the existing and ongoing connections, and there will be spare places for the other four bays in both the switchgear field and the control room. The outdoor switchyard 330kV at SS

Kremenchug needs to be converted to the “one-and-a-half-breaker” scheme, which corresponds to the requirements of Ukrainian technical standards.

8. **Zhytomyrska SS** envisages construction of indoor 330kV GIS using the scheme (330-11) "one-and-a-half-circuit-breaker" for 6 connections: 3 ATs + 3 OTLs. Total – 6 connections, organized in 3 diameters (9 CB modules). Additionally, a place for 1 reserve field with 3 CB for prospective connections will be envisaged. Outdoor Switchyard 110 kV will be replaced by indoor GIS 110kV using the scheme (110-8) "two main busbars, segmented by circuit-breakers without transfer busbar with two bypass circuit-breakers and two bus couplers". Total – 15 connections (19 CB modules). For future SS development a place for reserve bays for 4 connections (4 cable/overhead lines, out of which 2 cable/overhead lines «Zhytomyr-Tyaga-1» and «Zhytomyr-Tyaga-2» are considered for connection) will be provided.

9. **Cherkassy SS** envisages replacement of obsolete and physically worn-out high-voltage equipment of the 330kV Outdoor Switchyards, whose design life has expired, without modification of the existing primary scheme of Outdoor Switchyard 330kV (330-10) – "transformer – busbars” with lines connection via two circuit-breakers. The scheme of the Outdoor Switchyard 330kV envisages 4 connections (AT-2, AT-3 and 2 OTLs). This scheme requires 4 circuit breakers, three of which are already replaced with recently installed new SF6 insulated CBs. So, installation of only 1 new circuit breaker is needed. For rehabilitation of Outdoor Switchyard 110 kV the Project envisages construction of GIS-110 kV under «two main busbar systems without a transfer busbar» scheme. Total – 10 connections (11 CB modules), Additionally, a place for four cable lines connections will be envisaged at GIS 110 kV.

10. **Sumy SS** Upon reconstruction of SS "Sumy" the primary connections scheme of the Outdoor Switchyard 330kV will remain unchanged: (330-10) "transformers – busbar” with lines connection via two circuit-breakers. Reconstruction will include expansion of Outdoor Switchyard 110kV by construction of one line bay (OTL 110kV at SS "Basy") and bringing primary connections to a standard scheme: "two main busbars, segmented by circuit-breakers and a transfer bus system with two bypass circuit-breakers and two bus couplers" (110-8) by construction of two bays for bus tie CB installation and two bays for bus couplers. At the same time, all primary high-voltage equipment will be replaced (circuit-breakers, disconnectors, voltage transformers, current transformers, valve-type lightning arresters and so on). These connections under this scheme will require 21 CBs. Additionally, a place for reserve bays for 4 connections (4 cable/overhead lines, out of which 2 cable/overhead lines «Sumy-Basy-1» and «Sumy-Basy-2» for railroad are considered for connection) will be envisaged in AIS-110 kV.

11. The implementation schedule for Component 1 is shown in Annex 2-A.

Component 2: Electricity Market Enhancement (US$110.925 million). This component will consist of four subcomponents:

Subcomponent 2.1: Implementation of the Program for Integration of the Ukrainian Power System to ENTSO-E (US$11 million).

12. **Shunt Reactors** will work at five 35 kV SSs (Novovolinskaya, Lutsk Pivdenna, Kovel, Shepetıvka, and Kamenets-Podilska). Reconstruction will consist of the installation of shunt devices at the 35 kV busbars and assuming that in the proposed Substations there are two bus bars at 35 kV level. The required equipment will be, for each shunt: (i) Three-phases or three single-phase 20MVAr at 35kV busbars; (ii) Measurement equipment; (iii) Protections

equipment; and (iv) Local and remote control. The implementation schedule for this subcomponent is shown in Annex 2-A.

Subcomponent 2.2: Smart Grid Introduction (US$48.425 million CTF).

13. This subcomponent includes several technical activities, such as priority investments (a) modernization of the telecommunications network between renewable energy sources, key substations of transmission networks and system operator control centers; and (b) modernization of the regional and national system of load control centers to improve system control and dispatch including more efficient integration renewable energy into the power grid.

Subcomponent 2.3: Balancing Market (US$41.5 million).

14. This subcomponent will consist of procurement and installation of hardware, software, metering, and other elements needed by UE as the Balancing Market Operator to: determine the transfer capacities that are available for cross-border trading; receive and administrate physical notifications; perform system operational scheduling; and procure and utilize ancillary services. Balancing Market settlement and planning system components require substantial metering input. Metering information is furthermore required for forecasting purposes and load profiling and will be installed at SSs.

Subcomponent 2.4: Institutional Development of Ukrenergo (US$10 million).

15. This subcomponent includes establishment of a corporate-wide Management Information System (MIS) in UE. It will also finance consulting services for UE to improve financial management, build capacity in procurement and project management, and train its staff.

Component 3: Institutional Strengthening of MoECI (US$2.5 million IBRD).

16. Component 3 will finance TA to the MoECI, which will oversee Project implementation. TA will support: establishment of and training for the Project Implementation Unit (PIU); supervision of Project implementation; guidance and training in Project implementation and M&E; conduct of capacity-building and knowledge-sharing workshops; conduct of sector-wide knowledge sharing and Project results dissemination workshops; preparation of consolidated annual Project audits; preparation of required studies related to the Project; and financing of incremental operating costs.

17. The suggested budget for the TA component is shown in Table 4:

Table 4: Suggested Budget for Component 3

Expenses	**US$ mln**	**%**
Staff costs	0.5	20.0
Consulting/institutional development	1.5	60.0
Capacity-building costs	0.2	8.0
Annual Project audits	0.3	12.0
Total	**2.5**	**100.0**

Annex 2-A: Detailed Implementation Schedule for Component 1 and Subcomponent 2.1

UKRAINE: Second Power Transmission Project (PTP2)

1. Details of the implementation schedule for Component 1 (Rehabilitation of six Transmission Substations) and Subcomponent 2.1 (Implementation of the Program for Integration of the Ukrainian Power System to ENTSO-E) are found in the following table:

Central Power System

Novokievska

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Installation preparatory work																				
Supply of Equipment																				
Installation of New Equipment 330 kV																				
Installation of New Equipment 110 kV																				
Installation control & prot 330 kV																				
Installation control & prot 110 kV																				
Local Mini SCADA/RTU (final tuning)																				
Existing Equipment Dismantling																				
Capacity Building																				
Testing and Commissioning																				

October

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Installation preparatory work																				
Supply of Equipment																				
Installation of New Equipment 330 kV																				
Installation control & prot 330 kV																				
Dismantling 330 AIS & Installation Preparatory works for 110 GIS																				
Installation of New Equipment 110 kV																				
Installation control & prot 110 kV																				
Local Mini SCADA/RTU (final tuning)																				
Existing Equipment Dismantling																				
Capacity Building																				
Testing and Commissioning																				

Zhytomyr

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Installation preparatory work																				
Supply of Equipment																				
Installation of New Equipment 330 kV																				
Installation of New Equipment 110 kV																				
Installation control & prot 330 kV																				
Installation control & prot 110 kV																				
Local Mini SCADA/RTU (final tuning)																				
Existing Equipment Dismantling																				
Capacity Building																				
Testing and Commissioning																				

Cherkassy

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Installation preparatory work AIS 330 kV																				
Supply of Equipment AIS 330 kV																				
Installation of AIS Equipment 330 kV																				
Installation control & prot 330 kV																				
Testing and Commissioning 330 kV																				
[illegible] 330 kV																				
Supply of Equipment GIS 110 kV																				
Installation of GIS Equipment 110 kV																				
Installation and control & prot 110 kV																				
Local Mini SCADA/RTU (final tuning)																				
Existing Equipment Dismantling																				
Capacity Building																				
Testing and Commissioning																				

North -East Power System

Kremenchuk

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Installation preparatory work																				
Supply of Equipment																				
Installation of New Equipment 330 kV																				
Installation of New Equipment 150 kV																				
Installation control & prot 330 kV																				
Installation control & prot 150 kV																				
Local Mini SCADA/RTU (final tuning)																				
Existing Equipment Dismantling																				
Capacity Building																				
Testing and Commissioning																				

Sumy

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Supply of Equipment																				
Build a new relay panel amd controls building																				
Installation preparatory work 330/110																				
Installation main Equipment 330 kV																				
Installation control & prot 330 kV																				
Installation main Equipment 110 kV																				
Installation control & prot 110 kV																				
Local Mini SCADA/RTU (final tuning)																				
Capacity Building																				
Testing and Commissioning																				

Shunt Reactors

	2014				2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Preparatory work																				
Tender for EPC Company																				
Engineering work																				
Tender for Supervision Consultant																				
Supply of Equipment																				
Installation preparatory work 330/110																				
Installation of new Equipment (regulators)																				
Local Mini SCADA/RTU (final tuning)																				
Capacity Building																				
Testing and Commissioning																				

Annex 2-B: Detailed Overview of the Ukrainian Transmission System and its Performance

UKRAINE: Second Power Transmission Project (PTP2)

1. Details of the technical condition of OHLs and SSs and critical needs for their rehabilitation are outlined in the following sections.

Table 5: Technical Condition of OHLs 35–800 kV (as of 12/31/2013)

Voltage	Total km (by circuit)	Years in service (by circuit)					
		25-30		30-40		Over 40	
		km	%	km	%	km	%
800 kV	98,540	0	0.0	0	0.0	98,540	100.00
750 kV	4,120,541	1,493,770	36.25	1,582,351	38.40	414,740	10.07
500 kV	374,760	159,600	42.59	177,060	47.25	0	0.0
400 kV	338,950	0	0.0	0	0.0	338,95	100.00
330 kV	13,346,558	1,501,978	11.25	3,604,239	27.01	6,382,167	47.82
220 kV	3,975,965	209,092	5.26	268,620	6.76	3,289,660	82.74
110 kV	555,352	15,460	2.78	127,978	23.04	330,105	59.44
35 kV	112,403	0	0.0	465,500	41.41	364,630	32.44
Total:	**22,923,069**	**3,379,900**	**14.74**	**5,806,798**	**25.33**	**10,890,625**	**47.51**

2. According to Table 5, about 16,700 km of transmission lines (TLs) have been in operation for over 30 years (72.8 percent of all lines), of which 10,890 km have been in operation for more than 40 years (47.5 percent of all lines). For reference, the projected useful life of OHLs is 40 years. Compared to 2011, the incremental length of TLs by years of operation is 0.7 percent with over 30 years of operation and 6.0 percent with over 40 years of operation. This suggests further aging and inadequate rates of reconstruction of TLs, which has led to complications in their operation.

3. With the increase in recent years of emissions of harmful substances by chemical and metallurgical enterprises in some regions, the aging of the metal structures has been accelerated and is largely reflected in the increasing number of automatic dropping of TLs.

4. The annual plans for repair works of foundations, supports, ground wares and porcelain insulation replacement, and other works aimed at ensuring the reliability of transmission require more material and labor every year. Developed in 2011, UE's "Program for Modernization of Transmission" includes significant investments in upgrades to OHLs for the period 2012-2016, which will significantly improve their condition. However, funds for capital repair, modernization, and reconstruction of TLs allocated pursuant to Decree No. 1 and the investment program in recent years, including planned for 2013, do not cover the costs. The aging of facilities and equipment occurs much faster than the replacement performed during reconstruction and repair.

5. Actual rates of reconstruction and repair not only do not reduce existing disproportions, but they also do not even cover the actual wearing out of the lines.

6. To maintain a satisfactory technical condition for TLs in operation for over 40 years, a number of additional measures for maintenance and repair are required: regular inspections of

metal parts' corrosion, including welding; replacement of porcelain insulation; and use of modern fittings to protect OHLs from vibration and galloping, etc.

7. The situation of some of the most important and expensive equipment (such as power transformers and circuit breakers) should be highlighted. The Western experience suggests a lifespan of up to 50-60 years for transformers using modern materials with low losses and low resulting heat (electrical steel, winding insulation, and so on). But ATs installed at Ukrainian SSs, manufactured locally especially before 1972, have construction weaknesses as well as components that do not comply with modern requirements (such as untightened bushes, tanks that do not protect oil from contact with ambient air, and so on). The established state standard lifespan for ATs and transformers is 25 years; therefore equipment that has worked for more than 25 years is classified as having exhausted its term of operation and is obsolete (increased no-load losses, overheating, low technical characteristics of insulation). All ATs of Component "A" of first stage of the first Power Transmission Project (renovation of 10 SSs of Dnieper and Donbas Power Systems) belonged to the above-mentioned transformers and were replaced.

8. There is still a great need to replace a significant amount of equipment at UE's SSs. According to UE data, as of December 31, 2012, 229 of 343 ATs were 25 years or more, meaning that 67 percent of ATs have exceeded their projected useful life and should be replaced. By voltage, ATs that have been in service over 25 years (the standard lifespan) are distributed as follows: 56 units 220 kV (84 percent); 130 units 330 kV (61 percent); 3 units 400 kV (100 percent); 7 units 500 kV (64 percent); and 33 units 750 kV (69 percent).

9. When changing them, it is important to choose modern technology transformers with low levels of own losses to the extent possible. This implies a larger initial investment, but this would be amortized over a reasonable time during the lifespan of the equipment.

10. For power transformers with great capacity, single-phase units should be fitted instead of three-phase units (the initial investment is bigger) and single-phase units should be kept as a reserve (they are more manageable) to serve for several transformers with similar characteristics, a circumstance that occurs with some frequency (e.g., two identical transformers in the same SS). In case of failure, replacing a single-phase unit is much more economical than replacing a three-phase transformer.

11. For SSs located in the transmission network, it is worth noting the convenience of using the 1.5 breaker scheme (there are other flexible schemes) as a more flexible design that allows maintenance works of SSs in operation without putting lines out of service.

12. As for the CBs installed in the power grid, the situation regarding obsolete technology and useful life is distributed by voltage level as follows: 220 kV – 75 percent use obsolete technology and 71 percent have worked over 25 years; 330 kV – 72 percent use obsolete technology and 58 percent have worked over 25 years; 400-500 kV – 70 percent are obsolete and 55 percent have worked over 25 years; and 750 kV – 46 percent are obsolete and 22 percent have worked over their projected lifespan.

13. A final comment is that in international practice there is a tendency to avoid a wide variety of equipment and a large number of manufacturers to reduce the variety, quantity, and total cost of spare parts in stock. This should be taken into account while replacing old equipment.

14. The situation regarding technical losses is also very critical, as evidenced in Table 6.

Table 6: Technical Losses

Indicator		Power System								IPS of Ukraine
Losses		South-Western	Dnipro	Donbass	Central	Crimean	Western	Southern	Northern	
2010										
Absolute losses	Million kWh	459.06	1028.70	685.62	554.58	293.14	489.85	365.41	277.57	**4,153.93**
Relative losses	%	1.69	1.84	1.60	2.53	4.83	1.98	1.38	1.68	**2.59**
Gross supply		27,226.2	55,845.5	42,819.8	21,924.8	6,063.3	24,748.9	26,568.9	16,527.9	**160,293.5**
2011										
Absolute losses		488.86	1041.22	667.16	489.54	276.15	521.30	348.29	276.31	**4,108.82**
Relative losses	%	1.76	1.67	1.53	2.35	4.42	1.81	1.35	1.8	**2.51**
Gross supply		27,817	62,394	43,487	20,870	6,247	28,796	25,772	15,341	**163,456.0**
2012										
Absolute losses		540.21	1,104.92	648.97	518.22	230.60	570.04	352.17	300.77	**4,265.9**
Relative losses	%	1.93	1.70	1.50	2.36	3.80	1.85	1.35	1.72	**2.53**
Gross supply		27,961	64,843	43168	21,929	6,061	3,0791	26,148	17,449	**168,822.0**

15. System disturbances resulting in breakdowns/outages of lines/equipment in the backbone network of Ukraine's Interconnected Power System **(**IPS) at SSs and OTLs 220-800 kV are major reasons for Energy Not Served (ENS). ENS during 2008-2012, with an indication of the number of disturbances/incidents by each power system, are given in Table 7.

Table 7: Faults and Energy Not Served (ENS)

Power System	Period (year)	Total # of disturbances	# of human-caused O&M and managerial disturbances	# of human-caused poor organization of SS equipment maintenance	ENS ('000 kWh)
Total for UE	2008	126	24	21	220.32
	2009	93	18	16	152.75
	2010	107	16	16	1,361.11
	2011	87	19	14	272.12
	2012	102	7	15	156.86

Source: Annual reports of UE for 2008-2012.

16. Technical failures of main network equipment on OHLs and SSs are the major cause of ENS. The specific causes of failures for the last three years are presented in more detail in Table 8.

Table 8: Specific Causes of Failure in Network Equipment

Cause	2010		2011		2012	
	Category I	Category II	Category I	Category II	Category I	Category II
Staff fault	2	14	0	19	0	7
Poor maintenance	0	16	0	14	2	15
Poor quality of technical and operational guides	2	6	1	4	1	3
Design deficiencies	0	8	0	3	0	2
Construction deficiencies	1	2	0	1	0	3
Manufacturing deficiencies	2	7	0	7	3	9
Erection deficiencies	0	7	0	6	0	5
Repair deficiencies	0	6	0	4	1	1
Natural disasters	2	19	0	10	1	19
Unauthorized persons' actions	0	13	2	16	3	27
Total	**9**	**98**	**3**	**84**	**11**	**91**
ENS (MWh)	**1,133.750**	**227.36**	**0.00**	**272.12**	**0.00**	**156.86**
Total ENS (MWh)	**1,361.11**		**272.12**		**156.86**	

Note: Category I: Damage to the main equipment, a complete suspension of all power generating equipment of thermal power plants and CHPs with installed capacity of over 100 MW and hydropower stations with installed capacity of over 20 MW, main equipment damage, leading to interruption of power supply for more than 24 hours, technological breakdowns, resulting in outages lasting more than 3 days, an interruption of the power supply to consumers resulting in the ENS amount of 100,000 kW/h and more, an operation of UPS of Ukraine or part of it with a frequency below 49.5 Hz for more than 30 minutes or with a frequency of 50.3 Hz for more than 1 hour.
Category II: Similar to Category I, but for TPPs and CHPs with installed capacity less than 100 MW and for HPPs with installed capacity below 20 MW, secondary equipment damage, leading to the interruption of power supply for more than 24 hours, technological breakdowns that lead to forced outages of less than 3 days, an interruption of the power supply to consumers resulting in the ENS amount from 10,000 to 100,000 kW/h., breakdowns as a result of wrong operation of protection and automation equipment, staff mistakes, leading to outages of lines and equipment with not served electrical or thermal energy, etc.

17. The most frequent failures are caused by such reasons as: staff fault, poor maintenance, manufacturing deficiencies, and unauthorized persons' actions. The number of failures due to staff fault dropped substantially in 2012, although it is too early to detect a trend. The number of failures caused by poor maintenance seems quite stable, although high, which is probably related not only to the poor quality of maintenance but also to insufficient time for implementation due to the impossibility of line outages. The number of failures caused by unauthorized persons' actions (e.g., theft, vandalism) has increased, which suggests the need to strengthen asset security measures.

18. The Unified Power System (UPS) of Ukraine presents some "bottlenecks" that reduce its stability and reliability:

a) The transmission system operation is affected by the suboptimal structure of generating capacities. The structure of generation in Ukraine is characterized by insufficient load following capacities, which, with the slowdown in growth of base consumption, has

increased problems in daily load regulation. These problems manifest themselves especially acutely during the spring/summer periods, in winter when a sudden warming takes place, and during weekends and holidays, when a sharp drop of consumption overnight forces the System Operator to restrict NPPs' generation and to reduce TPPs' generation to a volume below the permitted minimum of equipment.

b) According to UE´s data, there is a lack of about 1,000 MW of mobile cold reserves in the system (with a startup time of less than eight hours). 200 MW units at TPPs form a group of regulating capacities with a startup time from hot to semi-cold regime in less than eight hours. The Market Operator uses these reserves for daily load adjustment, which leaves the System Operator without sufficient mobile cold reserves. The new WEM model and the tertiary/Balancing Services Market, including the possibility of contracting in the intraday markets in real time, will allow a significant improvement in load adjustment.

c) In the current regime, maintaining the required voltage levels, including at NPPs, has become more complicated, and operational measures (use of reactive power from TPPs and HPPs) are not sufficient. In the short run, one solution to maintain acceptable voltage levels on busbars 750 kV and 330 kV of nuclear power facilities is to install compensating devices on NPPs' busbars (or on busbars on core SSs, located close to the plant). These devices (for example, shunt reactors and batteries of static capacitors) will contribute to increased static stability of the grid.

d) Disconnection of TLs is a common practice in Ukraine to maintain voltage levels in the transmission grid. Installation of reactive power sources (reactances and banks of capacitors) in conflictive points (with a high index of ENS) is effective in regulating the voltage level in the network. Frequent disconnection of the lines to regulate voltage levels in the network "punishes" the CBs, as many position changes per year cause wear and shorten their useful life.

e) It should be added that installation of reactive power regulation in the transmission voltage levels of 330 kV and 750 kV is particularly urgent.

f) It is clear that improving the infrastructure of the transmission grid represents a tangible benefit and allows bringing the transportation network to the European network parameters and so facilitates its integration with the ENTSO-E system, one of the GoU's objectives.

g) The Southern Power System continues to be a problematic region of Ukraine's UPS, with a low reliability of power supply. Low throughput capacity of separate components of the main network in the region and recent changes in load flows require construction of new lines and modernization and reconstruction of several SSs, such as the 750 kV Dniprovska, Zaporizka, and Pivdennodonbaska SSs. The Ismail node and Odessa region also need improvements in their power supply quality.

h) Given the out-of-service status of the Chernobyl NPP, the issue of the Central Power System's power supply reliability, particularly in the city of Kyiv, has arisen. Due to improper operation of open switchgear at the Chernobyl NPP, emergency regimes are possible, in which two feeding high-voltage lines (HVL) lines of 750 kV will be disconnected. Besides, since 2009, due to its technical condition, the maximum load of

AT-3 of Chernobyl's open switchgear is limited to 60 percent of its nominal capacity. Thus in the repair modes, it is necessary to provide additional load. The first step to solving this problem was the construction of the 750 kV Kyivska SS.

i) The growth of electricity consumption in Kyiv led to operational limits of the OHLs and ATs of Kyiv's 330 kV ring. The overload of these lines makes impossible the implementation of the planned 330 kV transmission repairs and affects the operation of the Kyiv node. In these circumstances, to improve the reliability of power supply to consumers in Kyiv, it is necessary to link the 750 kV Kyivska SS to the 330 kV grid of the Kyiv node. First, there is an urgent need to construct the entry of HVL 330 kV Pivnichna – Novokyivska into the 750 kV Kyivska SS. Also, to address the issue of rapid growth of consumption in Kyiv, the project for the 330 kV Zakhidna SS was approved in 2012 and its commissioning is scheduled for the end of 2014.

j) In the South-Western System, the separation of Burshtynsky Island from Ukraine's UPS to operate in parallel with ENTSO-E has created imbalances, greatly complicating the main network repair campaign and reducing the reliability of power supply to consumers in the Ivano-Frankivsk, Chernivtsi, and Ternopil regions, especially in post-accident mode when the minimum voltages on busbars 110 kV of SSs 330 kV are not provided, which can lead to automatic emergency shutdown. All of these problems acutely raise questions about the need for change in the rest of this transit nodal scheme by building cross-connection with transit 330 kV Burshtynsky TPP-Ternopil-Khmelnytsky. In addition, there is an urgent need for network construction for power supply in the Chernivtsi region.

k) In the western part of Ukraine, there is a concentration of more than 6,000-7,000 MW of generating capacity (Rivne and Khmelnytsky NPPs, Dniester pump storage plant), the excess of which should be transferred to the energy deficit areas of Ukraine. The currently operating transmission network of 330-750 kV cannot transmit the excess power from the west to other regions of Ukraine. The throughput capacity of intersections West-Vinnitsa, Vinnitsa-South Ukraine, South Ukraine NPP-Dnieper, Lviv-Ukraine has to be increased substantially.

l) To date, the design scheme for power off-take from Zaporizhzhya NPP, while expanded to 6,000 MW, has not been fully implemented. The scheme envisaged the construction of the 750 kV transmission line Zaporizhzhya NPP-Kakhovska with the 750/330 kV Kakhovska SS for delivering power from the NPP to southern Ukraine and unloading network crossings of the Southern Power System. Currently, for the purpose of financing construction of the 750 kV transmission line Zaporizhzhya NPP-Kakhovska with SS 750/330 kV Kakhovska, a loan agreement with EBRD and EIB has been signed and construction completion is scheduled by the end of 2015.

m) Most of the SSs of the 330-750 kV network of Ukraine's UPS are usually overloaded, which creates a problem for their timely and full maintenance due to the complexity of disconnecting them for repairs.

n) Most SSs' equipment has reached the end of its useful life, is obsolete and worn out, and needs to be replaced. Lack of funding for modernization programs precludes significant improvements in the reliability of equipment and in the automation of monitoring and operation of Ukraine's UPS.

ANNEX 3: IMPLEMENTATION ARRANGEMENTS

UKRAINE: Second Power Transmission Project (PTP2)

Project Institutional and Implementation Arrangements

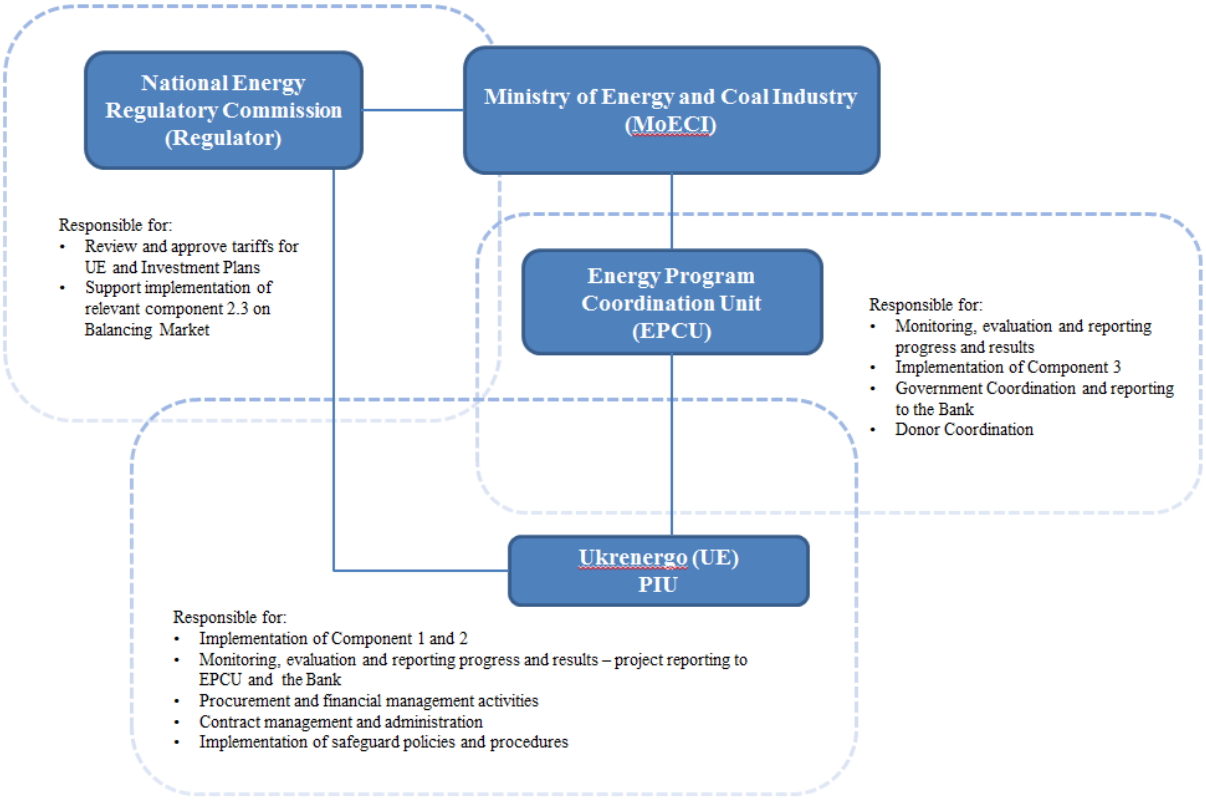
Summary of Implementation Arrangements

1. Most of the Second Power Transmission Project (Components 1 and 2) will be implemented by Ukrenergo (UE), the implementing agency for the ongoing Power Transmission Project (Loan 4868-UA). UE will be the implementing agency for both the IBRD and CTF financing (except for US$2.5 million of IBRD funding).

2. The Ministry of Energy and Coal Industry (MoECI) will be the implementing agency for Component 3. The MoECI is involved in implementation of the first Power Transmission Project (Loan 4868-UA) as the line ministry for this sector. Additionally, the MoECI is responsible for implementation of one of the components of the ongoing Hydropower Rehabilitation Project (Loan Nos. 4795-UA and 7791-UA).

3. Figure 2 illustrates implementation arrangements that will be utilized under the Project and the entities involved. Key responsibilities are described in more detail below.

Figure 2: PTP2 Implementation Arrangements



Second Power Transmission Project

4. The implementation of Components 1 and 2 of the proposed Project will be the responsibility of the national energy company Ukrenergo (UE, the Project Implementing Entity).

5. UE has experience in all aspects of development and operation of high-voltage power networks in Ukraine. It utilizes UkrSetProekt, an engineering firm, for specialized support on a regular basis, including the preparation of the Project. The rehabilitation of transmission SSs and strengthening of the transmission network under the proposed Project will be based on the same engineering and procurement approach used by UE during the first Bank-supported power project (Loan 3865), which was successfully completed in 2002, and the first Power Transmission Project (Loan 4868-UA). An experienced international consultant, who has prepared the feasibility study, will also assist UE in Project management, preparation of bidding documents and technical specifications. The organizational structure of the entities involved in the Project can be found on UE's website.

6. The proposed Project represents about 20 percent of UE's investment program over the next five years. It covers the main priorities of the investment program; therefore, its implementation requires strong support from several key parts of the company. To meet this requirement, UE has established a Project Implementation Unit (PIU) that is an integral part of the company and consists of staff who regularly perform technical, financial, procurement, and construction management activities related to the implementation of investment projects. The PIU will be responsible for procurement scheduling, preparation of bidding documents, contract management, reporting, and other aspects of Project implementation that require technical coordination of various Project activities. The PIU's financial management specialist will be responsible for financial management and disbursement under the Project. The head of the PIU will be responsible for overall management of the Project and reports to the director of UE. The head of the PIU will also manage consultants hired under the TA component of the proposed Project.

7. UE has prepared and will implement an Environmental Management Plan (EMP) for the Project.

8. EPCU in the MoECI will continue to provide overall reporting Energy Sector Reforms, including implementation of the ongoing Hydropower Rehabilitation Project and on Component 3 of the proposed Project.

9. UE will monitor and evaluate on an ongoing basis the progress of Components 1 and 2 and achievement of Project objectives, and will submit annual progress reports to the Bank at the end of each calendar year. UE will also prepare and furnish to the Bank, by December 31, 2017, a Mid-term Review (MTR) report integrating the results of the M&E activities. UE will review the MTR report with the Bank by March 31, 2018, and will take all measures required to ensure efficient completion of the Project, based on the conclusions and recommendations of the MTR.

10. **Implementation schedule**. According to the draft implementation schedule shown in Annex 2-A, the Project will be implemented over a period of five years and is expected to be completed by December 31, 2019. The rehabilitation of six 330 kV SSs is on the critical path of Project implementation due to constraints in scheduling outages of 330 kV TLs for replacement of high-voltage equipment. The installation of new protective relaying and SS automation and control equipment is also a challenging task that will require close coordination with other

Project components. Introduction of the corporate-wide MIS and Balancing Market elements is a stand-alone activity that will primarily depend on the support and readiness of UE's corporate management to adopt new organizational and business practices.

11. **The MoECI will supervise Project implementation with the help of EPCU**. EPCU was created around an existing PIU in the MoECI that has been implementing Energy Sector Reforms under Component D of the Hydropower Rehabilitation Project. The responsibilities of EPCU will include: reporting to the World Bank, providing procurement and FM support to UE's PIU, aggregating data and reports, checking invoices and delivering them to the MoF, supervising the quality of service survey, and M&E. The existing EPCU capacity will be increased by adding procurement, FM, and power engineering specialists and a secretary. The Project EPCU will benefit from the lessons learned and experience of the Hydropower Rehabilitation Project's EPCU.

Energy Sector Reforms

12. The key policy and institutional elements of the GoU's proposed Energy Sector Reforms were defined and established by the GoU in partnership with the World Bank and in close cooperation with the European Commission and other donors. The Energy Sector Reforms agenda has strong country commitment and a well-established coordination mechanism. At the level of the MoECI, program coordination is performed by the Department for Cooperation with IFIs, which leads the Energy Sector Reforms program. The IFI Department at the MoECI has two main tasks: (i) to review, approve, and update the conceptual plan for legal and technical harmonization of Ukraine's energy sector with the EU Internal Energy Market; and (ii) to coordinate and supervise implementation of the conceptual plan, including review and approval of changes in the legal and regulatory framework, prioritization of investments in energy infrastructure, and identification of priority programs of technical assistance.

13. The IFI Department at the MoECI is supported by the Energy Program Coordination Unit (EPCU), established in 2005. Initially, EPCU was funded by the PHRD Grant[2] provided by the Government of Japan, which was rolled over in 2007 to the TA component of the ongoing Hydropower Rehabilitation Project. EPCU's main responsibilities include: (i) developing an action plan for legal and technical harmonization of Ukraine's energy market with the EU Internal Energy Market, including regulatory requirements for electricity, coal, and gas markets, environmental requirements, regulation of cross-border trade, and a monitoring and evaluation program; (ii) developing a program of priority investments in energy infrastructure; (iii) identifying TA needs and preparing proposals for donors' support in the energy sector; and (iv) assisting the MoECI and other government agencies in preparing and coordinating implementation of specific investment projects supported by the Bank, such as the proposed PTP2.

Financial Management, Disbursements and Procurement

Financial Management

14. The FM arrangements for Project implementation will be Satisfactory subject to implementation of two conditions (see below). UE is currently implementing the ongoing Power Transmission Project and will continue to use similar arrangements, which will be further

[2] The PHRD Grant Agreement was signed by the GoU and the World Bank on November 18, 2004.

strengthened to address the known weaknesses, as described below. UE will be responsible for both the IBRD and CTF financing. MoECI, the second implementing agency, is currently involved as an implementing agency in the ongoing Hydropower Rehabilitation Project, and will implement a small portion (US$2.5 million) of the IBRD financing.

15. The FM assessment was finalized during Project preparation and appraisal and covered both UE and MoECI in their respective areas. The overall FM risk rating for this Project is currently "Substantial," and it will be reassessed during implementation. The key risks are related to UE's project accounting system, which is still not fully automated, and to problems with Project allocation in the state budget repeatedly observed during implementation of the ongoing Power Transmission Project. Given the changes in the government, both UE and the MoECI may face changes in top management, which may impact Project implementation and disbursements at the early stages.

16. UE will continue to use the FM arrangements in place in the ongoing Power Transmission Project, and its established PIU which consists of UE staff. Specifically, UE's financial staff is available and has broad experience in project FM. Project records will be maintained by UE in a set of accounts segregated from UE's other activities. An automated accounting system is available to maintain UE's accounting records in accordance with the National Accounting Standards, and accounting records related to project implementation are not fully automated. UE will update accounting software that will enable fully automated project accounting and reporting (*condition for effectiveness*). UE will be responsible for accounting and reporting for the use of its share of IBRD and CTF funds, and quarterly IFRs will be submitted separately for IBRD and CTF funding. IFRs will be prepared on a quarterly basis and submitted to the Bank within 45 days after the end of each calendar quarter, starting from the quarter in which the first Project disbursements occur. The format will be based on the templates agreed with the Bank.

17. UE will also be responsible for the annual audit of Project financial statements that will cover the components implemented by UE. UE will carry out an audit of its entity financial statements, prepared under the requirements of International Financial Reporting Standards (IFRS). Such entity audit is requested for the financial analysis of UE. Both audits will be carried out by an auditor acceptable to the Bank based on acceptable ToRs and in accordance with the International Standards on Auditing (ISA). The due date will be six months after the end of each year. Both audit reports shall be publicly disclosed by both UE and the Bank on their respective websites within two months of their submission. Management letters will be excluded from the disclosure requirement.

18. The issue of sufficient project funds allocation in the state budget arose repeatedly during the implementation of the ongoing Power Transmission Project, and discussion of risk mitigation measures to address and prevent this problem were part of this Project's preparation. UE, MoECI, and MoF will need to follow the budgeting procedure closely; further, commitment of MoECI and MoF management to ensure timely and full allocation of funds in the state budget will be required.

19. Given the complexity of the Project, multiple implementing agencies, and different sources of finance, a Project Operations Manual (POM) will be prepared for this Project *(condition of effectiveness).* The POM will cover all aspects of FM and disbursement at UE, including use of IBRD and CTF funding, as well as coordination with the MoECI and the MoF

where relevant. The POM will provide more detail on the internal controls in place for Project implementation and will also put time limit requirements on review/approval of Project documents by MoECI/MoF.

20. MoECI will also continue to use the FM arrangements in place in the ongoing Hydropower Rehabilitation Project. MoECI's chief accountant is currently in charge of FM and disbursement in the ongoing project and she will continue in this role until the new financial consultant is hired early during the project implementation. The MoECI's FM capacity has been developed through attendance at World Bank seminars and involvement in the ongoing Hydropower Rehabilitation Project.

21. The Project's accounting records will be maintained in a segregated set of accounts in MoECI's existing systems. MoECI will be responsible for quarterly IFRs related to its portion of the Project. IFRs reports will be prepared on a quarterly basis and submitted to the Bank within 45 days after the end of each calendar quarter, starting from the quarter in which the first Project disbursements occur. The format will be based on the templates agreed with the Bank.

22. The MoECI will be responsible for the annual audit of Project financial statements related to its component. The audit will be carried out by an auditor acceptable to the Bank based on acceptable ToRs and in accordance with the ISA. The due date will be six months after the end of each year. The audit report shall be publicly disclosed by MoECI and the Bank on their respective websites within two months of their submission. Management letters will be excluded from the disclosure requirement.

23. The Project will use existing country systems to the extent possible, particularly at the UE level (e.g., use of a commercial bank and not the State Treasury, responsibility of existing staff). Existing country systems at the MoECI will also be used to the extent possible (budgeting, accounting, staffing, etc.). Additional arrangements are being made to strengthen capacity when needed.

24. The Project's FM supervision will follow the traditional risk-based approach, and will be carried out annually in full scope. Timing and frequency may be modified in response to changes in the risk assessment.

Disbursements

25. Disbursements of both IBRD and CTF financing will follow the traditional disbursements mechanism, which includes direct payments, special commitments, and use of Designated Accounts (DAs). The MoF will open two DAs for UE (one for IBRD and one for CTF), as well one DA for the MoECI. DAs will be opened in Ukreximbank in US$, and additional transit accounts may be opened as needed for payments in other currencies. The MoF will delegate to the MoECI and UE management of payments from DAs, but will retain the oversight function. Such disbursement arrangements will enable efficient control over the flow of funds, reconciliation of account balances, and preparation of periodic reports.

Procurement

Applicable Guidelines:

26. Procurement for the proposed Project will be carried out in accordance with the Bank's:

- Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits & Grants by World Bank Borrowers, published in January 2011;

- Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits & Grants by World Bank Borrowers, published in January 2011; and
- Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits, dated October 15, 2006, and revised in January 2011.

Summarized Procurement Plan:

27. Based on the results and recommendations of the feasibility study, the detailed Procurement Plan was discussed and agreed with the Beneficiary and provides information on procurement packages, methods, and the Bank review method. This plan will be agreed and finalized at negotiations. The finalized Procurement Plan will be disclosed on the Bank's external website. Based on recent experience in implementation of similar contracts in the region, it was decided that procurement of contracts for Design, Supply and Installation (DS&I) and Supply and Installation (S&I) will be done on a post-qualification basis.

28. During Project implementation, the Procurement Plan will be updated as needed in agreement with the Bank Project team to reflect actual Project implementation needs.

I. General

29. Period covered by this Procurement Plan: the Project implementation period.

30. The entire investment component of the Project will be implemented by UE with the help of the selected consulting firm, similar to the arrangements under the ongoing Power Transmission Project.

31. The TA component will be implemented by the MoECI with the help of its current EPCU, which is responsible for implementation of similar assignments under two other Bank-financed projects currently under implementation.

32. The procurement risks are mainly related to the complexity of the procurement packages; the limited number of qualified potential suppliers/contractors due to the uniqueness of the sector and complexity of the tasks; Project implementation delays due to unfinished bidding documents; insufficient funds allocations for a specific country financial year leading to delays in the contracts' implementation and eventual complaints from the contractors.

33. The risks will be mitigated by hiring an International Procurement Consultant (firm) to help the Agency in implementing the activities properly and in a timely manner; broadly advertising bidding opportunities; and ensuring timely availability of funds by agreeing with the MoF on actions to regularize or increase cash flow as needed by the Project to meet cash flow needs in case there is a need to increase allocations under the special fund of the state budget.

34. Unmitigated residual risk consists of delays in the selection of a procurement consultant and lack of interest from potential bidders, resulting in a low level of competition.

35. The procurement risk under the TA component is minor, as the current group of implementation consultants (in the EPCU) is experienced in the Bank's procurement rules and especially in the selection of consultants. The MoECI should maintain the EPCU for the entire duration of Project implementation.

36. The overall Project risk is "Substantial," and residual Project risk is "Moderate" after implementation of mitigation measures.

37. A detailed procurement capacity assessment is provided in the Procurement Risk Assessment management System (PRAMS) module.

II. Procurement of Goods

Ref. No.	Description of Assignment	Estimated Cost (US$ mln.) including VAT and contingencies	Procurement Method	Pre-Qualification	Review by Bank (Prior/Post)	Expected Bid Opening
1	Lot 1 Reconstruction of "Novokievska" SS	39	ICB	n/a	Prior	April 2015
	Lot 2 Reconstruction of "Zhovtneva" SS	25				
	Lot 3 Reconstruction of "Zhytomirska" SS	40				
	Lot 4 Reconstruction of "Cherkasska" SS	37.5				
	Total for 4 lots	***141.5***				
2	Lot 1 Reconstruction of "Sumy" SS	40	ICB	n/a	Prior	August 2015
	Lot 2 Reconstruction of "Kremenchuk" SS	60				
	Total for 2 lots	***100***				
3	Installation of 5 reactivation shunt reactors	***11***	ICB	n/a	Prior	September 2015
4.	Management Information System	***10***	ICB	n/a	Prior	
5.	Equipment for Smart Grid operation	***48.425***	ICB	n/a	Prior	
6.	Balancing Market System	***25***	ICB	n/a	Prior	
7	Metering for SS	***16.5***	ICB	n/a	Prior	
	Total	***352.425***				

III. Selection of Consultants

38. **Prior Review Threshold**: Selection decisions are subject to prior review by the Bank as stated in Appendix 1 to the Guidelines on Selection and Employment of Consultants.

39. **Shortlist comprising entirely national consultants:** A shortlist of consultants for services estimated to cost less than US$300,000 equivalent per contract may comprise entirely national consultants in accordance with the provisions of paragraph 2.7 of the Consultants Guidelines.

40. All technical specifications and ToRs will be subject to Bank prior review.

	Selection Method	Prior Review Threshold (US$)	Comments
1.	Firms	500,000	First contract by each method of selection will be subject to Bank prior review
2.	IC (individuals)	200,000	First contract will be subject to Bank prior review and long-term consultants for key positions
3.	Single Source Selection	All	

41. Any other special selection arrangements**: NA**

Consultant Service Assignment (UE component)

Ref. No.	Description of Assignment	Estimated Cost (US$ mln.)	Selection Method	Review by the Bank	Expected Proposal Submission	Contract Signing
1	Services on Project management	1.8	QCBS	Prior	April 2015	
2	Audit of Project and company accounts	0.7	LCS	Prior	February 2016	

Consultant Service Assignment (MoECI component)

Ref. No.	Description of Assignment	Estimated Cost (US$)	Selection Method	Review by the Bank	Expected Proposal Submission	Contract Signing
Energy Sector Reforms and Development of Program Coordination Unit						
1	Head of PCU - Procurement Specialist	158,112	IC	Prior	Jan 2015	
2	Financial Management Specialist	124,224	IC	Prior	Jan 2015	
3	Power Sector Specialist	124,224	IC	Prior	Jan 2015	
TA component						
4	Support of introduction of Directive 2003/80/EC provisions by Ukrainian Power Plants	400,000	QCBS	Prior	Aug 2015	
5	Preparation of the Feasibility Study for the Hydropower Rehabilitation Project-3	500,000	QCBS	Prior	Oct 2015	
6	Adoption of EU legislation in Ukrainian Energy Sector	600,000	QCBS	Prior	Jun 2015	
7	Preparation of the Feasibility Study for the Power Transmission Project-3	500,000	QCBS	Prior	Apr 2017	
Audit of Component 3						
8	Audit for 2015	18,000	LCS	Prior	Nov 2016	
9	Audit for 2016	18,000	LCS	Prior	Nov 2017	
10	Audit for 2017	18,000	LCS	Prior	Nov 2018	
11	Audit for 2018	18,000	LCS	Prior	Nov 2019	
12	Audit for 2019	21,740	LCS	Prior	Nov 2020	
	Total	**2,500,000**				

42. **Post-review percentages and frequency:** In addition to the Bank's prior review, the Project team recommends a post-review of at least 10 percent of the total number of contracts signed that were not subject to prior review. Procurement documents will be kept readily available for the Bank's *ex post* review during supervision missions or at any other point in time. It is expected that post-reviews will be conducted every 12 months. A post-review report will be prepared and filed in the procurement post-review system.

Environmental and Social (including safeguards)

Environmental

43. The Bank has supported Ukraine in its efforts to rehabilitate and restructure its energy sector through policy dialogue, TA, and financing since the early 1990s. Substantial institutional capacity to implement the Bank's safeguard policies has been developed, particularly by beneficiaries of the first Power Transmission Project, including UE, the beneficiary of the proposed Project. UE has adopted ISO 14001, so environmental management is an important element of its institutional development agenda. The company is currently performing ISO 14001 internal audits at all eight of its Energy Systems and plans to go through an ISO 14001

Surveillance Audit in August 2014 to confirm its Environmental Management System. At present, each Energy System has several experts with environmental backgrounds who report to the Chief Engineer of the respective region. In addition, there is a Chief Environmental Department in UE's office in Kyiv, consisting of three experts who collect data from each Energy System and carry out supervision of EMP implementation. In summary, the institutional capacity to implement the requirements of the EMPs already exists within the Borrowers' organizational structure.

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP 4.01)	[x]	[ ]
Natural Habitats (OP/BP 4.04)	[ ]	[x]
Pest Management (OP 4.09)	[ ]	[x]
Physical Cultural Resources (OP/BP 4.11)	[ ]	[x]
Involuntary Resettlement (OP/BP 4.12)	[ ]	[x]
Indigenous Peoples (OP/BP 4.10)	[ ]	[x]
Forests (OP/BP 4.36)	[ ]	[x]
Safety of Dams (OP/BP 4.37)	[ ]	[x]
Projects in Disputed Areas (OP/BP 7.60)*	[ ]	[x]
Projects on International Waterways (OP/BP 7.50)	[ ]	[x]

Social

44. **Social Impact**. The proposed Project is an element of the government's Energy Sector Reforms. Specifically, the Project aims to improve the reliability of electricity supply through investments to rehabilitate transmission SSs and strengthen the power transmission network. The Project raises no issues of inequity, conflicting rights, adverse social impacts, or governance.

45. Access to reliable electricity is a key driver of economic growth and a direct means of reducing poverty by improving the productivity of households and enhancing the delivery of social services. Ukraine has virtually universal electricity service coverage and the tariff system includes a functioning mechanism to support low-income households. Like many other countries in the region, Ukraine is implementing reforms in its energy sector, which *inter alia* involves tariff adjustments towards full cost recovery and financial discipline, including bill collection. This raises the issue of social protection, to ensure that low-income households have access to an adequate energy supply. The proposed Project does not contain additional financial targets or conditions, but reinforces these ongoing national efforts by stimulating creation of additional fiscal space through a more efficient energy market.

46. **Gender Aspects.** Electricity SSs do not have direct operational impacts on men or women. The Project's footprint as designed will not have a direct impact on the ultimate electricity end users at the household level; therefore, it is not necessary to disaggregate the impacts of the Project's outcomes on men and women. Overall improvement of the stability of electricity supply will benefit the entire population and therefore the gender composition of the beneficiaries will be identical to that of Ukraine's population. Given that direct project beneficiary is the UE, the institutional gender analysis will be conducted in the framework of subcomponent 2.4 Support for Institutional Development and recommendations of the

* By supporting the proposed Project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas.

assessment will be incorporated in the development strategy and other relevant institutional development documents.

47. **Involuntary Resettlement.** OP 4.12 is not triggered by the Project. The proposed investments will not cause any permanent or temporary physical or economic displacement. Land acquisition will not be required. The team has visited the proposed sites for the transmission SSs and confirmed they will be rehabilitated within existing facilities on land that belongs to UE and is not used in any other way. There are no illegal users or squatters; moreover, most of the transmission improvements will occur on existing transmission towers. The direct beneficiary will be UE, which proposed and designed the investments. The UE has had experience with land acquisition and resettlement and received orientation on the Bank's social safeguards, and thus is in a good position to ensure that the Involuntary Resettlement Policy is not triggered throughout the whole period of Project implementation. The social development specialist will join the monitoring mission at least once to visit subprojects' sites.

Monitoring & Evaluation

48. Monitoring of Project implementation progress and results indicators, as well as progress towards the achievement of PDOs, will be the responsibility of the MoECI as well as UE. The PIUs of UE and the MoECI will collect data and reports and will bi-annually present data on progress in achieving the key and intermediate indicators to the Bank. This will be followed up in conjunction with the Bank team's supervision missions.

ANNEX 4: OPERATIONAL RISK ASSESSMENT FRAMEWORK (ORAF)

UKRAINE: Second Power Transmission Project (PTP2)

<table>
<tr><th colspan="7">Project Stakeholder Risks</th></tr>
<tr><td>Stakeholder Risk</td><td colspan="6">Rating Substantial</td></tr>
<tr><td rowspan="4">Risk Description:

The Project’s stakeholders are: (i) MoECI; (ii) UE, (iii) Other power sector stakeholders i.e. NERC /NAK ECU /Energorinok and others. Major stakeholdes MoECI, UE, NERC are state organizations and stable but can be influenced by changes in national politics. Impacts are more likely to affect the reform program than the Project’s physical implementation.
There is a stakeholder risks that several distribution companies, at least one power generation company, and many large power consumers -- who will engage in the bilateral power market (WEM) -- are private enterprises. It is likely that these private players, as well as the stakeholders in the government and state-owned power companies, will need time to prepare for the bilateral trade</td><td colspan="6">Risk Management:

The Presidential Administration and the Ministry of Energy and Coal Industry started implementation of Energy Sector Reforms in 2006 with approval of the Energy Strategy till 2030, followed by review and update of this strategy in 2011/2012, with final approval of Updated Energy Strategy till 2030 in March 2013. From the beginning, the government’s approach has been incremental and cautious, and this will not change in the short period. However, the MoECI and other government (NERC/NAK ECU/Energorinok and others) stakeholders understand the urgent need to modernize the energy system and improve efficiency of their operations. Risks of policy reversals at this stage are limited.</td></tr>
<tr><td>Resp:
Client</td><td>Stage:
Implement ation</td><td>Recurrent:
☑</td><td>Due Date:</td><td>Frequency:
Yearly</td><td>Status:
In Progress</td></tr>
<tr><td colspan="6">Risk Management:

The Project would include a communication campaign aimed at raising awareness of the population concerning the ongoing reforms of the Wholesale Electricity Market (WEM). The campaign would emphasize the changes related to introduction of a new model of bilateral contracts in the WEM. To facilitate beneficiaries’ participation in Project monitoring, the team plans to work with civil society organizations and other stakeholders to ensure efficient monitoring of the results by stakeholders. Risk of engagement of private players will be mitigated by in-depth capacity building, public consultations trainings to mitigate the stakeholder risk and possible delays in the implementation of WEM.</td></tr>
<tr><td>Resp:
Both</td><td>Stage:
Implement ation</td><td>Recurrent:
☑</td><td>Due Date:</td><td>Frequency:
Yearly</td><td>Status:
Not Yet Due</td></tr>
</table>

and in some cases may have issues with elements of the new law and how it is implemented.						

Implementing Agency Risks (including fiduciary)						
Capacity	**Rating**	**Moderate**				
Risk Description: UE and MoECI have adequate implementation capacity. Their procurement and FM specialists are experienced and have worked with the first Power Transmission and under Hydropower Rehabilitation Projects for the past seven years without major problems. The contract management capacity in UE is distributed between its head office in Kyiv and the regional branch offices in eight regional grids. Main works financed under the Project are done in two out of eight regional grids. UE has sufficient capacity as it has a rehabilitated around 40 similar SSs and is constructing numerous TLs every year with Bank and other IFIs' support and with its own funds. MoECI has also participated in multiple TAs financed by IFIs and donors, actively cooperates with the Energy Community Secretariat, and has a very active IFI Department with support from EPCU. UE and MoECI fiduciary staff has participated in number of trainings over the past seven years.	**Risk Management:** The Bank team will monitor implementation during supervision visits and in addition UE prepares quarterly progress reports for the most important high value contracts.					
	Resp:	**Stage:**	**Recurrent:**	**Due Date:**	**Frequency:**	**Status:**
	Both	Implementation	☑		Quarterly	In Progress
	Risk Management: All Project components and subcomponents were defined at both the central (in Kyiv) and local levels and at two participating energy grids (Central and Northern). UE's Central PIU will be responsible for Project implementation. MoECI will continue to operate with the established EPCU, which will implement Component 3 (Institutional Strengthening of MoECI). The Project will establish and detail implementation arrangements, systems, and procedures to be followed through the Project Operations Manual (POM). Additional training will be provided by the Bank related to FM, procurement, M&E, and environmental and social safeguards as per the recommendations and findings from the assessments carried out during preparation.					
	Resp:	**Stage:**	**Recurrent:**	**Due Date:**	**Frequency:**	**Status:**
	Client	Implementation	☑		Quarterly	In Progress

Governance	Rating	Substantial				
Risk Description: Given the number of governmental agencies (MoECI, NERC, NAK ECU, Energorinok) and one transmission company (UE) involved in the Project's implementation, it could be difficult to exercise sufficient oversight and control of Project implementation.	**Risk Management:** The overall management, coordination, and monitoring and reporting requirements for the Project are the responsibility of EPCU at MoECI and UE's PIU, which are experienced and have managed similar activities through the first Power Transmission and Hydropower Rehabilitation Projects. Governance structures and Project controls were developed and set out in the POM and training will be provided to EPCU and UE's PIU and other Project participants as required. The Project budget allocations will reflect the necessary requirements for governance and management of the Project, including training and institutional strengthening.					
	Resp:	**Stage:**	**Recurrent:**	**Due Date:**	**Frequency:**	**Status:**
	Bank		☑		Yearly	In Progress
	Risk Management: The Bank will continue to facilitate broader engagement with civil society, development partners, think tanks, and other organizations on policy discussions and will support coordinated efforts. However, the Bank realizes that the upcoming Parlament election puts certain limitations on what can be done.					
	Resp:	**Stage:**	**Recurrent:**	**Due Date:**	**Frequency:**	**Status:**
	Both		☑		Yearly	In Progress
Project Risks						
Design	**Rating**	**Substantial**				
Risk Description: The project design works for the first Power Transmission Project are fully completed. Tender Documents and Design Documentation for Components 1 and 2.1 of Second Power Transmission Project are in process of development and by Board date will be finalized. UE has good consultants (AF Mercados) international power and procurement consultants, and local Ukrainian consultants (IMEPOWER and ENCOG).	**Risk Management:** During all the stages of Project preparation specific attention to this issue would be given by setting conditions for participating in the Project. The new Smart Grid subcomponent will require particular attention as it introduces new innovative tools that have not been used in Ukraine before.					
	Resp:	**Stage:**	**Recurrent:**	**Due Date:**	**Frequency:**	**Status:**
	Both	Preparation	☐	15-Jul-2014		Not Yet Due
	Risk Management: Ensuring effective Project implementation will require special monitoring effort at various levels (Project supervision and implementation support at the Bank, UE, and MoECI), with clearly defined performance indicators. Possible conflicts will be anticipated and explicit solutions found among concerned stakeholders. The team is in regular contact with UE via audio- and video-conferences to monitor the progress of Project preparation/implementation and to identify issues early if/when they arise. In parallel, the Bank will continue active donor coordination with EBRD, EIB, KfW,					

<table>
<tr><td rowspan="2">EBRD and EIB will also fund projects for rehabilitation of SSs and construction of new TLs and UE recently started a project with KfW. There is a risk that the PIU at UE might be stretched with so much financing coming from different sources. Another risk is that the Smart Grid component and Balancing Market elements are still not fully designed and UE does not have experience in such projects.</td><td colspan="6">and other IFIs on Project design and implementation of projects in the sector.
UE's PIU is supported by consultants to ensure adequate attention is given to the development of investment plans and that feasibility level and preliminary designs are accurate and can be used to determine cost estimates upon which the Project can be appraised (relevant to Subcomponents 2.2, 2.3, and 2.4). This will include a careful review of design inputs, technical standards, and estimates along with market value comparisons – as appropriate. The designs will be developed to a more advanced stage where possible to further improve the reliability and accuracy, and contingencies will be put in place in line with industry standards where applicable. UE capacity will increase as they will work with international consultants that implemented similar projects on Smart Grid introduction and Balancing Market Design and experience will come with the implementation.
The utilities will be supported by specialized firms for the review of designs, management, and supervision of major contracts.</td></tr>
<tr><td>Resp:
Bank</td><td>Stage:
Implementation</td><td>Recurrent:
☑</td><td>Due Date:</td><td>Frequency:
Yearly</td><td>Status:
In Progress</td></tr>
<tr><td>Social and Environmental</td><td>Rating</td><td colspan="5">Low</td></tr>
<tr><td rowspan="2">Risk Description:
Identified subprojects may violate the Bank's safeguards policies.</td><td colspan="6">Risk Management:
No land acquisition is expected. All sites will be located on UE-owned land that is not used in any other way. There are no illegal occupants or squatters on expected Project sites. The feasibility studies for Components 1 and 2 (where SSs will be rehabilitated and Smart Grid and Balancing Market elements introduced) will include social and environmental impact assessments (EIAs and EMPs) consistent with the Bank's safeguards OP 4.01 requirements. The Project takes place at existing SSs and on land owned by UE. Social impacts are minimal and environmental impacts are regularly supervised by local environmental, occupational, health, and safety authorities.</td></tr>
<tr><td>Resp:
Both</td><td>Stage:
Preparation</td><td>Recurrent:
☐</td><td>Due Date:
31-May-2014</td><td>Frequency:</td><td>Status:
Not Yet Due</td></tr>
<tr><td>Program and Donor</td><td>Rating</td><td colspan="5">Low</td></tr>
<tr><td rowspan="2">Risk Description:
Uncoordinated donors' position in the energy sector could negatively affect project implementation.</td><td colspan="6">Risk Management:
The Bank and other donors (EBRD, EIB, EC, KfW, USAID, other bilateral agencies) are in agreement on priority reforms in the sector and UE financing. Coordination of activities of all donors in Energy Sector Reforms and Project implementation with UE including M&E will be given priority attention.</td></tr>
<tr><td>Resp:
Bank</td><td>Stage:</td><td>Recurrent:</td><td>Due Date:</td><td>Frequency:
Yearly</td><td>Status:
In Progress</td></tr>
</table>

<table>
<tr><td>Delivery Monitoring and Sustainability</td><td>Rating</td><td colspan="6">Moderate</td></tr>
<tr><td rowspan="3">Risk Description:

Limited capacity of UE and MoECI could affect implementation and monitoring of the Project.
Sustainability could be affected due to absence of increase in tariffs for power sector where there is a need to bring them to cost recovery level and remove cross-subsidies.</td><td colspan="7">Risk Management:

MoECI is managing several IFI-funded projects and is familiar with IFI monitoring requirements including monitoring requirements of the Bank. As part of the first Power Transmission Project UE has established a proper monitoring and reporting mechanist to capture all monitoring indicators and performed superbly. UE’s PIU, and MoECI’s EPCU will get necessary training and support by the Bank team. Civil society organizations will be involved during Project preparation and implementation to ensure effective monitoring of the results in conjunction with implementation of the new WEM. Baseline indicators will be established during the preparation stage. Headquarters and field-based staff will regularly supervise Project implementation. Bank will engage in work with MoECI and NERC to bring tariffs to cost recovery level and remove cross-subsidies existing in the sector.</td></tr>
<tr><td>Resp:</td><td>Stage:</td><td>Recurrent:</td><td>Due Date:</td><td>Frequency:</td><td colspan="2">Status:</td></tr>
<tr><td>Both</td><td></td><td></td><td></td><td>Yearly</td><td colspan="2">In Progress</td></tr>
<tr><td colspan="9">Overall Risk</td></tr>
<tr><td>Overall Implementation Risk</td><td>Rating</td><td colspan="7">Substantial</td></tr>
<tr><td colspan="9">Risk Description:
An overall risk rating of “Substantial” reflects elevated country implementing agency, stakeholder and Project design risks (see above). Apart from the country-level risks, the key factors include: (i) possible cost increases between feasibility and contract award stages; (ii) resistance or delays to NERC investment plans and tariff adjustments; and (iii) frequent changes in the senior management of government ministries.
These risks will be partly mitigated by effective project management, advanced preparation, and training and capacity building. The Project builds on the capacity and knowledge developed by UHE during Hydropower Rehabilitation Project and by UE during first Power Transmission Project. The bidding process will be initiated for a number of projects by effectiveness, which should help to manage cost overruns. In addition, the Project will support training for PIU staff during both Project preparation and implementation.</td></tr>
</table>

ANNEX 5: IMPLEMENTATION SUPPORT PLAN

UKRAINE: Second Power Transmission Project (PTP2)

Strategy and Approach for Implementation Support

1. The Operational Risk Assessment Framework (ORAF) identified the main risks to achieving the PDO and proposed risk management measures for these risks. As described in Annex 4 and summarized in the main text, the overall implementation risk for the Project is rated "**Substantial**." In addition, the risks in each category are rated either "**Moderate**", "**Low**" Or "Substantial."

2. Accordingly, the Implementation Support Plan (ISP) was developed taking into account the following factors:

(a) Most technologies are well proven and widely used in the world and in Ukraine, except for the Smart Grid and Balancing Market elements, which are relatively new to UE's operational staff;

(b) UE has experience and good capacity to implement the Second Power Transmission Project. UE has a long record of over 15 years of implementing Bank-financed projects, while the MoECI has more than 20 years of experience;

(c) Based on the volume of works, UE and its PIU may delegate some implementation activities to regional power transmission grids in the Project areas. This arrangement will reduce the PIU's workload and facilitate implementation, particularly supervision of works and the detailed measures for compensation. Some regional power transmission grids already have experience carrying out similar activities in the ongoing Power Transmission Project and have proved their capacity, while others will require more training and capacity building;

(d) UE has a good track record in procurement under Bank-financed projects;

(e) Potential delays may be caused by site clearance;

(f) Delays in UE due to excessive workload and lengthy internal approval processes may occur during parts of Project implementation; and

(g) Contract management capacity may cause delays.

3. Based on these factors, the ISP's focus would be to:

(a) Continue training UE staff (including experts from regional power transmission grids) on procurement, financial management, and safeguards, which started during preparation;

(b) Mobilize consultants to assist UE for the preparation and implementation of subprojects under Components 1 and 2;

(c) Maximize the use and benefits of the TA for capacity building of UE and the MoECI on regulations and monitoring;

(d) Provide intensive Bank supervision during the first year of the Project to give UE and the MoECI the advice and support needed to ensure its smooth startup; and

(e) Continue intensive consultation with relevant stakeholders, particularly Project Affected Persons.

Implementation Support Plan

4. The ISP in presented in Table 9.

Table 9: Implementation Support Plan

Time	Focus	Skills Needed/ Functional Specialist	Est. Staff weeks /year	Partner Role
First 12 months	**Procurement:** Bank to provide review of bidding documents, procurement plans, and bid evaluation reports and *ad hoc* training to disseminate the experiences to UE's PIU and MoECI's EPCU.	Bank procurement specialist	8	
	Support for Rapid Mobilization of TA Consultants: The immediate priority is to support UE and the MoECI to start procurement activities for the major contracts.	Project management and procurement	8	PIU to mobilize consultants and procurement support for UE's PIU.
	Training PIU and EPCU: The Bank will continue training activities for procurement, fiduciary, and safeguards issues.	Bank procurement, FM, and safeguards specialists	8	PIU to mobilize their staff for traning
	Project Management and Coordination: The Bank will work with MoECI's EPCU and UE's PIU to ensure that effective coordination and support roles are established between MoECI and UE's PIUs and regional power transmission grids' PIUs. This is important to help strengthen supervision practices.	Project management	4	UE's PIU to increasingly lead and coordinate the Project and provide oversight and support to regional power transmission grids PIUs.
	Project Monitoring and Evaluation: The Bank will work with the UE's PIU and MoECI's EPCU to develop and put in place a template for monitoring Project implementation progress, to use for online monthly reporting to MoECI, UE, and the Bank. The Bank, with consultant support, will prepare the M&E framework for the Project, including information collection, data validation, calculation of indicators, and reporting.	Project management M&E framework expert	4	MoECI and UE to implement TA support under the Project for the implementation of an M&E framework and reporting.
12-48 months	**Environment, Social, and Technical:** Strengthen focus on implementation quality, improving counterpart and contractor capacity, and compliance with safeguards policies.	Safeguards specialist	n/a	UE's PIU and MoECI's EPCU to strengthen supervision and their interaction with local authorities.
	Construction Supervision: Focus on implementation quality, compliance with EMPs (including site safety and materials handling) and quality of works.	Engineer	n/a	UE to conduct spot checks and training.

ANNEX 6: ECONOMIC AND FINANCIAL ANALYSIS

UKRAINE: Second Power Transmission Project (PTP2)

1. Economic and financial analyses were carried out for Components 1 and 2 of the Second Power Transmission Project.

A. ECONOMIC ANALYSIS

2. The economic analysis was carried out in accordance with the World Bank's Guidelines for Preparation of Economic Analysis for Investment Projects (dated April 2013). Detailed analytical files and worksheets with regard to the economic and financial analysis are kept in the Bank's Project Files, and the principal features and results are summarized below.

Rationale for Public Sector Investment

3. Ukrenergo is responsible for operation of Ukraine's national electricity transmission grid, and it is the nation-wide connecting link between producers and consumers of electricity in Ukraine. Consequently, the integrity, efficiency, reliability, and safety of the transmission service are of vital national importance. Since their activities cover and impact the entire electric power sector, transmission companies tend to be natural monopolies. Unlike investments in other areas of the power sector where projects tend to be generally smaller in size, located in one area, and shorter in duration, transmission investments have special risks and challenges since they are more capital-intensive. These investments also cover large geographic areas, and require longer lead times in the planning process. As a natural monopoly, and given the vital nature of its functions, Ukrenergo remains under state ownership since it has a crucial nation-wide role in providing safe and reliable transmission services in Ukraine.

4. The proposed investments under the Project will further strengthen UE's ability to provide quality transmission services. In addition, the option of private sector investment is not feasible as Ukrenergo is a state company which is allowed to finance its investments either from public sources including tariff or to borrow from International Financial Institutions for priority reconstruction as agreed in Cabinet of Ministers Directive # 1027. Presently, UE can borrow from commercial banks but the interest rates are very high which does not allow the company to fulfill its investment plans and do reconstruct/upgrade transmissions lines as it is overseen in Energy Strategy until 2030.

Rationale for Bank Involvement

5. The Bank has played an important role through policy advice, technical assistance, and financing in the process of design and implementation of Ukraine's Energy Sector Reforms over the last decade. Under the ongoing Power Transmission Project, in addition to investment financing and technical assistance to Ukrenergo, the Bank is supporting the MoECI in carrying out important reforms and improvements with regard to the electricity market. This includes the introduction of a new Electricity Wholesale Market model and a Balancing Market, and the planned establishment of a Smart Grid. The Government is therefore keen to have continuing assistance from the Bank in helping it deepen and strengthen the ongoing reforms, and in further

capacity-building in important sector institutions including MoECI, NERC, and DP Energorynok.

Fiscal Impact

6. UE is a substantial net contributor to the state budget through the annual: (i) taxes on its profit; and (ii) distribution of dividends from its profit. UE's investments are financed through its own revenues and through external borrowing from international financial institutions (IFIs), including the Bank. UE is responsible for the debt service, including assumption of the foreign exchange risk.

Economic Benefits of the Project

7. An economic assessment of the costs and benefits was made with respect to the following Project components: (i) rehabilitation of six substations (SSs), with a total investment of about US$295 million; and (ii) reactive compensation works, with a total investment of about US$56.5 million. These two components account for about US$351 million, or 87 percent of the total investment under the Project. The estimates are based on detailed feasibility studies available in the Project Files.

(a) Rehabilitation of Six Substations

8. Rehabilitation investment will be carried out in the following six SSs: Novokyivska, October, Kremenchug, Zhytomyrska, Cherkaska, and Sumy.

9. The principal benefits from the Project investments result from:

- Reduction in Energy Not Served (ENS);
- Facilitation of meeting increased electricity demand in the region; and
- Reduction of operations and maintenance (O&M) costs.

10. Reduction in ENS: Estimates for the reduction in ENS attributed to each SS are based on: (i) estimation of the ENS for the Central Power System; and (ii) the relevant allocation to each of the SSs based on (a) comparison of the annual peak loads at the SSs with that of the Central Power System as a whole and (b) attribution of a proportion of the average annual ENS amount to SS equipment failures. It is assumed that: (i) the amount of ENS will reduce by 60 percent due to configuration changes and renewal of equipment under the Project; and (ii) in the absence of the Project, the ENS would increase by 2 percent per year at each SS. Valuation of the reduction in ENS is based on an estimated economic value of US$1.10 per kWh (estimated as the economic impact per kWh lost due to outage – conservatively taken as 50 percent of the GDP/total power consumption ratio).

11. Facilitation of increased demand met at the SSs: As a result of the rehabilitation works, the volume of sales capacity at the six SSs is estimated to increase by a total of 165 GWh starting in 2018, increasing to 1835 GWh by 2025. These increased sales are valued at US$0.03 per kWh, estimated as the difference between the average end user tariff (US$0.07 per kWh) for electricity and the average cost of electricity generation (US$0.04 per kWh).

12. Reduction in O&M costs: The estimated impact of the rehabilitation investments is a reduction in the O&M costs ranging between 45 percent to 75 percent in the six SSs.

13. Estimates of the economic viability indicators (the Economic Internal Rate of Return (EIRR) and the Economic Net Present Value (ENPV)): The estimates of the incremental costs and benefits are based on the difference in the costs and benefits under the "with Project" and "without Project" scenarios. Investment costs are net of taxes. Valuation of other costs and benefits is at economic prices. The discount rate assumed for the ENPV is 10 percent. The assumptions include: (i) a modeling period of 25 years; (ii) an average asset life of 40 years; and (iii) a total construction period of four years (2015 to 2018).

14. The estimates of the base case EIRR and ENPV (at a discount rate of 10 percent) for each SS and in total are given in Table 10.

Table 10: EIRR and ENPV of the Project

Substation	**Base Case**	
	EIRR (%)	**ENPV (US$ million)**
Novokyivska SS	25	74.7
October SS	29	86.9
Kremenchug SS	22	89.4
Zhytomyrska SS	24	76.0
Cherkaska SS	26	61.6
Sumy SS	19	35.9
Total (for six SSs)	**24**	**424.6**

15. Risk analysis: The base case estimates of economic viability are robust. The risk analysis was carried out for the following scenarios: (i) a 1-year delay in benefits; (ii) a 20 percent reduction in benefits; (iii) a 20 percent increase in capital costs; and (iv) a 20 percent reduction in benefits and 20 percent increase in capital costs. The resulting EIRR estimates are shown in Table 11.

Table 11: EIRR Estimates Under Alternative Scenarios

Substation	**Base case**	**1 year delay in benefits**	**20% reduction in benefits**	**20% increase in capital costs**	**20% reduction in benefits and 20% increase in capital costs**
Novokyivska SS	25%	24%	21%	22%	19%
October SS	29%	28%	25%	26%	22%
Kremenchug SS	21%	20%	19%	19%	17%
Zhytomyrska SS	20%	18%	18%	19%	16%
Cherkasksa SS	24%	22%	21%	22%	20%
Sumy SS	19%	17%	16%	17%	15%
Total (for six SSs)	**24%**	**21%**	**21%**	**22%**	**19%**

(b) Reactive Compensation Works (for five SSs)

16. Reactive compensation works will be carried out at the following five SSs: Novovolinskaya, Lutsk Pivdenna, Kovel, Sheptivska, and Kamenets-Podilska. The main benefits of these investments include:

- Improvements to system stability due to greater voltage stability, increased system security, and reduced vulnerability of the system due to incidents.
- Reductions in system losses by compensating reactive power as close as possible to the origin, which will reduce the reactive circulation in the network.

17. These reactive compensation works are essential investments necessary to meet regulatory requirements. They have been evaluated on a cost minimization basis taking into account relevant experience.

B. FINANCIAL ANALYSIS

18. The main results of the financial analysis are summarized below and the detailed analysis is available in the Project Files.

19. UE is wholly owned by the state and the company is supervised by MoECI. UE's main activities are provision of power dispatch and transmission services with high-voltage transmission networks for the entire territory of Ukraine. Tariffs for transmission and dispatch services are regulated by the National Electricity Regulatory Commission (NERC).

20. Current and projected financial performance of UE: As seen in Table 12, UE's financial performance was strong in 2012 and 2013, and is projected to remain satisfactory over the period 2014 to 2021. UE's annual plans are subject to review by NERC. Each year, NERC approves UE's operational and investment plans and establishes UE's transmission tariffs. The tariff for each year has separate components that cover: (i) O&M expenses; (ii) UE's own internal contribution to the annual investments; and (iii) the annual debt service. In addition, UE can finance a part of its investment expenditures from borrowings from local banks as well as IFIs (UE has ongoing loans from the World Bank, EIB, and EBRD).

21. Over 95 percent of UE's revenues are from its transmission activities. The transmission volume is currently around 133 TWh per year and is projected to increase at a rate of about 2 percent per year over the period 2014 to 2021. The transmission tariff is currently around 2.504 kopek per kWh. The financial settlements are carried out by Energorynok, the entity responsible for the settlement of inter-entity accounts in Ukraine's electricity sector. Collection performance from Energorynok varies between 92 percent to 99 percent and is affected by the overall state of the economy.

22. UE's profitability rate (net profit after tax to revenues) has varied between 25-29 percent in recent years. The annual profit is allocated to: (i) taxes: (ii) dividends to the state; and (iii) debt service; while (iv) the residual is allocated as an internal contribution for investments. UE has been a strong annual net contributor to the state budget in the form of taxes and dividends.

23. Compliance with covenants: Under the ongoing Power Transmission Project, UE agreed to the following financial covenants: (i) a current ratio (current assets/current liabilities) of at least 1.2; and (ii) a debt service coverage ratio of at least 1.5. UE was in compliance with the covenants in 2012 and 2013 (based on unaudited statements for 2013).

24. Projected financial performance: With regard to UE's projected financial performance over the period 2014 to 2021, the projections were made on a conservative basis and indicate that UE's financial situation will remain satisfactory with respect to the key financial indicators shown in Table 12. The main assumptions are:

- Transmission volumes will grow at 2 percent annually;
- Tariffs will gradually increase from 2.504 kopek/kWh in 2014 to about 2.899 kopek/kWh by 2017 and 3.391 kopek/kWh by 2021; and
- Annual capital expenditures under UE's investment program will be about UAH 2,000 million (based on the level of about UAH 1,872 million in 2014).

25. Other assumptions regarding the financial analysis are detailed in the Project's financial analysis files, kept in the Project Files.

26. Proposed financial covenants: The following financial covenants are proposed for the Project.

- A self-financing ratio (ratio of net cash from operations to the average of the capital expenditures in the preceding, current, and succeeding years) of at least [25] percent starting from the year [2016]; and
- A debt service coverage ratio (ratio of net income after tax plus depreciation plus interest to debt service – i.e., the sum of interest and principal repayment) of at least [1.5].

27. The self-financing ratio covenant replaces the current ratio covenant, as it is judged to be more appropriate in UE's current circumstances, whereby its annual tariffs are established by NERC.

Table 12: UE's Key Financial Indicators (UAH million)

Indicator	2012	2013	2014	2015	2017	2019	2021
Transmission volume (TWh)	136.3	133.0	135.5	138.2	143.8	149.6	155.6
Transmission tariff (kopek/kWh)	2.495	2.501	2.504	2.629	2.899	3.135	3.391
Operating revenues	3489	3490	3503	3573	4079	4616	5177
Operating expenses	2522	2408	2643	2814	3176	3530	3870
Operating margin	967	1182	859	760	903	1085	1307
Net profit before tax	1090	1219	850	663	729	855	1053
Net profit after tax	956	1035	722	563	619	726	894
Current assets	796	1509	1885	2255	2994	2881	3938
Total assets	10109	12202	13912	15637	18877	20885	23705
Current liabilities	693	755	836	1174	1200	1227	1256
Medium- and long-term debt	1232	2123	3026	3864	5839	6416	7496
Equity	6895	7930	8651	9215	10422	11816	13518
Total liabilities & equity	10109	12202	13912	15657	18877	20885	23705

Annual investment expenditure	1833	1835	1872	2000	2000	2000	2000
Financial Ratios							
Net profit after tax/revenues (%)	27%	29%	21%	16%	15%	16%	17%
Self-financing ratio (%)	79%	72%	50%	45%	39%	55%	72%
Current ratio	1.2	2.0	2.3	1.9	2.5	2.3	3.1
Debt service coverage ratio	15.6	8.4	4.9	3.6	2.1	2.4	2.8

ANNEX 7: CLEAN TECHNOLOGY FUND

UKRAINE: Second Power Transmission Project (PTP2)

Table 13: Key Indicators Associated with Funding Sources

Indicator	CTF/IBRD-funded Project by 2020 [3]	Scaled-up Phase by 2030 [4]
Increased RE power generation capacity due to deployment of Smart Grid Technologies (over BAU scenario) [MW]	1,100	1,500
Energy Savings from reduced technical losses and improved system management (over BAU scenario) [MWh/yr] [5]	430,000 MWh/yr	520,000 MWh/year
Tons of GHG emissions reduced or avoided (over BAU scenario) ▪ **Tons per year** [tCO_{2eq}/yr] ▪ **Tons over lifetime of the project** [tCO_{2eq}]	 ▪ 2.8 million ▪ 48.5 million	 ▪ 3.7 million ▪ 75.1 million
Financing leveraged through CTF funding [US$ million] [6]	US$1,732.5, of which: • IBRD US$332.5 • Private US$1,400	US$3,000, of which: • Public US$50 • Private US$2,100 • MDB US$700 • Bilateral US$150
CTF leverage ratio	1: 36	1 : 62
Cost effectiveness ▪ **CTF Investment cost effectiveness** [US$$_{CTF}$/$tCO_{2eq}$ avoided] ▪ **Total project cost effectiveness** [US$$_{Total}$/$tCO_{2eq}$ avoided]	 ▪ 1.0 ▪ 35.7	 ▪ 0.6 ▪ 40.0
Improved reliability of services provided by power companies	Increase RE Generation. Reduced number and duration of interruptions to electricity consumers due to optimization of transmission system configuration and faster detection of and response to faults.	
Environmental co-benefits	Lower local pollutants due to avoided thermal power generation.	
Other co-benefits	▪ Changed nature of power transmission with integration of intermittent power capacity, such as solar and wind, supporting the GoU's target in development of these renewable sources ▪ Improved reliability of power transmission/energy security	

[3] The *CTF/IBRD-funded Project Phase* assumes the deployment of an additional 1,100 MW of RE installed capacity (wind/solar) as a result of the project. In the business-as-usual (BAU) scenario, the RE installed capacity would be 2,950 MW by 2020. In the Smart Grid project scenario, RE installed capacity would increase to 4,050 MW by 2020. The difference of 1,100 MW may be attributed to the proposed CTF-funded project.

[4] The *Scaled-up Phase* assumes that the project contributes to the GoU's target of 8 GW of RE capacity installed by 2030. In the absence of the proposed CTF-funded project, it is estimated that about 6,000 MW of RE installed capacity would be installed (business-as-usual) by 2030. The replication of similar smart grid investments (triggered by the proposed CTF-funded project) would contribute to the deployment of an additional 1,500 MW of RE installed capacity over business-as-usual (total 7,500 MW) by 2030, bringing total RE capacity close to the GoU's target of 8 GW. Estimates for the scaled-up phase are subject to uncertainties in future generation mix and system dispatch under the new balancing market. Additional investments may be required in generation reserves and system expansion to increase the 7,500 MW potential RE to reach the 8 GW RE target by 2030.

[5] Estimates based on preliminary results from feasibility studies and subject to update once the studies are completed.

[6] Estimates for private contribution based on assumed private sector investment of US$1 million per MW of installed wind power capacity and US$2.5 million per MW of installed solar capacity. Additional capacity includes 800 MW wind and 300 MW solar power capacity for *CTF/IBRD-funded Project Phase* and 1,100 MW wind and 400 MW solar power capacity for *Scaled-up Phase* scenarios.

	▪ Lower cost of power transmission of RE ▪ Improved quality of power transmission of RE ▪ Reduced macroeconomic imbalance ▪ Potential technology cost reduction ▪ Development of local Smart Grid industry ▪ Improved economic competitiveness ▪ Reduced local pollution (SO_2, NO_x) through reductions in transmission losses and power generation ▪ Health co-benefits due to reduced emissions
Enhanced demand forecasting and optimization of available generation resources	Significant improvements in load forecasting and operational planning, including optimization of generation scheduling and dispatch, due to access and processing of data at key points of the network and consumers for real-time operation optimization and better short-term load forecasting.
Empowering customers and reducing load shedding	Reduction of compulsory load-shedding events by providing information to customers on their electricity use and their enhanced participation in demand response programs.

A. Introduction

1. **Ukraine is one of the 20 largest primary energy-consuming nations, and one of the top 10 most energy-intensive economies in the world.**[7] Its energy intensity is three times higher than the EU average and is the key driver of GHG emissions in the country.[8] For example, Ukraine's energy use per unit of purchasing power parity (PPP) adjusted for GDP exceeds Germany's by a factor of 4.7 (0.45 kg of oil equivalent in Ukraine vs. 0.12 kg in Germany[9]). Ukraine's energy intensity is higher than that of energy-rich Russia, and its CO_2 intensity is considerably above that of Russia. District heating (DH) companies are the third biggest consumers of natural gas in the country (after households and industry). A significant majority of buildings in cities and towns are connected to DH networks. About 80,000 high-rise buildings consume 44 percent of the country's heat energy resources.

2. **The carbon intensity of the economy is correspondingly high.** In 2006, Ukraine produced about 450 million tCO_{2eq} of GHG emissions, and CO_2 accounted for 76 percent of the emissions (and methane another 18 percent).[10] The energy sector was responsible for 69 percent of the total emissions. DH accounted for 20 percent of the CO_2 emissions and 81 percent of the methane emissions from fossil fuel combustion in the country. Industrial processes produced another 22 percent. Emissions from the energy sector and industrial processes are expected to grow as the economy recovers. Achieving the GoU's 2050 GHG emissions target and the associated net zero growth in emissions will depend critically on substantially improving the efficiency with which energy is produced and consumed. This will require a shift to cleaner fuels and more efficient technologies.

3. **The GoU made a strategic commitment to reduce energy intensity (i.e., improve efficiency) 20 percent by 2015 and 50 percent by 2030.** The government also set a goal to keep

[7] Measured as the amount of primary energy used to produce one unit of GDP (PPP). Source: IEA World Energy Statistics and Balances; World Development Indicators.

[8] The discussion follows IEA's *Ukraine. Energy Policy Review 2006*. Paris: International Energy Agency, 2006.

[9] WDI (2009).

[10] National GHG Inventory Report, 2008.

GHG emissions 20 percent and 50 percent below 1990 levels by 2020 and 2050, respectively. The Energy Strategy of Ukraine for the Period until 2030 (Energy Strategy), adopted in 2006, provides a platform for supporting this commitment and addressing key challenges in the sector; this platform has been iterated in the recently approved update of the Energy Strategy. The GoU plans to improve the efficiency of existing assets with a three-pronged effort: (i) replacing the oldest equipment with new equipment; (ii) upgrading plants with a reasonable remaining operating life (typically more than 10 years); and (iii) decreasing energy production from old plants while investing in new plants. Additionally, the GoU set an ambitious target of achieving 8 GW of installed renewable energy capacity by 2030, or 12.60 percent of total installed capacity. Of the 8 GW of new RE, the current plan is to have 4 GW installed by 2020. The "Green Tariff" introduced in 2009 has already led to some increase in wind and solar power generation over the last couple of years. As such, the total renewable energy-based installed generation capacity reached about 620 MW by the end of 2013. Not only does the GoU need to mobilize substantial resources to accomplish these low carbon growth goals, but it particularly needs Clean Technology Fund (CTF) resources to lower the market barriers so that the private sector can participate. Consequently, the GoU prepared a CTF Investment Plan.

4. **Ukraine already initiated a number of projects** in order to modernize the transmission network and to ensure an efficient management of transmission system of Ukrenergo and a better integration of Renewable energy. The first Power Transmission Project and number of other projects financed by EBRD, EIB, KfW and Ukrenergo with its own funds identified major needs for transmission upgrade and rehabilitation of UE substations and integration of RE into the grid. Second Power Transmission Project provides possibilities not only to rehabilitate UE Substations but also includes a subcomponent financing innovative Smart Grid technologies to improve the information exchanges and communication systems of Ukrenergo and to further enhance the reliability and management of the transmission networks and RE integration.

B. Ukraine CTF Investment Plan

5. **The CTF Investment Plan for Ukraine was endorsed by the CTF Trust Fund Committee in March 2010.** Under this plan, the GoU will use US$350 million from the CTF to finance and catalyze greater investments in: (i) renewable energy; (ii) energy efficiency in residential and government buildings, DH, and the industrial sector; (iii) introduction of Smart Grid components in the transmission system; and (iv) zero emissions power generation from the gas network. Ukraine updated its investment plan to reflect the reallocation of funds within priority sectors and the impact of proposed changes on achieving its objectives and targets. The updated plan, approved in May 2013, selected four activities for CTF co-financing:

a. ***Ukraine Renewable Energy Financing Facility*** (EBRD, IFC): a program to address policy, finance, business, and information barriers to renewable energy market developments as well as to direct financing for private sector generation of 100 MW of large-scale wind power capacity and 80 MW of medium-sized renewable sources;
b. ***Improving Energy Efficiency*** (EBRD, IBRD, IFC): an energy efficiency program targeting: (i) reconstruction and refurbishment of municipal and mixed ownership housing stock; (ii) upgrade of government-owned buildings; (iii) decreased losses in DH supply; and (iv) improved industrial energy efficiency;

c. ***Smart Grids*** (IBRD): a program for strengthening management and control systems, which would allow loss reduction through demand management and large-scale integration of intermittent renewable sources; and

d. ***Zero Emissions Power from the Gas Network*** (EBRD, IBRD): commercial-scale demonstration of zero emissions power generation from waste heat recovered from compressors in Ukraine's gas network.

6. The indicative financing of the updated Ukraine CTF plan is shown in Table 144.

Table 14: The Indicative Financing of the Updated Ukraine CTF plan (US$ Million)

		Renewable Energy Financing Facility	Improving Energy Efficiency	Smart Grids	Zero Emissions Power from the Gas Network[3]	Total	
CTF	EBRD	100	50		TBD	150	**350[4]**
	IBRD		70-100	50-80	TBD	150	
	IFC	35-50[1]	0-15[1]			50	
MDB[5]	EBRD	219	200		TBD	419	**1,269-1,519**
	IBRD		500-650	250-350	TBD	750-1000	
	IFC	40	60			100	
Ukraine counterpart			105	50	TBD	**155**	
Other donors		8	100			**108**	
Private sector		366	25	200[2]		**591**	
Total		**768-783**	**1,110-1,305**	**550-680**	**TBD**	**2,473-2,723**	

[1] Depending on market demand and the speed of Project development, the IFC may reallocate the remaining US$15 million of CTF funds to the Renewable Energy Financing Facility.

[2] Around US$200 million is expected to be invested by the private sector into renewable energy by 2018 and at least US$1000 million by 2030.

[3] Project amounts, including CTF funding and co-financing, will be determined at a later stage.

[4] Smart Grids and Energy Efficiency funds are mutually exclusive; hence the total CTF allocation remains US$350 million (instead of US$320-380 million). This is also why the horizontal and vertical totals do not add up to the amount in question.

[5] MDB – multilateral development bank.

7. **The proposed Second Power Transmission Project is part of the Smart Grid program** (highlighted above)**.** CTF resources are proposed to be blended with the IBRD-financed *Second Power Transmission Project*, which aims to improve the reliability of power transmission system and support implementation of the Wholesale Electricity Market in Ukraine as well as strengthen system capacity for integrating RE power into the grid. CTF resources specifically are proposed to be utilized for assisting UE in the design and implementation of the next generation of modern communications, grid management and control systems, which will enable large-scale integration of wind and solar energy resources and improve management and operation of the transmission network.

8. Today, nearly 620 MW of MW RE capacities have been commissioned in Ukraine. In accordance with the issued technical specifications, in 2015 about 2,400 MW of RE (1,200 MW of WPP and 1,180 MW of SPP) have been authorized for development and are planned for operation by 2020. In addition about 3,600 MW of proposed RE projects are under advance

stage of feasibility study phase. Therefore by 2020 the potential for RE development could reach 6,595 MW as summarized in Table 15. Estimates for 2030 are subject to uncertainties in future generation mix and system dispatch under the new balancing market. Additional investments may be required in generation reserves and system expansion to increase the 7,500 MW potential RE to reach the 8,000 MW RE target by 2030.

Table 15: Prospective Ukrainian RE Capacity (MW) by 2020

	Operating	**Approved**	**Feasibility Stage**	**Total**
WPP (wind)	381	1,200	2,494	4,075
SPP (solar)	240	1,189	1,100	2,520
Total	621	2,380	3,594	6,595

9. These changes create new possibilities and new challenges for the Unified Energy System (UES) of Ukraine. Nowadays, trunk power grids are not ready for connection of new generating capacities of renewable energy sources at such a pace. In addition the daily and hourly intermittent generation by RE imposes additional requirements on the balancing generation of the UES system which in turns limits the amount of new RE generation that can be developed. Therefore, there is a growing need for clearly outlining how the UES should develop to best meet these challenges in the most economically efficient way. To this end, it is necessary to explore the utilization of smart grid technologies including new real-time monitoring and controlling capabilities to improve system performances and to safely increase RE hosting capacity while optimizing operational and capital expenditures. The proposed Project is further described in the following sections.

C. Second Power Transmission Project: Introduction of Smart Grid Technologies to Ukraine's Electricity Transmission Grid

C1. Rationale for introducing Smart Grid systems in Ukraine's electricity transmission grid

10. Several projects have been initiated in Ukraine to identify and specify the needs for innovative and smart technologies. In particular, Ukrenergo is undertaking a feasibility study, funded by a CTF grant, whose objective is to define a Smart Grid roadmap with investments needed for the modernization of the Ukrainian power system. Dynamic modelling and system analysis undertaken during the first phase of the feasibility study have shown that current grid constraints, generation dispatch, and scheduling procedures would limit RE integration into the UES to about 2,950 MW by 2020, instead of the 6,600 MW of RE generation capacity under consideration. The Feasibility study has assessed the impact of deploying various smart grid technologies by 2020 for improving RE integration and dispatch into the grid. The deployment of these technologies would significantly increase the maximum allowable RE integration to 4,000 MW compared to the "business as usual" scenario of 2,950 MW (see Table 16).

Table 16: Maximum allowable RE by 2020 with introduction of smart grid technologies (MW)

	BAU Scenario	Smart Grid Implementation Scenario
WPP	1,200	2,000
SPP	1,750	2,050
Total	2,950	4,050

11. The second phase of the (ongoing) feasibility study focuses on the development of a smart grid investment plan designed to upgrade the power transmission network as part of a smart grid roadmap for the UES to accommodate 4,050 MW of RE by 2020 and to support achieving the 8,000 MW RE target by 2030. Based on preliminary results, it is proposed that CTF funds will finance innovative Smart Grid technologies which have high potential to address urgent key needs of the Ukrainian power system, particularly ensuring safe integration of an increasing level of RE, and improving the monitoring and operations of the Ukrainian Power System.

12. **Use of CTF funds.** The proposed CTF project will deploy new Smart Grid technologies and applications for improving the monitoring and control of generation power plants, particularly renewables. Specifically, the CTF will finance the following activities under subcomponent 2.2:

a. Modernization of communication systems and data exchange requirements among RE plants, substations and dispatching centers for ensuring coherence with rules within the ENTSO-E area; and

b. Systems of advanced applications for forecasting of RE generation to support dispatching center operations. The project will deploy modern Smart Grid technologies like wide area monitoring and control systems (WAMS, WACS, WAPS), which aim at optimizing system operations based on a dynamic assessment of stability and thermal margins. By operating the system closer to its actual safety limits and maximizing power transfer through the existing transmission corridors, a higher penetration of RE and a reduction of congestions can be achieved while deferring investments in new line installations.

13. The introduction of the proposed targeted Smart Grid investments for enhanced grid monitoring and control would greatly benefit the Ukrainian power system, as it will contribute to ensuring optimal dispatching operation, stability control and congestion management at transmission level, which is particularly important in view of an increasing penetration of variable RE.

Innovation potential

14. The proposed Smart Grid investments are innovative in the Ukrainian power system context. In order to ensure a successful implementation, the proposed project will build on the outcome of the ongoing feasibility study to undertake a strategic approach for the deployment of smart grid technologies in Ukraine. The feasibility study will identify priority smart grid technologies in selected power system substations as well as in grid control, monitoring, management and communications systems. This strategic approach will allow for gaining experience on implementation of new smart grid technologies and operation of new technologies before proceeding with a more ambitious roll-out at the national level. Support from the CTF would be essential to demonstrate the feasibility of implementing and operating these highly-innovative technologies in Ukraine, which would help bridge the knowledge and innovation gap with respect to the technologies currently deployed in the Ukrainian power system.

Scalability potential

15. The proposed project has also a strong potential to support the replicability of Smart Grid elements both at transmission and distribution level. First of all, a successful project implementation financed by the CTF will create the basis for wider replication of similar Smart Grid technologies at national transmission scale. In a second phase, leveraging on the implementation at transmission level Smart Grid technologies and applications could then also be applied at distribution level, for the implementation of advanced monitoring and control distribution systems, particularly in presence of high penetration of distribution-connected RE. There is already interest from privately held Distribution Companies for investments in Smart Grid applications, but the technologies have not yet been tested and their impact not yet assessed in Ukraine. The pioneering introduction of Smart Grid elements by UE can indeed serve to demonstrate the potential of Smart grid technologies and create the conditions for a larger penetration of smart grid solutions in the country. This would lead to further significant benefits for the Ukrainian Power system, including energy savings, higher penetration of RE, and reduction of GHGs.

16. Finally, the proposed CTF-funded smart grid investments are in line with the on-going development of the Smart Grid roadmap for Ukraine, which aims at effectively assessing and identifying Smart Grid technologies that could mostly benefit the Ukrainian power system. The project's contribution to the implementation of the Smart Grid roadmap will inherently support the scaling up of Smart grid technologies in the Ukrainian power system.

C2. Modernization of information and communication systems

17. The first pillar of the proposed project is to introduce Smart Grid technologies to increase the observability and predictability of generation power plants, particularly from RE technologies. The GoU is pursuing climate change mitigation through the development of renewable generation. Due to the new Wholesale Electricity Market (WEM) law and beneficial Green Tariffs established in Ukraine in 2010 and other support programs, including provisions on "must buy" and priority dispatch by UE and distribution companies, 620 MW of wind and solar power had been generated, mainly in the Central region of Ukraine, in only two years (by December 2013). It is expected that more than 3,000 MW of new RE generation (from solar and

wind) will be developed and connected to UE's high-voltage transmission and distribution networks over the next five years.

18. However, connecting and integrating intermittent RE (wind/solar) will require investment and modernization of UE's transmission system and Ukraine's distribution and operation systems. If the system is not ready to connect this new capacity, then new coal or gas-fired power plants, which are easier to integrate into the existing power system, will provide the required energy to supply the demand. In order to successfully integrate large-scale power generation capacity from RE into the power grids, it is necessary to have a deep understanding of the nature of intermittent generation from wind and solar power plants both in the spatial and time dimensions.

19. Therefore, the smart grid roadmap being developed under the ongoing feasibility study will focus on the implementation of communication infrastructure for remote monitoring of RE power plants, ensuring a bidirectional data exchanges among RE plants, substations and control centers. This will also entail the installation of remote monitoring and control devices at selected RE facilities. Requirements for data exchange between REs and system operator will be considered.

20. A second aspect will be the implementation of advanced systems for forecasting RE production and their integration in control center operations (e.g. applications forecasting wind speed and capacities of wind power plants, models of forecasting the power output by solar power plant, as well as requirements for measuring facilities, equipment and personnel).

C3. Implementation of wide area monitoring; control and protection systems

21. The second pillar of smart gird investment will focus on the implementation of advanced monitoring and control systems based on the introduction of wide area monitoring control and protection systems (WAMS, WACS, WAPS). The implementation will complement the modernization of information and communication systems defined in section C2. The overall integration of these new functionalities with EMS/SCADA systems will also be ensured.

22. Wide area monitoring, control and protection systems rely on the installation of time stamped high-speed sensors for phasor measurement units (PMUs), which allow dynamic assessment of power system conditions by taking GPS synchronized current and voltage phasor measurement from critical locations of the power system. More specifically, the implementation of wide area monitoring control and protection systems allows to:

- assess in the on-line mode the real resilience reserves and marginal capacity value that could be transmitted;
- assess compliance of the current mode with N-1 criterion for all controlled crossings and generating facilities;
- project a possibility of emergencies and their specific development;
- carry out a deep analysis of real transition processes;
- clarify an impact of automatic incitation controllers, direct compensation plants, static capacitor banks, synchronous condensers, on-load tap changers, booster transformers, distribution boxes, turbine speed governors, as well as large load centers at the resilience level of overhead power transmission lines;

- significantly detail characteristics of elements of the designed model of Ukraine's UES; and
- provide timely recommendations to the operating personnel and automatically activating anti-emergency automated equipment in the real time of the transition process, not allowing for the progression of local emergency blackouts into systemic emergences.

23. Wide area monitoring control and protection systems provide benefits in terms of security (continuous stability monitoring and protection), optimization (on-line calculation of available transmission capacity and optimization of power flows), monitoring of network parameters (Voltage phase angle and difference between locations — Active and reactive power and direction) reducing conditions of equipment stress and maintenance costs Moreover the implementation of WAMS/WACS/WAPS with enhanced functionalities integrated in the SCADA/EMS systems allows the assessment of suitable countermeasure to respond to disturbances, thanks to improved knowledge of the power system conditions and of corrective actions. The shift from preventive operation mode to corrective operation mode to ensure power system stability under certain disturbance conditions, can significantly increase the exploitation of the existing system and equipment, optimize power system operations, increase power system capacity and improve congestion management, without performing costly investments in new transmission corridors.

24. The proposed project will consider options for the installation of PMUs (together with installation of Phasor Data Concentrators -PDCs- to carryout pre-processing of raw measurements and optimize the volume of data flows between PMUs and the control center), specification of strategic location of PMUs, information/data visualization technologies for PMUs, signaling about instant changes in power interchanges, adaptive networks of restoration measures and post emergency launch. The project will also consider deploying suitable communication systems to support the information exchange load between the PMUs, PDC and central system. The project will also address the integration into EMS and SCADA system (and needs for upgrades of the EMS/SCADA) of new wide area monitoring and control functionalities and of required exchanges with monitoring and control information from generation plants, particularly RE (see previous points).

D. Assessment of the Proposed Project with CTF Criteria

D1. Demonstration potential at scale

25. The proposed CTF-funded project will provide necessary basis for the implementation of the Smart Grid roadmap for the Ukrainian power system, which would allow for significant avoided GHG emissions from increased RE penetration, reduced technical losses, and improved system management. Lessons learned from implementing and operating the CTF-funded smart grid technologies will facilitate the shift toward adopting a stronger approach for smart grid operation of the entire Ukrainian power system. In particular, the project will mainly focus on Smart Grid elements on the monitoring and control of the transmission and generation assets, and will create the basis for smarter management of demand as well, with the implementation of Smart Grid applications and necessary market structures (e.g. balancing market) to activate demand flexibility (implementation of demand response programs, creating signals and incentives for customers to maximize efficiency in consumption) and to bring additional

important benefits for the system (e.g. capability to better cope with the intermittency of RE, facilitating RE penetration; energy savings; further reduction of GHG, etc.).

26. Additionally, the installation of PMUs at selected locations of the transmission system will implement a scalable architecture that would expand WAMS/WACS/WAPS functionalities to cover the entire transmission system. Scale-up of the project will bring direct additional benefits in relation to increased optimization of power system operations and penetration of RE, as well as reduced GHG emissions. Leveraging on the implementation at the transmission level, Smart Grid technologies and applications could then also be applied at distribution level, for the implementation of advanced monitoring and control distribution systems, particularly in presence of high penetration of distribution-connected RE.

D2. Expected benefits and development impact

27. Incorporation of proposed Smart Grid technologies (RE monitoring and forecasting, WAMS/WACS/WAPS) will contribute to improving effectiveness and efficiency in the operation of UE's transmission grid. Expected positive impacts include: (i) higher penetration of RE thanks to better observability and forecasting; (ii) better reliability and quality of service provided by UE through optimized configuration of its transmission networks and faster detection and response to outages; (iii) reduction of technical losses thanks to dynamic network management; (iv) deferment of traditional investments thanks to better exploitation of system thermal and stability margin; (v) lower rates of equipment damage and maintenance costs; and (vi) lowered risks of power system instabilities and reduced impact of disturbances.

28. Positive impacts of the project, in particular from increased level of RE integration, will lead to environmental co-benefits from avoided thermal power generation. In Ukraine's power sector, hydropower and other renewable resources are prioritized in the generation scheduling and dispatch process. The project will therefore contribute to the reduction in carbon emissions from coal-based electricity generation, which is the predominant source of thermal power generation in the country. The project will also contribute to reduced local pollution (SO_2, NOx) from reduced thermal power generation and transmission losses. A more thorough analysis about the project's impact on reduced GHG emissions is presented in section E ("Potential for GHG Emissions Savings").

29. **Local socioeconomic development**. Overall, the Second Power Transmission Project will contribute to the achievement of Ukraine's longer-term social development goals. As UE will upgrade and expand the transmission system, enhance the quality, operation, and reliability of power supply services, reduce electricity losses, and improve the performance and accessibility of electricity transmission services, the Project will contribute to enhancing the effectiveness of the poverty reduction program, reducing the current gap in equality of access to services among regions, and consolidating social security. Particularly in the areas benefitting from transmission system investment subprojects, the improvements will support local development objectives such as accelerating economic and social development, increasing productive uses of electricity, improving quality of life, and expanding access to better public services.

30. **Gender**. The project's footprint as designed will not have a direct impact on the ultimate electricity end users at the household level, thus it is not expected to have direct impact on men

or women. However, the project will apply a gender lens to ensure that it will not lead to unintended negative gender impacts and will account for possible unexpected positive gender impacts. Overall improvement of the stability of electricity supply will benefit the entire population and therefore the gender composition of the beneficiaries will be identical to that of Ukraine's population. Given that direct project beneficiary is the UE, the institutional gender analysis will be conducted in the framework of subcomponent 2.4 Support for Institutional Development and recommendations of the assessment will be incorporated in the development strategy and other relevant institutional development documents.

E. Potential for GHG Emissions Savings - Emissions Reduction Potential of Investment

31. The proposed CTF Smart Grid project will significantly contribute to the reduction of GHG emissions. Conservative estimates for yearly GHG emissions reduction were derived from preliminary outcomes from the ongoing feasibility study. For the *CTF/IBRD-funded Phase*, the potential GHG emission reduction was estimated at 2.8 $MtCO_{2eq}$ per year and 48.53 $MtCO_{2eq}$ over the lifetime of the project (20 years). Annual potential for GHG emission reduction was estimated at 3.75 $MtCO_{2eq}$ under the *Scaled-up Phase (by 2030).*

32. ***Scope of emissions.*** The estimate for avoided GHG emissions is based on energy savings primarily from increased level of RE integration (due to investment in smart grid technologies) and reduced technical losses. The integration of RE will displace thermal power generation, which is predominantly fueled by coal in Ukraine. Energy savings from reduced technical losses (and associated avoided GHG emissions) are due to optimization of transmission system configuration. These savings will be attributed to interventions in Components 1 and 2.1 (traditional transmission investments – where substations will be rehabilitated and reactive power compensation devices will be installed) plus Component 2.2 (Smart Grid with CTF co-financing).

33. Savings from improved management of the system were not considered due to lack of information. It should be noted that the utilization of Smart Grids (e.g., load management) can help optimize the functioning of the power generation system, therefore leading to GHG savings from avoided thermal power generation. The use of smart grids systems can help decrease the congestions in the transmission system, as well as in the distribution networks during certain periods of the day by moving parts of "controllable" customer's loads from these periods to the hours of lower load increasing the fill factor of the load coverage schedule. The effect of such actions will be amplified by the fact that it will be revealed not only to the energy losses in certain regions and in the whole UPS of Ukraine, but also in the decrease of the production and transmission costs for electrical energy. In the absence of sufficient information, the GHG emissions savings associated with improved management of the system were not considered in the assessment.

34. ***Emission factor.*** When calculating the emissions, the specific CO_2 emissions indices were taken into account according to the *Order of the State Environmental Investment Agency of Ukraine of 12.05.2011 No 75.* According to this Order, the specific CO_2 emissions factor for electricity generation using thermal power plants connected to the Unified Power System of Ukraine is 1,063 tCO_2/kWh.

35. ***Potential for GHG emissions.*** The potential for GHG emissions in the *CTF/IBRD-funded Phase* is based on the assumption that the project will directly contribute to the deployment of an

additional 1,100 MW of wind/solar RE installed capacity. This capacity results from subtracting RE capacity expected under project (4,050 MW) and business-as-usual (2,950MW) scenarios. The potential for GHG emissions in the *Scaled-up Phase* is based on the deployment of an additional 1,500 MW of wind/solar RE installed capacity over business-as-usual. The table below illustrates the potential for GHG emissions reduction once savings from increased RE penetration and reduced technical losses are considered.

Table 17: Potential for GHG emissions reduction

Sources of displaced thermal power generation due to smart grid investments	**2016**	**2017**	**2018**	**2019**	**2020**	**2030**
1- Energy savings from reduced technical losses (MWh)	1,500	8,000	47,000	220,000	430,000	520,000
2- RE power generation (MWh)	322,300	682,900	894,170	1,265,660	2,208,200	3,011,182
Additional RE installed capacity (MW)	180	395	500	680	1,100	1,500
Total MWh	323,800	690,900	941,170	1,485,660	2,638,200	3,531,182
EF (tCO2/kWh)	1,063	1,063	1,063	1,063	1,063	1,063
GHG Emission Reduction (tCO2/yr)	**344,199**	**734,427**	**1,000,464**	**1,579,257**	**2,804,407**	**3,753,646**

36. To perform the calculation of the GHG emissions reductions in CO_2 equivalent, the RETScreen software that includes the Ukraine database was used. The WPP were assumed to be located in the regions with a high wind speeds, and solar plants – in the high solar irradiation regions. Forecasting system implementation and utilization of separate subcomponent will reduce emissions by shifting of generation from TPP to HPP by means of 2-8 hours advance optimization (so called commercial dispatch), however this part of the effect was not precisely defined due to the complexity of calculations, absence of the state approved methodology and restricted data to be used as baselines. The results of calculations for the year 2020 are given in Table 17.

37. ***Lifetime emissions.*** In the *CTF/IBRD-funded Phase*, a project lifetime of 20 years was considered for estimating lifetime emissions, resulting in 48.5 $MtCO_{2eq}$. The calculation was derived based on 5 years of cumulative savings during project implementation and 15 years of annual savings following the completion of the project. The same number of years was considered to derive an equivalent lifetime GHG emissions in the *Scaled-up Phase*.

F. Cost effectiveness

Table 18: CTF Investment Cost-Effectiveness

	CTF/IBRD-Funded Project	**Scaled-up Phase**
CTF investment cost-effectiveness [$\$_{CTF}/tCO_{2eq}$ avoided]	1.0	0.6
Total project cost-effectiveness [$\$_{Total}/tCO_{2eq}$ avoided]	35.7	40.0

i. The CTF cost-effectiveness was estimated by dividing the CTF funding amount by the lifetime GHG emissions avoided at each phase of the Project. Similarly, the cost-effectiveness for the Total project was estimated by dividing Total project funding by lifetime GHG emissions avoided.

ii. Expected cost reductions from Smart Grid technology (i.e. modernization of communication system and implementation of wide are monitoring, control and protection system). Because the technology is new in the country, only a handful of companies have experience with it; as the technology and IT solutions should therefore come from outside of Ukraine, the prices will be high for the first stage of the Project. As the penetration of Smart Grid systems increases and Ukrainian companies develop expertise in this field and start producing, the prices will likely fall due to competition in the market.

38. **Marginal abatement cost.** In October 2013, the CTF Trust Fund Committee suggested providing information on the estimated marginal abatement cost (MAC) for projects for which the marginal abatement cost is likely to exceed US$100 per $tCO2_{eq}$. This decision draws from the CTF criteria, which specifies that CTF co-financing will not be available for investments in which the marginal cost of reducing one $tCO2_{eq}$ exceeds US$200, which reflects the lower-end estimate of the incentive needed to achieve the objectives of the BLUE Map Scenario as indicated in the International Energy Agency's Energy Technology Perspectives 2008 Report.

39. Preliminary calculations for *Total Project Cost Effectiveness* (35.7 US$/$tCO_{2eq}$) confirm that the MAC for the proposed Second Power Transmission project will fall far below the aforementioned US$100 threshold value per $tCO2_{eq}$. These preliminary computations using cost effectiveness overestimate the MAC, which is usually estimated as the Net Present Value (NPV) adjusted for local co-benefits (jobs creation, reduced local pollution etc.) and knowledge spillovers.

G. Implementation Potential and Readiness

40. Several projects have already initiated in order to identify and specify the needs of innovative and smart technologies in Ukraine. Especially the ongoing smart grid feasibility study is on track and is expected to be completed by the end of 2014. This study will result in the definition of a procurement plan in which smart grid projects will be prioritized. In addition the smart grid roadmap to be developed by the feasibility study will include the necessary institutional set up required to ensure that, in the future, the smart grid implementation will be replicated and sustained.

41. Once the initial (demonstration) stage co-financed by CTF is implemented and successful results achieved, the long-term smart grid roadmap in Ukraine envisages the enhancement and replication of the Smart Grid elements through additional stages, including the extension of WAMS/WACS/WAPS technologies to the whole transmission system, introduction of Smart Grid technologies for advanced monitoring and control at distribution level, and for introduction of Smart Grid technologies for the activation of demand flexibility (advanced metering infrastructure, demand response) to reach all Ukrainian customers.

42. UE is fully committed to participating with the Component 2.2 Smart Grid investments in the Project and will contract the support of international expert consultants to help with tendering and project management to ensure successful implementation. UE has already invested heavily in a SCADA system and the modernization (automation with GIS/AIS) of a number of SSs. However, until now its investments have focused on the "hardware" components, so UE now needs to look into metering/software. The CTF project will demonstrate the benefits of adding these functionalities ("smartness") through EMS application and standardized software packages. Combined with the TA package for UE in Component 2.4, the Smart Grid subcomponent of the Project will enable UE to successfully implement modernization of communication system and implementation of wide are monitoring, control and protection system and associated programs, which will in turn provide key data on the costs and benefits of scaling up.

H. Additional Cost/Risk Premiums

43. Ukraine faces a constrained financial scenario that is likely to persist in the near future, imposing significant challenges to the development of its infrastructure sector. Introduction of Smart Grid technologies and programs focused on modernization of communication system and implementation of wide are monitoring, control and protection system tool to optimize the use of existing infrastructure in the electricity sector and possibly defer investments in cost-intensive transmission corridors. However, access to financial resources needed to implement Smart Grid programs in the transmission segment is severely restricted due to the higher priority upgrading and rehabilitating transmission systems to satisfy increasing demand and to control losses. It is therefore essential to count with CTF's support to effectively deploy the initial and demonstrational phase of Smart Grid technologies in Ukraine.

ANNEX 8: COUNTRY, SECTOR AND PROGRAM BACKGROUND

UKRAINE: Second Power Transmission Project (PTP2)

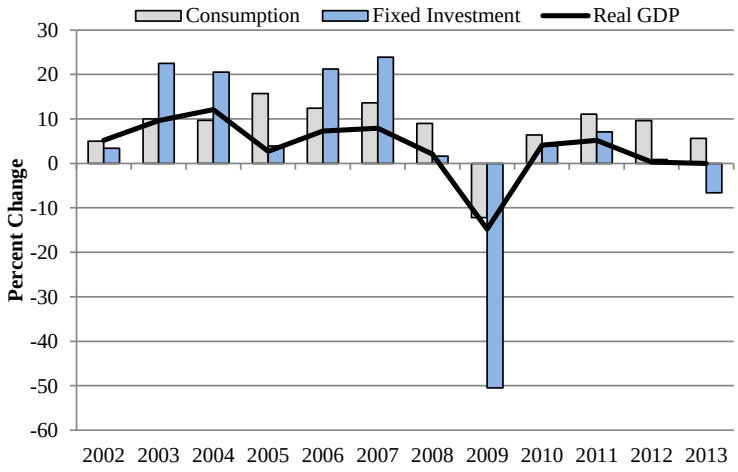
A. Introduction

1. Economic stagnation for most of the 1990s and the crisis in 2008 meant less demand on Ukraine's energy infrastructure, which also led to inadequate investments and insufficient maintenance of aging infrastructure. Ukraine has not recovered yet since the crisis of 2008/2009. GDP growth was closed to zero 2012-2013 and still remains below 2007 level, while, the pressure on energy infrastructure is increasing. This is far more than a sector issue. An adequate supply of energy is an essential prerequisite for achieving sustainable economic growth and improving the quality of life. Without economic growth momentum, it will be difficult for Ukraine to both implement its social programs and poverty alleviation agenda and improve and maintain necessary fiscal discipline for sustainable development. Ukraine's aspirations to increase access to the EU Internal Energy Market add to the country's energy challenges the need to harmonize its legal and regulatory environment with relevant EU directives and other minimum standards.

B. Macroeconomic Context

2. To fully understand the current situation of the energy sector in Ukraine, its problems, and its prospects, it is crucial to consider the macro-economic situation, in particular, the evolution of GDP and structural changes (see Figure 3).

Figure 3: Real GDP Evolution (2002-2013)



Source: Ukrstat.

3. Against the backdrop of intense political unrest and macroeconomic turmoil, the economy contracted by 1.1 percent during the first quarter of 2014. During 2001-2008, real GDP growth averaged 7.5 percent. After a deep contraction in 2009 precipitated by the global economic crisis, Ukraine experienced a modest recovery in 2010-2011 followed by economic stagnation during the past two years due to lack of structural reforms, inconsistent macroeconomic policies, declining investment, and weak external demand. As a result, in 2013, real GDP remained below its 2007 level. Moreover, Ukraine's economic performance has lagged its regional peers over the

last 5 years. Real GDP continued to decline in the first quarter of 2014, largely driven by falling industrial production (-5.3 percent, y/y), construction (-5.8 percent, y/y), and wholesale trade (-4.1 percent y/y), which was only partially offset by positive (albeit slowing) growth in retail trade (5.6 percent, y/y) and agriculture (5 percent, y/y).

4. Following a sharp devaluation in February 2014, the nominal exchange rate has stabilized. Against the backdrop of political turmoil and the suspended disbursement of the second tranche of US$ 2 billion from the Russian Federation initially scheduled for late January, exchange rate pressures intensified in the first two months of 2014. These pressures were compounded by outflows of deposits from banks due to heightened devaluation expectations and political uncertainty. By late February, faced with rapidly declining reserves, the NBU switched to a flexible exchange rate regime, setting the official exchange rate based on the average interbank rate. Consequently, the Hryvnia lost a quarter of its value and since then has been fluctuating between 11 and 12 per US$.

5. Faced with economic stagnation, mounting fiscal and external pressures, and a fragile banking system, the authorities undertook urgent measures to stabilize the economy. In late February 2014, to avoid an imminent balance of payment crisis, the authorities switched to a flexible exchange rate regime, resorted to fiscal consolidation, and requested an SBA with the IMF which was approved on April 30, 2014. The World Bank Board also approved the multi-sector DPL1 in late May to bolster budget financing and support structural reforms. While these measures have resulted in initial signs of stabilization, risks remain significant. Continuing unrest in eastern Ukraine, heightened geopolitical tensions, banking sector instability and slowdown in reforms could result in a deeper and more protracted recession, hamper macroeconomic adjustment, and put at risk the sustainability of the macroeconomic framework.

6. Real GDP is expected to decline by 5 percent in 2014 in the baseline scenario before recovering to 2 percent in 2015. This scenario takes into account slower growth in key trading partners, higher gas import prices announced in March 2014, and disruption of economic activity in eastern Ukraine. The ongoing macroeconomic adjustment is expected to be contractionary in the short term and will negatively affect purchasing power of households and businesses. Therefore, a decline is expected in both consumption and fixed investment in 2014. Meanwhile, external demand from Ukraine's largest trade partners is likely to be muted. Despite this, contribution from net exports to growth is projected to be positive, as imports will contract more due to depreciation. From 2015 onwards, a moderate recovery is expected driven by growing domestic and foreign investment, net exports and consumption.

C. Long-Term Energy Strategy till 2030

7. The GoU has begun the process of reforming the energy sector and addressing the challenges identified in the Economic Reform Program for 2010-2014. The program recognizes the poor state of Ukraine's energy sector due to aging assets, low efficiency of electricity production and transmission, low effectiveness of asset management (which are state-owned), non-transparent and inconsistent regulatory policies, price distortions, subsidies, and insufficient incentives to invest in energy efficiency.

8. Promoting energy efficiency through price signals and increasing the competitiveness and reliability of the electricity sector are the main objectives of the Economic Reform Program in the energy sector. The main approaches to achieve these goals are to update the national energy strategy, ensure the independence of regulation, increase tariffs for greater correspondence to costs, gradually eliminate subsidies, and provide incentives to improve energy efficiency.

9. In June 2012, the draft of the Updated Energy Strategy till 2030 was published for discussion; it was approved in October 2013. Revisions to the original Energy Strategy were needed due to the following main factors.

10. In the Energy Strategy adopted in 2006, the following world trends in the energy sector were not sufficiently considered: (i) a new focus on energy efficiency and energy conservation; (ii) development of competitiveness, efficiency, and transparency of markets; and (iii) an increased focus on environmental protection.

11. Over the last five years, changes in Ukraine's economy and its energy sector that directly and significantly affect the prospects of the energy sector include: (i) Ukraine's commitments under the accession to the ECT were registered at the international level; (ii) changes in the Ukrainian and world economy caused by the financial and economic crisis led to significant adjustments of development indicators; and (iii) most of the programs of modernization and construction of generation and network facilities provided in the Energy Strategy of 2006 have not been completed.

12. Considered scenarios range from pessimistic – under which various risks associated with the slowdown in the economic recovery from the crisis and in global demand for steel and industrial products are implemented (assuming an average annual real GDP growth until 2030 of about 3.8 percent) – to optimistic (assuming an average annual real GDP growth until 2030 of about 6.4 percent). In the base scenario adopted, average real GDP growth of 5 percent per year is assumed until 2030.

13. Since the IMF and World Bank lowered the forecast of Ukraine's GDP growth for 2012-2015 to 2-3 percent per year, the 5 percent projected in the base scenario of the Energy Strategy was deemed too optimistic. The 2012 Ukrainian budget was based on the forecasted GDP growth of 3.9 percent but estimated GDP growth in 2012 was 0.2 percent (CIA Factbook). Consequently, the pessimistic scenario is likely more realistic, and should be the one used in further analysis.

14. According to the pessimistic scenario, GDP growth rates by sector are: 1.2 percent – industry; 4.45 percent – services; and 1.5 percent – agriculture. If the pessimistic scenario is realized, Ukraine's GDP will be 2.0 trillion UAH, and its electricity demand 234 TWh.

15. The foreseen electricity demand levels by sector under the pessimistic scenario of demand development and GDP growth are shown in Table 15.

Table 15: Electricity Demand (TWh) Under Pessimistic Scenario of GDP Growth

	2009	2015	2020	2025	2030
Industry*	85.0	107.0	116.0	126.0	133.0
Agriculture	3.0	4.0	4.0	5.0	5.0
Commercial consumers and households	60.0	75.0	85.0	95.0	106.0
Transmission and distribution losses	21.0	22.0	22.0	22.0	23.0
Export	6.0	6.0	6.0	6.0	6.0
Total	**175.0**	**214.0**	**233.0**	**253.0**	**272.0**
* including power plant auxiliaries (24.0 TWh in 2030).					

16. To address the electricity sector's priorities, the MoECI will develop an integral program of generation and transmission assets' development (SSs and transmission lines), with due consideration of the potential for power export, comprising: (i) a program for modernization of existing and construction of new generation assets; (ii) an updated program of transmission lines development coordinated with the program for construction and modernization of generation assets; (iii) a detailed program of distribution network development that should also be coordinated with the program for construction and modernization of generation assets.

17. Special-purpose programs will be structured so as to minimize the investment, reduce electricity production cost (given fuel prices' escalation), and improve the energy security and environmental situation in Ukraine.

18. Implementation of an integral program of electrical line and SS rehabilitation will facilitate significant reductions in capacity losses (due to utilization of equipment with better performance characteristics), maintenance costs, and number of maintenance staff.

19. According to the preliminary expert opinion in the analytical review "Update of the Energy Strategy of Ukraine till 2030 in energy sector," total investment into modernization of existing and construction of new generation and transmission assets in Ukraine's UPS during 2011–2030 (under the baseline demand scenario) are estimated at about 750 billion UAH. The projected installed capacity of Ukrainian generation by 2030 should grow up to 65.5 GW, and the overall electricity output to 133.0 TWh.

20. The projected distribution of required investments into Ukraine's energy sector development is shown in Table 16.

Table 16: Total Investment in Ukraine's Electricity Sector

Direction	Investments (UAH billion, in 2010 prices)				
	Period				Total
	Before 2015	2016-2020	2021-2025	2026-2030	
TPP modernization	15.0	15.0	2.0	1.0	**33.0**
HPP rehabilitation	5.0	0	0	0	**5.0**
Lifetime extension for nuclear units	10.0	12.0	0	2.0	**24.0**
Installation of flue-gas cleaning plant at TPP	12.0	29.0	21.0	1.0	**63.0**
CHP modernization	2.0	3.0	3.0	0	**8.0**
TPP construction*	11.0	50.0	55.0	62.0	**178**
Construction of HPP and PSP**	11.0	3.0	7.0	0	**21.0**
Construction of NPP***	28.0	35.0	35.0	4.0	**102**
Construction of alternative energy sources	14.0	26.0	46.0	45.0	**131**
Modernization and development of transmission network	29.0	11.0	7.0	7.0	**54.0**
Modernization and development of distribution network	27.0	35.0	36.0	36.0	**134.0**
Total investment	**164.0**	**219.0**	**212.0**	**158.0**	**753.0**

Notes: * including cost of gas-cleaning plant (about 43 billion UAH); ** excluding construction of Kaniv PSP; *** excluding investment to build new nuclear units to replace those to be decommissioned after 2030 (about 100 billion UAH until 2030).

21. A key objective of the new Energy Strategy is to reduce the historically high level of GDP energy content, which accounted for 0.4 kg of standard fuel per US$1 of GDP in 2011 (Statistics IEA) (two to three times the GDP energy content of developed countries) through more efficient use of energy resources and strengthened competitiveness of the national economy.

22. This will be achieved through a comprehensive energy savings program aimed at the manufacturing industry, the domestic and commercial sectors, and the energy industry itself. The policy also envisages a reduction of dependence on fossil fuel resources import, development of Ukraine's own fields of fossil energy resources, and continued dependence on nuclear power for around 50 percent of generated energy, as well as reliance on alternative/renewable energy generation development (which under the Strategy would represent over 5.3 percent of total power generation, or 13 GWh, by 2030).

23. Activities in the energy sector will include: development of a comprehensive and effective regulatory framework to promote competition, deregulation, and diversification of energy supplies; increased development of domestic energy resources; measures to improve energy efficiency and pricing, covering costs; and improvements in the environment for private investment. The new strategy has a greater focus on performance and activities in the field of energy consumption, where the potential savings are large and could be achieved with relatively low cost – at least compared to construction of new generating and transmission facilities – and would help reduce dependence on fuel imports, mitigate the impact of higher energy sources prices, and promote the development of a service sector that can create jobs and stimulate economic growth. To meet the requirements of the ECT, the new Energy Strategy of Ukraine till 2030 aims to accelerate the reform of energy policy based on a comprehensive assessment of the markets and reasonable projections, and to establish options for restructuring energy markets and energy policy in Ukraine.

24. The Ukrainian legislation has made significant progress in implementing some of the provisions of the Treaty establishing the ECT to promote greater competition in the electricity and gas sector, including preparing to restructure "Naftogaz Ukraine" and increasing NERC's role, as well as simplifying the tax code to support investment in the energy sector.

25. The draft of the Updated Energy Strategy till 2030 provides for regular reviews of renewed energy projections and of the Strategy every five years and for annual reviews to assess the current state of implementation.

D. Electricity Generation

26. The total installed generating capacity of Ukraine's power system is 53.8 GW. With a maximum peak load of 31.8 GW (February 2012), there is a surplus of installed capacity of approximately 59 percent. The relatively low increase in installed generating capacity compared to growth in demand reflects the reduction in the present surplus generating capacity to a more prudent level.

27. The Updated Energy Strategy envisages that the growing electricity demand will be met by an increase in all forms of generation, including renewable energy sources, which will need to be matched by expansion and reconstruction in the high-voltage transmission network.

28. Table 17 presents the structure of installed capacity and its growth from 2010-2012.

Table 17: Structure of Installed Capacity in Ukraine

Capacity, GW / %	2010		2011		2012	
TPPs	27.35	51.45	27.27	51.15	27.41	50.97
Combined cycle power plants	4.28	8.05	4.41	8.27	4.4	8.18
NPPs	13.84	26.03	13.84	25.96	13.84	25.73
HPPs, incl. PSPs	5.46	10.27	5.42	10.17	5.41	10.06
Solar power plants	0.01	0.02	0.19	0.36	0.32	0.60
Wind power plants	0.09	0.17	0.12	0.23	0.26	0.48
Others, incl. small HPP	2.14	4.03	2.07	3.88	2.15	4.00
Total capacity	**53.16**	**100.00**	**53.31**	**100.00**	**53.78**	**100.00**

Source: UE.

29. In 2012, Ukraine's UPS produced 198,119 million kWh of electricity. The generation structure is represented in Table 18.

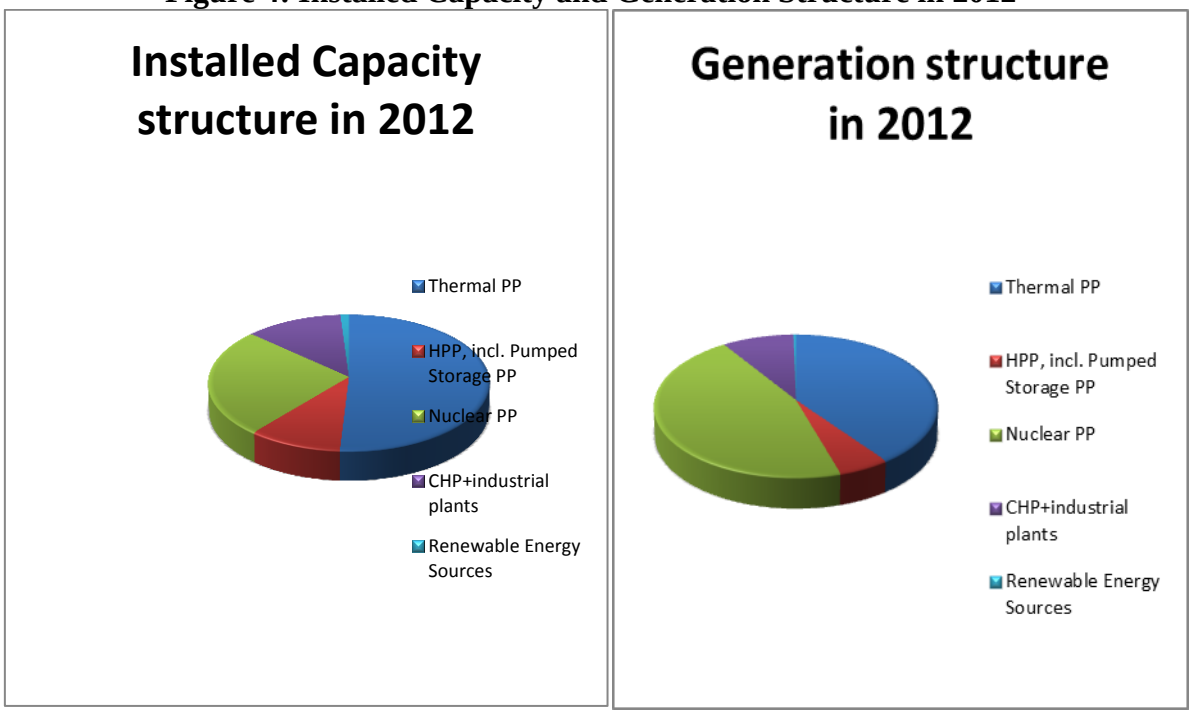
Table 18: Structure of Generation in Ukraine

Source of generation (million kWh)	2008	2009	2010	2011	2012	
					Million kWh	%
NPPs	89,841	82,924	89,151	90,248	90,137	45.50
TPPs	72,402	63,197	67,829	73,710	78,907	39.83
Combined cycle power plants	9,946	7,872	10,148	11,065	9,650	4.87
HPPs, incl. PSPs	11,332	11,768	12,953	10,773	10,833	5.47
Industrial plants and others, incl. renewable energy	8,369	7,341	8,016	8,308	8,592	4.34
Total	**191,890**	**173,102**	**188,097**	**194,104**	**198,119**	**100.00**

Source: UE.

30. Figure 4 compares the installed capacity and generation structure.

Figure 4: Installed Capacity and Generation Structure in 2012



31. It can be seen that TPPs' capacity is still underutilized, accounting for 44.7 percent of generation (whereas the installed capacity of all thermal plants (TPP+CHP) was 61 percent), although it is tending to decrease. NPPs account for 45.5 percent (25.7 percent of installed capacity), and HPPs 5.5 percent (10 percent of installed capacity).

32. Such a discrepancy between installed capacity and production volumes is due to the higher cost of energy produced at TPPs linked to the high level of their equipment depreciation, old technology, low fuel quality (Ukrainian energy coal), and the high prices of imported fossil fuels. The cost of electricity produced by NPPs is much lower, an additional stimulus for restricted use of thermal-produced electricity. Besides, there are spare hydro-capacities – 6.6 percent of total electricity volume and 9.0 percent of generation capacity.

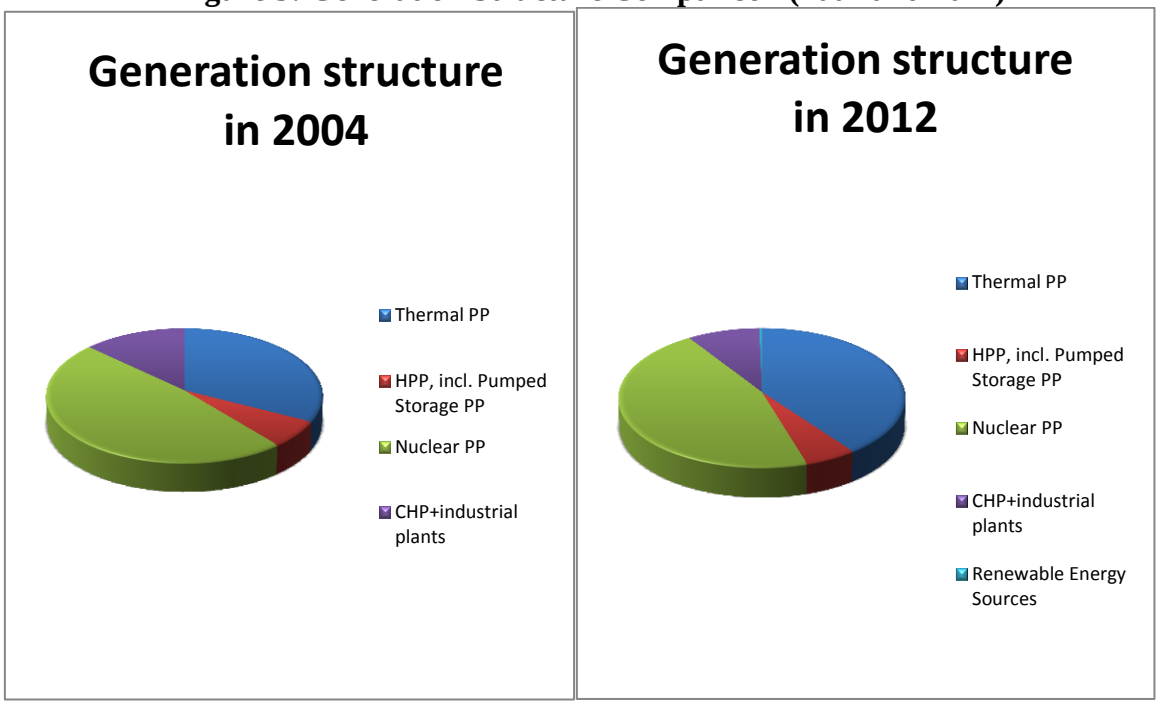
33. Compared to 2004, the electricity generation mix has remained almost unchanged. There has been a slight decrease in the share of nuclear energy (from 48 percent in 2004 to 45.5 percent in 2012) due to the increasing TPP share. Nonetheless, Ukraine has one of the highest levels of reliance on nuclear energy in the world. A new feature is the emergence of renewable energy, mostly due to recent construction of several wind and solar farms in the South; production is still low, but it is growing and is one of the GoU's priorities for energy sector development.

34. The relatively small share of flexible generation sources, able to follow the load variation, should also be noted. Maneuverability is provided basically by HPPs, PSPs, and TPPs, including combined cycle turbines, industrial plants, etc.

35. The State Target Economic Program for energy efficiency and the development of energy production from renewable energy sources and alternative fuels for 2010-2015, approved by the Cabinet of Ministers on March 1, 2010, aims to optimize the structure of energy balance by reducing the share of imported fossil energy sources, particularly natural gas, and their

replacement by alternative types of energy. The Program establishes a target share of 10 percent of renewable energy in Ukraine's total generation for 2015. This change in the generation structure presents an additional challenge for the transmission system, requiring more flexibility and stability, demand management, adjustment to actual production, and improvement of energy efficiency.

Figure 5: Generation Structure Comparison (2004 and 2012)



E. Electricity Consumption

36. The structure of electricity consumption in Ukraine is given in Table 19.

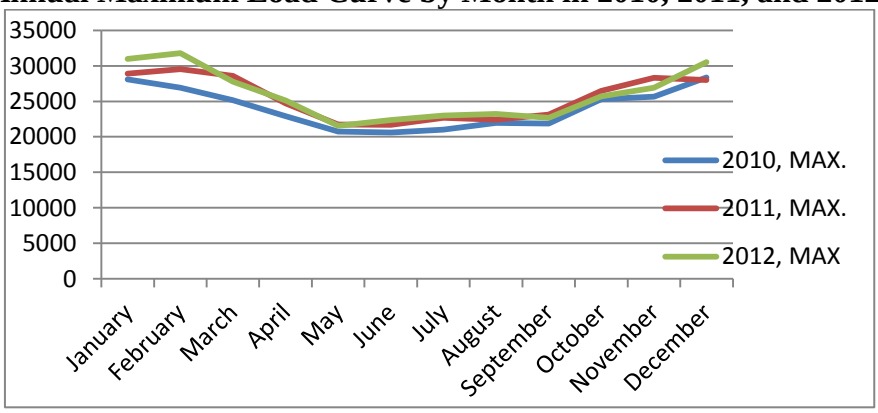
Table 19: Structure Of Electricity Consumption in Ukraine

	2010		2011		2012	
	Million kWh	**%**	**Million kWh**	**%**	**Million kWh**	**%**
Consumption (gross)	183,364	100.00	186,983	100.00	187,689	100.00
Own needs of power plants	18,149	9.90	18,630	9.96	19,228	10.24
Technological losses	17,977	9.80	17,819	9.53	17,990	9.59
Consumption (net), including	147,238	80.30	150,534	80.51	150,472	80.17
Consumption (net), including	147,238	100,00	150,534	100,00	150,472	100,00
Industry	71,272	48.41	72,767	48.34	70,512	46.86
Of which metallurgy	38,438	26.11	37,734	25.07	36,936	24.55
Communal sector + households	55,956	38.00	56,794	37.73	58,775	39.06
Agriculture, transport, construction, and services	20,010	13.59	20,973	13.93	21,185	14.08

Source: UE.

37. The general trends in consumption development are the same as those identified by Decon in 2006: a decline in the share of industry due to the increasing share of consumption of the service sector and the population.

Figure 6: Annual Maximum Load Curve by Month in 2010, 2011, and 2012 (MWh)

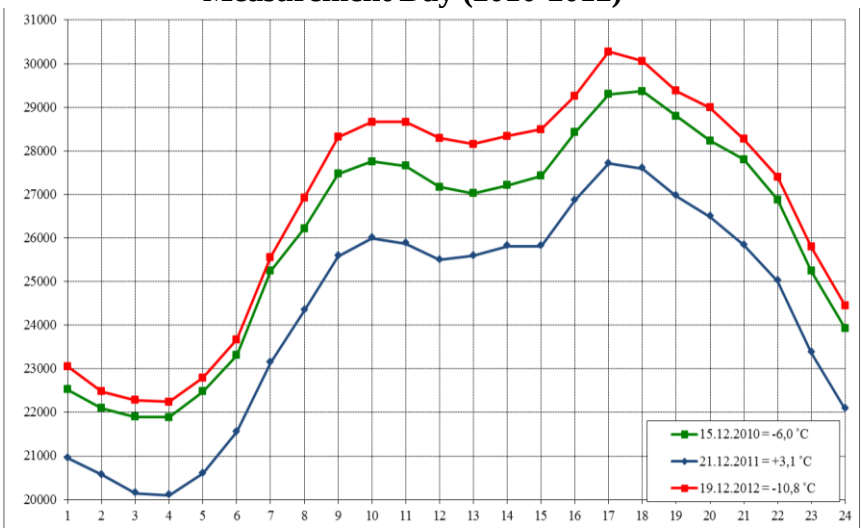


38. It can be seen that the monthly maximum load increased between 2010 and 2012: by 15.3 percent in February, 9.3 percent in January, and 7.1 percent in December (Figure 7).

39. The absolute annual maximum in 2012 was recorded on February 2 at 18:00, reaching 31787 MW at a frequency of 50.00 Hz and a temperature of -21,5°C (the long-term average temperature in February is -9.6°C).

40. Ukraine's electricity grid needs to be able to cope with rapidly changing demand, which varies widely throughout the day (Figure 7).

Figure 7: Daily Curve of Electric Power Consumption in Ukraine's UPS on a Winter Measurement Day (2010-2012)



Source: UE.

Annex 8-1: Action Plan for Energy Sector Reform

2015-2016	2017-2020
Financial Stabilization of Energy Enterprises	
Reduce the backlog of historical debt in the energy sector through implementation of the Law of Ukraine *On the Measures to Insure the Sustained Operation of Fuel and Energy Sector Enterprises.* Adopt the law "*On State Regulation in Ukraine's Energy Sector*," which would strengthen NERC`s (administrative and financial) independence and responsibility. Continue to work on improvement of discipline of payment for energy suppliers and maintenance of financial discipline. Formulate a strategy of social protection of the population amidst rising energy prices. Abolish the cross-subsidization of household consumers of electricity and natural gas at the expense of non-household consumers. Streamline the management of energy enterprises by setting transparent goals of commercial activity and strengthening the institution of supervisory boards that will monitor the goals' achievement. Introduce annual mandatory audits by independent auditors as well as mandatory publication of yearly reports on performance of energy sector enterprises, in particular Naftogaz Ukrainy, Energoatom, UHE, UE, and those Gencos/Discos with state shares.	Bring the prices of natural gas, power, and coal[11] to the level that ensures cost recovery and buildup of resources for investing in own infrastructure. Preclude nonstandard losses of power and natural gas in distribution networks by legislatively adopting an incentive system that would help improve corporate governance and by introducing power and natural gas metering systems. Cut standard losses of power and gas in trunk and distribution lines by investing in power and gas network upgrading.
Power Sector	
Finalize principles and a model of the new WEM and ways of transition to it; and develop a legal framework and draft codes and contracts that will underpin the WEM's operation as part of The Law of Ukraine "*On Operating Principles of Electricity Market of Ukraine.*" Develop the necessary statutory and organizational base to adopt a system of sale of power according to a new WEM model. Develop and adopt a concept of the system services market, and a model for launching such a market on the assumption of operation of the market of bilateral contracts for power supply, and either adopt official standards or	Complete transition to a market model that uses direct contracts between producers and consumers/providers as well as the Balancing Market mechanism, and start 100% opening from July 1, 2017, as stipulated by the The Law of Ukraine "*On Operating Principles of Electricity Market of Ukraine*." Finalize feasibility study for integration of Ukraine and Moldova's UPS to ENTSO-E.

[11] This concerns the viable part of the coal sector.

2015-2016	2017-2020
introduce ENTSO-E standards for frequency and power flows, and criteria for the reliability of Ukraine`s power grid. Put in place regulatory and legal documents regarding procedures for determining available power in transmission lines. Put in place legislative documents concerning the procedure for dispatching control of interconnected power flows. Further develop regulatory and legal documents to encourage development of RES as part of the "green" tariff, or special feed-in tariff, introduced in 2009.	Update the rates of regulation of power transmission and supply tariffs so that these tariff systems ensure recoupment of investment and a sufficient rate of return for sustainability of enterprises that transmit and supply power to customers. Settle through legislation the issue of market opening through the mechanism of a consumer's right to choose a power supplier. Develop legal documents to bring Ukraine`s legislation into compliance with requirements of EU Directive 2005/89/EC concerning security of electricity supply and requirements of 3rd EU Energy Package

2015-2016	2017-2020
Survey thermal, hydropower, and nuclear power plants and electric equipment of power plants and SSs (220kV and more) to establish whether they can operate in parallel with ENTSO-E power system (as part of feasibility study to be done for ENTSO-E integration of Ukraine and Moldova). Carry out computer simulation of Ukraine`s power supply system stability for different operating conditions with allowance for parallel operation with ENTSO-E power system. Identify and classify the investment projects necessary to achieve ENTSO-E standards of efficient frequency and power regulation in the power supply system. Prepare and approve an investment program designed to bring the frequency and power regulation system into compliance with ENTSO-E requirements.	Implement investment projects necessary for achieving ENTSO-E standards of efficient regulation of frequency and power in the power grid. Provide *primary, secondary and tertiary* regulation of the power supply system in compliance with ENTSO-E requirements. Harmonize operating methods of the power supply system with ENTSO-E requirements.
Conduct marketing research on the EU power market to find new markets to keep and subsequently increase power exports after integration of Ukraine`s national grid with ENTSO-E. Formulate the necessary strategy.	Carry out organizational and technical measures for getting into new power markets. Implement the "Action Plan for Export Potential Increase."
Survey Ukrainian thermal power plants to check how their emission amounts comply with Directive 2001/80/EC so as to establish whether the promising part of power units need to be modernized. Develop strategy of approximation of Ukraine`s legislation on emissions from fuel combustion with requirements of EU Directive 2001/80/EC concerning emissions of SO_2, NO_x and dust. Make a practice of formalizing power investment projects as Carbon Finance Projects and utilizing proceeds received through mechanisms specified in the Kyoto Protocol, including for carrying out environmental activities.	Carry out technical measures to modernize the promising part of power units to meet the requirements in line with EU Directive 2001/80/EC regarding emissions of SO_2, NO_x and dust. Carry out economically sound technical measures for reducing auxiliary power consumption of thermal power plants. Implement projects funded through the mechanisms specified in the Kyoto Protocol.
Adopt a strategic action plan for further transformation of ownership and promotion of increased private sector involvement in the power industry.	Implement the strategic action plan for further transformation of ownership and promote increased private sector involvement in the power industry.
Coal Sector	
Enact/implement a law on the privatization of enterprises in the coal sector. Carry out measures to mitigate the social and environmental impacts of coal sector restructuring.	Carry out measures for the privatization of mines producing coking coal. Carry out measures for the privatization of mines producing steam coal.

2015-2016	2017-2020
Abolish the pseudo-wholesale market of coal products to develop a competitive environment in the coal sector. Enact a law that regulates provision of state subsidies to the coal industry in compliance with EU legislation principles, including such principles as: phasing-out of subsidies for reimbursement of expenses at cost; changing of methods of provision of state assistance for capital investments and adoption of methods of distribution of investment resources on a competitive basis; and allocation of public funds on a shared and repayable basis. Implement a system to monitor provision and utilization of state assistance in the coal sector in line with EU legislation principles. Put in place a system to monitor coal imports. Carry out measures to improve the statutory base regarding mine safety. Carry out measures to monitor and ensure proper growth in the cost of coal production. Improve the quality of coal products supplied to TPPs by establishing a system of payments for coal products based on heat value. Make a practice of formalizing investment projects in the sector as "joint projects," and of utilizing proceeds received through mechanisms specified in the Kyoto Protocol, including for carrying out environmental activities.	Enforce the law that regulates provision of state subsidies to the coal industry in compliance with EU legislation principles. Introduce advanced technologies for mine degassing so as to increase mine safety standards. Reduce coal bed methane emissions into the atmosphere.

2015-2016	2017-2020
Gas Sector	
Enact a law that defines approaches to operation of the natural gas market and includes provisions for separation of types of activity, price and tariff setting, and provision of transparency of performance of gas transportation and gas distribution operators. Introduce a system of mandatory publication of annual reports on the performance of Naftogaz Ukrainy subsidiaries. Implement the Gas Transportation System Modernization Program with Ukrtransgaz with the first Pilot Emergency Project and follow up Modernization Project. Implement mechanisms for enforcement of legislation on production distribution so as to increase domestic production of natural gas. Enforce rules of the Code of Ukraine "*On Subsoil Assets*" and the Law of Ukraine "*On Oil and Gas*," which regulate the procedure for issuing permits to use subsoil assets. Make a practice of formalizing investment projects in the sector as "Carbon projects" and of utilizing proceeds received through mechanisms specified in the Kyoto Protocol, including for carrying out environmental activities. Complete work on fitting meters at outlets that sell natural gas and complete work on adoption of a system of payment by consumers for amounts of natural gas actually consumed.	Update standards of regulation of tariffs for transportation and supply of natural gas for the tariffs to guarantee recoupment of investments and a sufficient rate of return to ensure sustainability of enterprises that transport and supply natural gas to customers. Adopt legal documents on procedures for consumers' right to choose a natural gas provider. Develop legal documents to introduce the institution of services for balancing the system of natural gas supply as well as principles of regulation of conditions for delivery of such services. Ensure creation of a system services market. Develop legal documents to bring Ukraine`s legislation into compliance with EU Directive 2004/67/EC concerning the security of the natural gas supply. Implement the Gas Transportation System Modernization Program. Thanks to investment in the upgrading of gas transportation and gas distribution systems, cut the downtime and short-supply of natural gas to customers caused by breakdowns and failures. Thanks to investment in the upgrading of Naftogaz Ukrainy enterprises, reduce losses of natural gas and its consumption for auxiliary purposes in terms of production, transportation, and supply.

ANNEX 9: TEAM COMPOSITION

UKRAINE: Second Power Transmission Project (PTP2)

World Bank staff and consultants who worked on the Project:

Name	Title	Unit
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