Review of Turkish Electricity Transmission Company Renewable Energy Integration Project (P144534) with CTF Financing

Introduction

Electricity demand in Turkey is expected to grow at 4.5 to 5.0 per cent per annum, and the Turkish government is keen to diversify its energy sources away from imported oil and gas and meet future demand through increased use of renewable energy resources (RES) such as wind and hydropower thereby meeting demand in an environmentally sustainable manner while improving energy security. Turkey promulgated the Renewable Energy Law (Law No.5346) in 2005 to increase the use of RES for electricity generation. Wind energy is a major RES and Turkey has a potential for generating an estimated 48,000 MW of power from wind energy. The present installed capacity however is only about 2,700 MW, and the government aims to install 20,000 MW of wind capacity by 2023, which would account for some 25-30% of the projected peak demand in 2023.

While Turkey offers feed-in-tariffs of up to 11 USD cent/kWh[1] to wind power plants, other barriers inhibit the large scale development of wind power plants (WPPs) and it is estimated that only about 400-500 MW of wind energy is likely to be added each year, whereas an annual wind capacity addition of about 1600-1700 MW would be needed to achieve the goal of 20,000 MW of installed capacity by 2023. Constrained or lack of transmission capacity is one of the major barriers to the development of WPPs, since the most favorable sites for wind power are typically located far from load centers. While the development of WPPs is phased, the transmission lines to sites would have to be planned to evacuate power from all planned WPPs to achieve the goal of installing 20,000 MW of WPPs by 2023. This requires heavy upfront investments in transmission capacity, which private project developers would be unwilling to finance thus placing the burden on public financing.

The Renewable Energy Integration Project for Turkey proposed by the IBRD to address some of the challenges to development of WPPs will require an estimated $476m USD to finance the project, and the IBRD is seeking CTF financing of $50m USD to supplement a loan of $300m USD, with the remaining to be financed by the TEIAS, the Turkish Electricity Transmission Company.

This document comments on the eligibility of the project for CTF co-financing based on a review of project documents, which were made available to the reviewer.

Project scope and objectives

The objective of the project is “to assist Turkey in meeting its increased power demand by strengthening the transmission system and facilitating large-scale renewable energy generation”. Additionally, the project seeks to “to avoid Green House Gas (GHG) emissions from fossil fuel based power through greater integration of renewable energy sources based generation in Turkey”.

[1] An amendment to the Renewable Energy Law in 2010 has a provision to increase feed-in tariffs from 7.3 USD cent/kWh up to 11 USD cent/kWh for projects that use of locally produced equipment.

The project has four components, two of which are proposed to be partly financed with CTF funds: (i) Upfront development of transmission infrastructure to facilitate faster development of WPPs (CTF: USD 25 million, IBRD: USD 25 million), which will install three 380kV 500 MVA highly digitalized sub-stations with associated grid connection structures for evacuation of wind power in the provinces of Can, Izmir and Hamitabat; and (ii) Smart-grid investments to strengthen grid operation and management in face of higher wind energy generation (CTF: USD 25 million, IBRD: USD 32.5 million), which will enable real-time monitoring of the network, system upgrades, and installation of remote terminal units, etc. to enable TEIAS to handle increasing amounts of wind energy. In addition, the World Bank is exploring Technical Assistance to support implementation of smart-grid technologies and wind energy markets and regulation, as well as support for safeguards strengthening through CTF grant of an additional USD 1 million, which will support capacity building at TEIAS, EMRA and Ministry of Environment and Urban Development. The other two components of the project to be financed by IBRD will install submarine power cable and underground transmission cables to interconnect wind energy locations and strengthen the transmission network.

Overall compliance with CTF objectives and criteria

Objectives

CTF is designed to support high abatement opportunities and promote low carbon technologies including power sector projects that result in substantial reductions in carbon intensity of electricity production, increase substantially the share of renewable energy in the total electricity supply, and reduce transmission and distribution losses. The proposed project in Turkey is thus consistent with the overall objectives of CTF. The activities to be financed with CTF funds are also consistent with Turkey's development strategy for the energy sector and its goal to diversify energy sources, increase the share of renewable energy, and install 20,000 MW of WPPs by 2023.

Overall compliance with CTF criteria

Potential for GHG emissions savings

The proposed project is designed to promote the installation of WPPs in place of gas-fired power plants and thus result in reduction in carbon emissions. The additional emissions reduction due to the CTF project is estimated to be 7.27 MTCO2/year by year 2030 or cumulative emissions reduction of 108.4 MTCO2 over a 15-year life of the project.

WPPs are a widely used commercial technology and have high mitigation potential, on the other hand, their faster implementation is being impeded by transmission requirements. Thus co-financing from CTF for the proposed transmission strengthening project is justified.

Cost effectiveness

The project document estimates the potential benefits from reduced CO2 emissions at $22 or €17 per ton of CO2. The threshold for CTF co-financing is projects where the marginal cost of reducing a ton of CO2-equivalent is lower than US$200. Unserved energy due to disruptions in the transmission system is valued in the Project Appraisal Document at €77 cents/kWh. Reduced energy losses due to improved transmission systems is valued at €6.3 cents/kWh, and additional transmission capacity due to the project is valued at €0.9 cents/kWh. While this review has not verified the analysis, the estimates appear to be reasonable and conservative.

Overall, the economic rate of return (ERR) for the upfront development of the transmission system (the component financed with CTF co-financing), which will enable addition of WPPs to the system, is estimated at 36-40%. A stress test analysis assuming 20% decrease in carbon and electricity prices combined with 20% increase in investment costs results in a ERR of 29-34%, which is still very favorable.

For the project as a whole, the Financial Internal Rate of Return (FIRR) is estimated at 22%, which is much higher than the estimated Weighted Average Cost of capital (WACC) of about 6.5% for TEIAS. The project's FIRR remains above 10% for increases of up to 50% in capital costs or decreases of up to 50% in incremental revenues.

The project document does not provide an analysis of the expected reduction in the cost of the technology due to organizational learning and scale effects at the country level, which provides for conservative analysis, but the report does estimate a multiplier effect leading to increased installation of WPPs over the 2030 period beyond that directly attributable to the CFT co-financed project. The analysis presented indicates that the project is cost effective.

Demonstration potential at scale

The project documents estimate the direct impacts of the CTF co-financed project and the projected transformational impact due to scaled up investments in WPPs engendered by the project. It is estimated that the project investment will directly result in about 600 MW of additional WPP capacity being added to the country, which will lead to additional investments in WWPs resulting in an additional 6,250 MW of WPP being added to the system by 2030 attributable to the CTF project. This is consistent with Turkey's goal of 20,000 MW of installed WPP capacity by 2023 – The WB realistically expects Turkey to achieve this goal by 2030 provided the program receives support for accelerated development of WPPs and financing of transmission systems

The project if implemented as planned would a transformational impact leading to broader deployment of low carbon WPPs, and the project document estimates the avoided annual GHG emissions expected as the CTF co-financed project is replicated in Turkey. The proposed project thus demonstrates potential for scaling up, though it is not clear if future projects would continue to need support for financing the related transmission systems.

Development impact

The proposed project seeks to strengthen the transmission system by increasing its capacity and installing automated control and protection systems to maintain grid stability when integrating intermittent WPPs into the system. The project is thus expected to lead to a reliable power system with lower losses and reduced emissions. The additional power generated by WPPs directly attributable to the CTF co-financed project is expected to result in about 600 MW of WPPs generating 1,734 GWh of power annually. The avoided energy losses from investments under the project are expected to be 711 GWh per year, and the environmental co-benefits are estimated at avoided cumulative emissions reduction of 108.4 MTCO2 over a 15-year life of the project. The project if implemented as planned the project will likely result in significant developmental impacts consistent with CTF eligibility criteria.

Implementation potential

The Turkish government has a goal to install 20,000 MW of WPP capacity by 2023 and has periodically amended the RE Law to promote greater development of RES in the country. The electricity market in the country has undergone market-oriented reforms to establish a competitive market for electricity. The proposed project is thus supported by enabling policies and laws that promote low carbon technologies.

CTF funds of $50m USD are being leveraged by IBRD funds of $300m USD and an additional $125m USD from TEIAS. The WPPs will be financed by the private sector, which is expected to make investments in excess of $1.0B USD for installing plants connected to project facilities.

Based on the goals of the government and the supportive policies the project appears to meet CTF eligibility criteria for its implementation potential.

Additional costs and risk premium

Additional CTF grant funds of $1.0m USD are being proposed for capacity building of TEIAS and other sector agencies. It will support technical assistance for: (i) design, implementation and capacity building at TEIAS for smart-grid technologies, (ii) simplification and strengthening of market and regulatory processes for allocation of licenses for wind power (and other RE) development, and (iii) capacity building at TEIAS and other agencies towards enhanced governance, fiduciary and safeguard practices. TEIAS does not have the capacity or experience with procuring and integrating large-scale intermittent wind power into the national power system, and would benefit from the proposed capacity building. This support is consistent with CTF requirements for financing.

Technology readiness

WPPs are a commercial technology and Turkey has installed some 2,700 MW of capacity. The market is thus primed for scaling up the installation of WPPs provided some of the key barriers related to transmission capacity, and controls and protection for integrating intermittent WPP can be overcome. The project as proposed will likely lower the barriers to increased installation of WPPs.

Conclusions and recommendations

As discussed above, the proposed project to augment and strengthen the transmission system and install control systems to enable greater integration of WPPs would help scale up the deployment of low carbon technologies and meets the eligibility criteria for CTF co-financing.

This reviewer provided comments to enhance the project report and lay down the case for CTF financing more clearly. The World Bank team prepared a revised project report to address the comments, which was submitted to this reviewer. The comments originally provided by the reviewer, and the team's response and final comment from the reviewer are summarized in the Table below.

Initial Comments	Team's Response	Final Comments
1. The FIRR for all components of the project is estimated to be 22%, which is much higher than the estimated WACC of about 6.5% for TEIAS, and	CTF funds being availed by the project offer a lower cost of funds (at 0.75% per annum service charge, 0.45% management fee, with 10 year	The rationale that CTF funds would bring to focus the barriers faced in

the project's FIRR is estimated to be above 10% even for increases of up to 20% in capital costs or decreases of up to 20% in incremental revenues. What would be the FIRR if CTF funds were replaced with other high-cost commercial financing? The report would make a stronger case for CTF financing if it addresses how concessional CTF is helping overcome the financial barrier of making investments in transmission systems to connect remote WPP sites to load centers.	moratorium and a 10 year repayment period thereafter) than the commercial (or IBRD) funds usually availed by TEIAS. However, CTF funds largely benefit wind power development in Turkey not by improving the viability of marginal projects, but by bringing into focus barriers affecting wind power development and addressing them systematically. TEIAS's investment program is typically well covered in terms of regulated tariff revenues.	developing large-scale WPP is a reasonable argument, which is supported by the experience of Egypt and India which have also sought support for financing transmission systems for intermittent RE. The rationale for CTF financing is thus justified.
2. The report does not address how Turkey financed transmission capacity for evacuating power from the presently installed 2,700 MW of WPP and related controls to accommodate intermittent power. Were these publicly financed? Or were existing transmission lines and substations in the region under-loaded and able to evacuate additional power from WPPs. It would be useful if the report addressed how these systems were financed and how the country overcame the barriers to making such investments given all the constraints discussed in the report. This would strengthen the case for seeking CTF co-financing.	The presently installed 2,700 MW of WPPs are being served largely through existing and incremental transmission infrastructure, rather than through transmission infrastructure specifically built to promote wind energy. While renewables are given a priority for grid connection, due to technical limitations, available transmission capacity is allocated to wind and solar projects on a sub-station basis, and is updated annually consistent with enhancements in available sub-station capacity. In case of multiple applications, grid connection rights are awarded based on competitive bidding. The Turkish transmission network is almost entirely publically owned (by TEIAS) and publically financed. So far WPPs have leveraged surplus capacity in existing transmission infrastructure (or with incremental augmentation) to meet the immediate needs of upcoming WPPs. Going forward, accelerated expansion of wind energy would require investments in transmission infrastructure largely dedicated to wind energy.	If the existing WPPs were developed largely based on the excess evacuation capacity of previously installed transmission systems, there is justification for CTF financial support for expanding the WPP portfolio to remote areas where no transmission systems exist or where the capacity of existing systems is saturated.
3. It is estimated that the project investment will directly result in 600 MW of additional WPP capacity being added to the country, which will lead to additional investments in WWPs resulting in an additional 6,250 MW of WPP being added to the system by 2030 attributable to the CTF project. The report would be strengthened if it were to explain why the experience from the presently installed WPPs and related transmission facilities coupled with the enabling policies and laws for promoting RE including FIT for WPPs is not engendering additional investments needed for scaling up WPPs in the country. The report could explain how this proposed CTF co-	The project is directly supporting 1500 MVA of transformation capacity in new substations, which can support about 1200 MW of wind power. Of this, about 600 MW of wind power capacity has already been licensed and is likely to be implemented within the project period, whereas the remaining would be implemented shortly thereafter. These new substations would seed the availability of transmission infrastructure in the vicinity of the wind power plants. Once transmission infrastructure has been seeded in an area, it is much easier for more infrastructure to be put up. In addition, the project is supporting an undersea cable that would help transfer	The response by the WB team appears reasonable since it will likely be easier to finance incremental systems in future to supplement and expand the capacity of systems to be financed through the proposed project not least since this project will finance new transmission

financed project which is expected to result in an additional 6,250 MW of WPP will engender additional investments needed to install 20,000 MW for WPP by 2030. Will transmission facilities always need concessional financing?	the wind power between Thrace and Anatolia areas, while also strengthening the grid control systems and establishing a renewable energy desk. Accelerated development of wind energy in Turkey is faced with some barriers that would be addressed through the CTF activities as well as through the EU-IPA funding. Once these barriers are addressed, faster execution of wind energy projects is expected. Transmission facilities would continue to be constructed using commercial (or near commercial) funding going forward.	capacity principally to support WPP development and will increase the knowledge and experience of both TEIAS and project developers. Based on the response, CTF financing for the proposed project is justified.
4. It is reported that TEIAS's annual plans are subject to review by EMRA, the electricity regulator, which establishes each year a revenue cap within which TEIAS is required to operate. It is reported that electricity transmission volumes have increased at an annual rate of about 6.0% and the average tariff has increased by over 30% (from YTL 0.0067/kWh in 2010 to YTL 0.0089/kWh in 2012). This increase in tariff was presumably to accommodate increased investments in the transmission system. The report would be strengthened if it were to describe why additional transmission lines cannot be financed through higher transmission tariff approved by the regulator.	The recent increase in transmission tariffs cover a back-log in tariff increases and make the revised tariffs cost reflective. TEIAS has been financing all transmission investments through transmission tariffs and would continue to do so going forward. Allocation of grid connectivity to wind and solar projects is constrained by lack of surplus substation infrastructure – especially in locations with high wind energy potential. Therefore, accelerated wind energy development would require faster implementation of substations in such locations. Investments for such infrastructure would be provided by TEIAS from its own resources, government allocations as well as loans from World Bank and other agencies. All such investment would be recovered through regular transmission tariffs over the useful life of the assets. .	The response is reasonable since transmission systems for intermittent wind projects are under-loaded and are more difficult to finance. CTF support for the proposed project appears to be justified.
5. The report states that Turkey will need to augment installed generation capacity from the present 38 GW to about 65-72 GW by 2030 to meet anticipated demand. This will clearly require substantial investments in transmission facilities. The report would be strengthened if it were to describe how Turkey proposes to finance the transmission expansion and explain why the expansion program cannot also include investments to evacuate power from WPP. Is it that these conventional generation facilities will not be located near the WPP sites where the same transmission facilities could be used for WPPs? How about transmission facilities to be built for conventional generation facilities located in the Thrace area of Turkey where wind potential is high and the region is close to the load center in Istanbul – could these transmission investments not be optimized to meet the needs to	As mentioned earlier, TEIAS finances its transmission expansion plans through internal resources, support from the Government of Turkey, as well as loans from agencies such as the World Bank. Transmission planning is done in an integrated manner for all sources of generation, including conventional as well as renewable energy power plants. However, wind energy resources are particularly concentrated in the Aegean, Marmara and East Mediterranean provinces. Wind energy sites typically have multiple WPPs planned and therefore the existing transmission infrastructure is usually insufficient. As a result, availability of surplus transmission capacity becomes a constraint to faster development of WPPs. Investments under the proposed CTF project would upfront develop the transmission infrastructure at some of these locations to facilitate accelerated development of wind energy.	Based on the response that the new WPPs to be developed will be in remote areas far from other planned generation projects, CTF financing for the proposed project appears to be justified.

evacuate power from conventional generation plants and WPPs?		
6. Given the intermittency of wind, WPPs will provide base load power to the system whereas gas-turbine systems could be used for base load or as peakers. Other conventional fuel power plants could be used as base load or peak load plants depending on the cost of generation. Will power from WPPs displace cheaper sourced base load power, and if so will the benefits of increased energy security and reduced emissions offset the potentially higher cost of power from WPPs? The report could be strengthened if it were to address the marginal capacity and generation cost of meeting future demand and compare it with the cost of WPPs (based on the FIT offered to WPPs)	This issue relates to an assessment of whether wind energy is economically preferable over marginal conventional power plants, when incorporating the environmental externalities as well. Turkey is endowed with good winds which allow a capacity utilization factors as high as 40%, and make wind energy viable at the prevailing feed-in tariff of 7 to 11 USD cents per kWh. Wind energy is treated as a negative load in the system rather than as base-load or peaking power. Wind energy would provide energy security to a country dependent on energy imports, while also providing a non-escalating source of energy (compared to the escalating prices of fossil fuels). The policy decision to develop 20,000 MW of wind by 2023 has been taken by Government of Turkey and reflected in the Investment Plan submitted to CTF earlier.	The response of the team indicates that the viability of wind power over conventional power sources has been considered in the analysis and is a basis for the Government of Turkey's policy to develop 20, 000 MW for 2023. This fully addressed the comment made earlier.
7. The expectation is that CTF co-financing will help mobilize future commercial investments for replication and scale up, which will stimulate economic growth and facilitate the long-term transition to low-carbon development. The justification for CTF financing is that it will improve the overall financial attractiveness and will help the transmission utility undertake the required investments. Given that investments in transmission infrastructure for RE projects (such as WPPs) that provide intermittent power and result in low capacity utilization of transmission lines will remain a barrier to investment, what is the assurance that increased installation of WPPs will not require concessional financing in the future? Or is it is expectation that the transmission company will be able to finance such investments through tariff increases in the future? The report would be strengthened if it were to describe how CTF financing for the proposed project will alleviate the long term barrier to making investments in transmission capacity especially to evacuate intermittent power.	As mentioned earlier, the medium and long term barriers to accelerated development of wind power plants would be alleviated through a mix of seeding transmission infrastructure at key wind energy locations, developing smartgrid capabilities, strengthening transmission interconnections across Thrace and Anatolian areas, strengthening overall grid infrastructure, and addressing market and regulatory barriers. While many of these activities would be done under the proposed project, some of them would require additional grant funding to support technical assistance. CTF funding under the proposed project has brought into sharper focus the issues related to transmission constraints to expansion of renewable energy in Turkey. TEIAS would continue to build its transmission network and cater to the needs of renewable energy expansion through investments funded through internal sources as well as from agencies such as the World Bank, and would rely on regulated tariff revenues for the same.	As indicated in the response from the team, the project brings to focus the barriers to wide-scale development of WPPs in Turkey and will likely engender increased investment in transmission facilities to support greater development of WPPs in the future. Also, as indicated in the response, there may be a need to provide additional financial support to realize the potential for WPPs in the country.

The proposed project document was reviewed again in view of the response provided by the WB team to the initial comments made by this reviewer. The response from the team adequately addresses the principal comments. Based on a revised review of the project document, the proposed project meets the eligibility criteria for CTF co-financing.