Extended Annual Review Report

Project Number: 45924-014
Loan Number: 2945 & 8260
September 2016

Loan
Theppana Wind Power Project
(Thailand)

This is the abbreviated version of the document that excludes commercially sensitive and confidential business information that is subject to exceptions to disclosure set forth in ADB's Public Communications Policy 2011.

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – baht (B)

		At Appraisal	At Project Completion
		1 October 2012	31 December 2015
B1.00	–	$0.03	$0.03
$1.00	–	B30.83	B36.06

ABBREVIATIONS

ADB	–	Asian Development Bank
CRS	–	community relations staff
CSR	–	corporate social responsibility
CTF	–	Clean Technology Fund
EGCO	–	Electricity Generating Public Company
EIRR	–	economic internal rate of return
EPC	–	engineering, procurement, and construction
FIRR	–	financial internal rate of return
GHG	–	greenhouse gas
IEE	–	initial environmental examination
NEPC	–	National Energy Policy Council
O&M	–	operation and maintenance
PEA	–	Provincial Electricity Authority
SPS	–	Safeguard Policy Statement
tCO_2	–	ton of carbon dioxide
VSPP	–	very small power producer
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

kWh	–	kilowatt-hour
MW	–	megawatt
MWh	–	megawatt-hour

NOTES

(i) The fiscal year (FY) of Theppana Wind Farm ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2000 ends on 31 December 2000.

(ii) In this report, "$" refers to US dollars.

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CONTENTS

BASIC DATA
Theppana Wind Power Project (45924-THA)

Key Project Data	As per ADB Loan Documents (B million)	Actual (B million)
ADB Investment:		
Loan:		
Committed	145.2	145.2
Disbursed		145.2
Supplementary Cofinancing		
CTF Loan:		
Committed	Up to 131.8/$4 million	131.8/$4 million
Disbursed		131.8/$4 million

Project Administration and Monitoring	No. of Missions	No. of Person-Days
Due Diligence and Loan Negotiation	6	77
Project Administration	1	4[1]
XARR Mission	1	12

ADB = Asian Development Bank, CTF = Clean Technology Fund, XARR = extended annual review report.

[1] Two safeguards officers in the Private Sector Operations Department participated in the project administration mission.

EXECUTIVE SUMMARY

On 20 November 2012, the Board of Directors of the Asian Development Bank (ADB) approved (i) a loan of up to B145 million from ADB's ordinary capital resources and (ii) the administration of a loan funded by the Clean Technology Fund (CTF) of up to $4 million to Theppana Wind Farm for the installation and operation of a 7.5 megawatt wind farm in Chaiyaphum Province in Thailand. This is ADB's first private investment in wind power in Southeast Asia and the first time that the CTF has been deployed for a wind power project in Thailand.

The Electricity Generating Public Company, the first independent power producer in Thailand, developed and controlled this project to demonstrate the viability of wind power generation in the country. This private initiative was implemented under Thailand's very small power producer program, a public–private partnership modality that promotes private participation in the development of clean energy infrastructure in the country. The Bank of Ayudhya Public Company, a local commercial bank cofinanced the project. The project was completed on budget and on schedule, and began commercial operations in July 2013.

The project was assessed as *highly successful* overall, based on the criteria in (i) the Project Administration Instructions 6.07B on the preparation of extended annual review reports for nonsovereign operations, issued in July 2008, and (ii) the Guidelines for the Preparation of Project Performance Evaluation Reports on Nonsovereign Operations, issued in November 2014. The four main criteria used were (i) development results, (ii) ADB's additionality, (iii) ADB's investment profitability, and (iv) ADB's work quality. Development results were evaluated on the basis of (i) contributions to private sector development and ADB's strategic development objectives; (ii) economic performance; (iii) environmental, social, health, and safety performance; and (iv) business success. The development results were assessed as *excellent* overall.

The project's contributions to private sector development and ADB's strategic development objectives were rated *excellent*. The project demonstrated the effectiveness of public–private partnerships through which the private sector's long-term capital investment played a critical role in the development of clean energy infrastructure. The demonstrated viability and sustainability of a utility-scale wind power project enhanced private investors' confidence in and experience with wind power in Thailand, and promoted subsequent replications on a larger scale.

The project also demonstrated developmental environmental sustainability and helped expand environment-friendly technologies for clean energy generation and use. The project's successful operation validated a new form of wind turbine technology, which was adopted as the best solution for locations with lower wind resources. From 2013 to 2015, the project transmitted 31,150 megawatt-hours of electricity and avoided 20,674 tons of greenhouse gas emissions.

The project fully aligned with ADB's Strategy 2020, country partnership strategy for Thailand, and Energy Policy. It met the strategy and/or policy objective of environmentally sustainable development and demonstrated the efficacy of private initiative in infrastructure development to meet growing energy demands in the region. The project supported the Government of Thailand's long-term objective for the Thailand Clean Technology Fund Investment Plan.

The project was rated *satisfactory* for economic sustainability. It contributes to people's social and economic well-being and quality of life in the service area.

The project was rated *satisfactory* for environmental, social, health, and safety performance. Environmental management at the project site focuses on maintaining site cleanliness and sanitation by properly disposing of garbage and waste. No complaints from the local community have been registered. The project has generated jobs for non-skilled workers in surrounding rural communities, and set a high standard for corporate social responsibility programs that improve livelihood opportunities and raise awareness of renewable energy. It has adequately met ADB's environmental and social safeguard policy requirements and Thailand's national laws.

Business success was rated *satisfactory*.

ADB's additionality was rated *excellent*. ADB's long-term financing helped address the constraints faced by private investors in bringing viable financing to clean energy development in Thailand, and catalyzed private participation therein. It facilitated the local commercial bank's capacity to extend its loan tenor, thus narrowing the financing gap between developing and mature markets for funding the wind power project. ADB identified the project as an eligible clean energy project and administered the CTF loan to support the government's strategic direction.

ADB's investment profitability was rated *satisfactory*. The interest margin and fees on the ADB loan yielded a gross contribution to ADB income as a fair return on the project risks assessed at appraisal.

ADB's overall work quality was rated *excellent*. ADB played a primary catalytic role in structuring the financing package through the provision of long-term local currency financing. ADB conducted due diligence on the project's technical, legal, environmental, social, and financial aspects to confirm its development impacts and ensure that it was fundamentally sound. ADB's work quality for screening, appraisal, and structuring was rated *excellent*. ADB's work quality for monitoring and supervision was sufficient and rated *satisfactory*.

Overall, the project was rated *highly successful*. The project has helped Thailand diversify its energy mix and progress towards its clean energy targets to achieve sustainable, long-term economic growth. It supported the government's objective of accelerating and expanding private investment in clean energy infrastructure in Thailand, enhanced private investors' confidence in wind power in Thailand, and promoted further sector development in the country and region. ADB will closely monitor the project's performance as well as the progress of ongoing regulatory reforms in the sector.

I. THE PROJECT

A. Project Background

1. Thailand has 40,645 megawatts (MW) of total installed power generation capacity as of May 2016. The country's electricity generation depends heavily on conventional fossil fuels, with 70% of power outputs using natural gas and 18% using coal and lignite. Natural gas has traditionally been a reliable and low-cost energy source, but growing demand and dwindling natural gas reserves in the Gulf of Thailand are driving the country to diversify and secure alternative energy sources to generate power. Thailand has abundant renewable energy sources such as biomass, biogas, mini-hydro, solar, and wind. Exploiting these clean, domestic sources of renewable energy can help boost Thailand's energy security, save foreign exchange, and protect the country from global price volatility in fossil fuel markets.

2. The 7.5 MW Theppana Wind Power Project was developed by Electricity Generating Public Company (EGCO), the first independent power producer (IPP) in Thailand, to demonstrate the viability of wind power generation in Thailand. This private initiative accords with Thailand's national energy policy, which evolved into the Thailand Power Development Plan 2015–2036 as endorsed by the National Energy Policy Council (NEPC) and acknowledged by Thailand's Cabinet in June 2015. The plan incorporates a revised Renewable and Alternative Energy Development Plan which targets an installed renewable energy capacity of 19,634 MW by 2036. The revised targets for each class of renewable energy are in Table 1.

Table 1: Revised Targets for Renewable Energy

Source Type	Unit	Current	Share (%)	Target by 2021[a]	Share (%)	Target by 2036[b]	Share (%)
Solar	MW	1,474	18.3	3,000	21.5	6,000	30.6
Wind	MW	234	2.9	1,800	12.9	3,002	15.3
Hydropower	MW	3,079	38.2	324	2.3	3,282	16.7
Biomass	MW	2,727	33.9	4,800	34.5	5,570	28.4
Biogas	MW	393	4.9	3,600	25.8	600	3.1
Municipal Solid Waste	MW	146	1.8	400	2.9	500	2.5
New Energy	MW	-		3	0.1	680	3.4
Total	**MW**	**8,052**	**100.0**	**13,927**	**100.0**	**19,634**	**100.0**

MW = megawatt.

[a] Department of Alternative Energy Development and Efficiency. 2012. *Alternative Energy Development Plan, 2012–2021*. Bangkok.

[b] Electricity Generating Authority of Thailand. 2015. *Thailand Power Development Plan, 2015–2036*. Bangkok.

B. Key Project Features

3. On 20 November 2012, ADB's Board of Directors approved (i) a local currency loan of up to B145,217,518 and (ii) the administration of a Clean Technology Fund (CTF) loan of up to $4 million to Theppana Wind Farm (the borrower) for the project. The project was a part of EGCO's long-term growth strategy involving investments in renewable energy to diversify its IPP business. The project entailed the construction and operation of a 7.5 MW wind farm in Chaiyaphum Province using three 2.5 MW wind turbines supplied by Goldwind Science and Technology Company, a leading wind turbine manufacturer in the People's Republic of China. The turbine's improved technology was adopted as the best solution for maximized power outputs under the low wind speed environment at the project site.

4. The project was developed and implemented under Thailand's very small power producer (VSPP) program, where the borrower entered into a power purchase agreement (PPA) with Thailand's Provincial Electricity Authority (PEA) for a power offtake of up to 6.9 MW by the PEA. The PPA has a 5-year automatic extension mechanism and provides a wholesale tariff and an adder applicable for 10 years from the date of commercial operations. The project was constructed under an engineering, procurement, and construction (EPC) contract with Italthai Engineering and Goldwind International Holdings HK on a fixed-price, date-certain, turnkey basis. The Bank of Ayudhya Public Company, a local commercial bank, cofinanced the project.

C. Progress Highlights

5. The project was completed on budget and on schedule. From 18 July 2013 when the plant commenced commercial operations to the end of 2015, a total of 31,150 megawatt-hours of electricity was sold to the PEA. The project's operations have been satisfactory due to the power plant's high average availability of 99%. Following the project's successful completion, EGCO replicated it with a larger wind power project with an 81MW capacity, which adopted the same proven technology and structure.

II. EVALUATION

A. Project Rationale and Objectives

6. The project helped Thailand diversify its energy mix by adding renewable energy (despite the project's marginal scale), and thus progress towards its clean energy targets to achieve sustainable, long-term economic growth. Wind energy is a clean, sustainable source of electricity that strengthens the country's energy security and reduces reliance on fossil fuel.

7. The project had a strong demonstration effect and supported the government's objective of accelerating and expanding private investment in clean energy infrastructure in Thailand. The project (i) demonstrated the viability and sustainability of a utility-scale, private wind power project in the country; (ii) enhanced private investors' confidence in wind power in Thailand; and (iii) promoted successful replications in larger scale wind power projects by private investors.

B. Development Impact

1. Contributions to Private Sector Development and ADB's Strategic Development Objectives

8. The project was EGCO's first wind power project, ADB's first private investment in wind power in Southeast Asia, and the first wind power project financed by a local commercial bank offering a longer-than-usual loan tenor in Thailand. The project demonstrated the effectiveness of a public–private partnership, in which the private sector's long-term capital investment played a critical role in developing clean energy infrastructure under a robust implementation framework established by the public sector. The demonstrated viability and sustainability of a utility-scale wind project, which was realized by ADB's catalytic role in mobilizing long-term financings, (i) enhanced private investors' confidence in and experience with wind power in Thailand, and (ii) promoted subsequent larger scale replications of the project by private investors.

9. After successfully developing the project, EGCO expanded its investments in larger wind power projects in the region, implementing an 81 MW wind farm in Thailand.[1] Other private investors are developing a larger wind farm in the country. Both projects benefit from long-term financial assistance via the effective partnership of local commercial banks and ADB, which used the experience of the previous successful project in these new investments.

10. The private partnership between Goldwind, the leading provider of wind turbine technology and maintenance support, and EGCO, the leading local IPP, enhanced the business viability of and financiers' confidence in a utility-scale wind power project in an area characterized by low wind speeds. The project's successful startup and operations validated the new wind turbine technology as the best solution to (i) maximize the use of wind resources in adverse wind conditions and (ii) lower maintenance costs compared to traditional turbine technology.

11. The project created new employment and work opportunities, directly employing 250 persons during construction and 13 staff during operations. The project's linkage included its extensive partnerships with wind turbine technology suppliers, EPC contractors, private financers, and public partners to assure the project's viability and sustainability. The project's procurement for local goods and services during construction achieved effective industry linkages.

12. The project also demonstrated environmental sustainability, and contributed to the expansion of environment-friendly technologies for clean energy generation and use by tapping Thailand's wind power potential. Since the start of operations, the project has avoided 20,674 tons of greenhouse gas (GHG) emissions.[2]

13. The project is fully aligned with ADB's Strategy 2020, country partnership strategy 2007–2011 for Thailand, and Energy Policy. It met the strategy and/or policy objective of environmentally sustainable development and demonstrated the efficacy of private initiative in developing energy infrastructure to meet growing regional demand.

14. The project supported the Government of Thailand's long-term objective for the Thailand Clean Technology Fund Investment Plan to use CTF resources to support renewable energy projects in the private sector. It also helped ADB achieve its target of investing $2 billion per year in clean energy by 2013 to accelerate low-carbon growth and reduce regional GHG emissions, as well as the Private Sector Operations Department's target to receive 25% of its annual approvals, by numbers, for clean energy projects.

15. The project's contributions to private sector development and ADB's strategic development objectives were rated *excellent*.

2. Economic Performance

16. The project contributes to the social and economic well-being and quality of life of people in the service area. A key economic benefit of the project is the value of power generated as an input to economic activity. As the project uses a renewable energy technology, another benefit is the avoidance of GHG emissions. The project's economic performance was rated *satisfactory*.

[1] Subyai Wind Power Project. Another example of EGCO's wind power investment is the 113 MW Boco Rock Wind Farm in Australia.

[2] Breakdown of annual GHG emissions avoided: 3,943 tons (2013); 9,586 tons (2014); and 7,146 tons (2015).

3. Environmental, Social, Health, and Safety Performance

17. The project was classified as Environment Category B in accordance with ADB's Safeguard Policy Statement (SPS) 2009. The borrower prepared an initial environmental examination report in compliance with ADB's SPS requirements.[3] The project is registered under the Clean Development Mechanism program. The environmental management plan outlined the key issues, concerns, and mitigating measures for any construction and operation impacts. During construction and operation, the environmental management plan was fully incorporated in the contract and strictly implemented by the EPC contractor as supervised by the lender's technical advisor (LTA).[4] During operation, environmental management at the project sites focuses on maintaining site cleanliness and sanitation by providing garbage cans and properly disposing of garbage and waste. No noise complaints have been received from local residents. The borrower established the Operation and Maintenance (O&M) Wind Farm Organization, which is headed by the project manager from Goldwind and O&M manager from EGCO and supported by technical staff and community relations officers. O&M activities for wind power are relatively simple, consisting of remote monitoring, regular inspections, minor repairs, parts replacement, measurements, and data verification. The borrower adopted Goldwind's Occupational Health and Safety Manual, and continuous Environmental, Health and Safety training is being provided to its personnel. The borrower was granted Environmental Management System (ISO 14001:2004) certification in 2015. No accidents or injuries during project operation have been reported.

18. With regard to social safeguards, the project was categorized as C for both involuntary resettlement and indigenous peoples based on ADB's SPS 2009. The wind farm is located in Watabaek 2 subdistrict, Thepsathit district in Chaiyaphum Province, and occupies 0.9 hectares of land owned by the Agricultural Land Reform Office. The borrower and Agricultural Land Reform Office entered into a lease agreement, including consent from 18 farmer beneficiaries who were using part of the project area for agricultural production. Consents were obtained after consulting and negotiating with individual farmers. The PEA constructed the transmission line using its existing right of way, and no additional land was acquired. The project did not physically or economically displace any informal users of the land or other individuals. The project site does not belong to any tribal group nor is claimed as an ancestral domain area.

19. At the peak of the project's construction, the borrower provided short-term employment to 250 local people, 20% of whom were women. All national labor policies and regulations have been complied with during construction and operation, and no non-compliance with labor regulations has been reported. The borrower has engaged community relations staff (CRS) to ensure good community relations and help receive and resolve community complaints. Through its CRS, the borrower regularly coordinates with the community with regard to complaints, and none has been filed against the project to date. The community leaders act as focal points for grievance management. The borrower is continuously working to demonstrate the project's benefit for the local community, and was able financially to support corporate social responsibility (CSR) activities, including (i) a site tour for local schools to familiarize students

[3] As Thailand's Ministry of Natural Resources and Environment does not require an environmental impact assessment for wind power projects, no environmental clearance has been obtained. The final IEE report for the Theppana Wind Power Project was disclosed on November 2012 on the ADB website.

[4] A lender's technical advisor (LTA) prepared three annual monitoring reports from 2013 to 2015 and conducted site visits during construction. No environmental non-compliance has been identified during project construction and current operation.

with the wind farm's operation and benefits, and (ii) a medical mission providing free check-ups and eyeglasses to the elderly.

20. The project's environmental, social, health, and safety performance was rated *satisfactory.*

4. Business Success

21. A wind power project involves a higher upfront capital requirement and relatively lower maintenance costs compared to conventional power projects. Thus, longer-term financing is required to assure its business viability, which this project achieved. From the start of commercial operations in July 2013 through the end of 2015, the project sold 31,150 megawatt-hours of electricity to the PEA, which translates to 20,674 tons of GHG emission reductions. The project generated nearly 20% more electricity than originally projected due to the optimal turbine technology, high plant availability, and limited downtime, which ensured that more wind resources were used for generation. The project's operations have been stable and maintained the plant's availability above 99%.

22. The project was rated *satisfactory* for business success.

C. ADB's Additionality

23. ADB's additionality was rated *excellent*. ADB's long-term financing in local currency helped address the constraints faced by private investors in bringing viable financing to, and catalyzed private participation in, the development of renewable energy in Thailand. The local financial market's condition and limited experience with wind power made it difficult for local commercial banks to provide loans with a longer tenor for wind power projects on a project finance basis. ADB financial assistance combined with CTF cofinancing (i) ensured the project's economic and financial viability despite high upfront technology costs, and (ii) enabled the local commercial bank to extend their loan tenors, thus narrowing the gap between developing and mature markets for financing wind power projects.

24. Besides enhancing private investors' confidence in wind power, ADB financial assistance has facilitated essential developmental impacts such as improving Thailand's energy security in an environmentally sustainable manner and mitigating GHG emissions. The project demonstrated how sustainable energy projects can positively impact the economy both locally and beyond. ADB's participation in the project fully supported the government's strategy to accelerate and expand private investment in clean energy infrastructure in the country. ADB identified the project as an eligible clean energy project and administered the CTF loan to support the government's strategic direction. This project was the first time the CTF was deployed for a wind power project in Thailand.

D. ADB's Investment Profitability

25. ADB's investment profitability was rated *satisfactory*.

E. ADB's Work Quality

26. **Screening, appraisal, and structuring.** Following concept clearance on 21 November 2011, ADB conducted due diligence on the project's technical, legal, environmental, social, and financial aspects, confirming the project's development impacts and ensuring that it was

fundamentally sound. ADB played a key catalytic role, through the structuring of the ordinary capital resources- and CTF-backed long-term loans, in mobilizing and extending the tenor of the local commercial bank's loan, which was critical to ensure the project's viability. The financing structure was so innovative as to be replicated in a larger scale wind power project, which was backed by private investors' enhanced confidence in the wind power in Thailand. ADB's overall performance in relation to screening, appraisal, and structuring was rated *excellent*

27. **Monitoring and supervision.** ADB's work quality in terms of monitoring and supervision was rated *satisfactory*. ADB has kept itself updated on the project and the borrower's performance in all material areas through monitoring reports submitted by the borrower and site visits.

F. Overall Evaluation

28.

Table 4: Evaluation of the Theppana Wind Power Project

Indicator/Rating	Unsatisfactory	Partly Satisfactory	Satisfactory	Excellent
Development Results				X
Contributions to Private Sector Development and ADB's Strategic Development Objectives				X
Economic Performance			X	
Environmental, Social, Health, and Safety Performance			X	
Business Success			X	
ADB's Additionality				X
ADB's Investment Profitability			X	
ADB's Work Quality				X
Screening, Appraisal, and Structuring				X
Monitoring and Supervision			X	
Overall Rating	**Unsuccessful**	**Partly Successful**	**Successful**	**Highly Successful** **X**

ADB = Asian Development Bank.
Source: ADB.

III. ISSUES, LESSONS, AND RECOMMENDED FOLLOW-UP ACTIONS

A. Issues and Lessons

29. **The vital role of long-term financing and private initiative as key success factors for clean energy development.** Thailand had a limited track record of wind power projects, and the local financial market's potential for financing long-term wind power projects had not been fully developed. At the time of Board approval for the project, the local financial market's maximum tenor of available wind power financing was 12 years, which was a key constraint to sector development. Wind power projects have high up-front capital costs and minimal operating costs. The availability of longer-term financing to help reduce asset-liability mismatches and better amortize high initial investments is crucial to ensure the financial viability

of wind power projects. The commitment of leading private sponsors like EGCO having a strategic interest in supporting renewable energy development is also important for the long-term success of similar projects. The project's demonstrated solid viability, having benefitted from these key success factors, paved the way for the subsequent development of larger wind power projects like the Subyai Wind Farm, which ADB supports in effective partnership with local commercial banks.

30. **Effectiveness of public–private partnership for infrastructure development.** The VSPP program, under which the PEA, Thailand's state-owned enterprise, is obligated to offtake all of the electricity generated by the project, reassures and provides a fair commercial incentive for private investors to undertake their primary roles in developing clean energy infrastructure. The standard renewable energy PPA, having a 5-year automatic extension mechanism, is structured to assure the project's bankability by providing a contractual term that eventually exceeds the project's economic life and the full loan tenors. The PEA has a policy incentive to meet its contractual commitments as per the government's strategic mandate to achieve renewable energy targets. As a proven public–private partnership modality for smaller scale infrastructure development, the VSPP program with consistent government support has fair potential to be replicated across the region.

31. **Regulatory environment under development.** While the government strongly supports renewable energy development, regulatory implementation and coordination by government bodies to support due project implementation can be improved. This is partly due to the sector's rapid development, which is relatively new and ongoing. Issues as observed in the project include lagged administration and documentation processes for mortgage registrations, the completion of which has been delayed for more than a year due to changes in Thailand's mortgage law and a lack of timely coordination by the administration. Ongoing changes to the regulatory framework for renewable energy—such as new implementing guidelines and tariff policies, including a shift from the adder mechanism to a feed-in tariff mechanism for new VSPPs—may impact the long-term status of existing projects in this sector. Establishing and consistently implementing a transparent regulatory environment is essential to maintain private investors' confidence in the sector.

B. Recommended Follow-up Actions

32. ADB will closely monitor the project's performance until the full maturity of the ADB facilities. The progress of regulatory reforms, such as in the tariff regime, will also be monitored to assess potential impacts on the project and further private investments in the sector.