



Completion Report

Project Number: 48489-001
Technical Assistance Number: 9005
October 2021

Bhutan: South Asia Subregional Economic Cooperation Green Power Investment Program

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TECHNICAL ASSISTANCE COMPLETION REPORT

TA Number, Country, and Name: TA 9005-BHU: South Asia Subregional Economic Cooperation Green Power Investment Program		Amount Approved: \$1,500,000	
		Revised Amount: Not applicable	
Executing Agency: Department of Hydropower and Power Systems, Ministry of Economic Affairs	Source of Funding: Japan Fund for Poverty Reduction	Amount Undisbursed: \$821,210	Amount Used: \$678,789
TA Approval Date: 3 December 2015	TA Signing Date: 8 January 2016	TA Completion Date	
		Original Date: 30 April 2018	Latest Revised Date: 30 November 2020
		Financial Closing Date: 9 March 2021	Number of Extensions: 2
TA Type: Project preparatory TA		TA Arrangement: Not applicable	

Description

Bhutan has one of the largest repositories of hydropower in Asia. With vast amounts of hydropower potential still untapped, significant development opportunities exist for Bhutan for sustained economic growth and overall socioeconomic development through accelerated hydropower development. Hydropower is the country's mainstay of economic growth being a significant contributor to gross domestic product (GDP). Hence, sustainable development of untapped hydropower reserves will be critical for the country in order to maintain its impressive growth trajectory. Furthermore, clean energy development in Bhutan is important at the regional level as it would help improve the region's energy supply stability, and foster climate change mitigation.

On 3 December 2015, ADB approved a project preparatory technical assistance (PPTA) to prepare a multitranche financing facility (MFF) that would support the development of a run-of-river hydropower plant and transmission system facilities in the eastern region of Bhutan. The eastern region has the highest population among the regions but is less developed in terms of overall infrastructure. The power generated by the hydropower plant would be supplied through the eastern grid network system for dual purposes of export and domestic consumption. This focus would create a geographical balance in the development support from the Asian Development Bank (ADB), following the Dagachhu hydropower plant in the western region, and the Nikachhu hydropower plant in the central region. At the same time, it would support the government's strategy to balance regional development by ensuring that development is inclusive and spread equitably across the country.

Specifically, the technical assistance (TA) was to promote the development of the 404 megawatts (MW) Nyera Amari hydropower project consisting of 112 MW Nyera Amari I powerhouse in upstream and 292 MW Nyera Amari II powerhouse in downstream by (i) conducting due diligence of the Druk Green Power Corporation's (DGPC) pre-feasibility studies and detailed project report (DPR), and Bhutan Power Corporation's (BPC) transmission plans; and (ii) strengthening the critical aspects required for engineering designs and assessments, commercial arrangements, financial structuring, safeguards, and procurement. The TA was also to support DGPC in establishing the project's special purpose company (SPC) and reaching legal agreements of commercial frameworks including the shareholders agreement and the power purchase agreement. The TA also aimed to study the project structuring options and development roadmap of DGPC's Dorjilung and Chamkharchhu hydropower projects located in the eastern and central regions of Bhutan and which may share the eastern grid network systems to be studied under the TA.

Expected Impact, Outcome, and Outputs

The expected impact of the ensuing program was expanded cross-border power trading. The expected outcome of the ensuing program was increased clean hydropower supply for power export and domestic consumption. The expected outputs of the TA were the consultant's reports on (i) climate change assessments; (ii) technical due diligence; (iii) least cost estimates; (iv) environmental assessment; (v) resettlement plan; (vi) institutional framework (i.e., SPC); (vii) power purchase agreement; (viii) shareholders agreement; (ix) financial analysis and structuring; (x) economic assessment; and (xi) bid document preparation.¹

¹ ADB. 2015. Technical Assistance to the Kingdom of Bhutan for [South Asia Subregional Economic Cooperation Green Power Investment Program](#). Manila.

Implementation Arrangements

The Department of Hydropower and Power Systems (DHPS), Ministry of Economic Affairs was the executing agency. DGPC, BPC and the SPC were planned to be the implementing agencies. A consulting firm, PricewaterhouseCoopers Pvt. Ltd., India, was engaged and commenced services on 3 June 2016. A total of 29 person-months inputs (26 international, 3 national) were utilized against the planned inputs of 49 person-months (36 international, 13 national). The firm performed satisfactorily.

The TA was estimated at \$1,750,000, of which \$1,500,000 was financed on a grant basis by the Japan Fund for Poverty Reduction (JFPR) administered by ADB, and the government was to finance the remaining \$250,000 equivalent through in-kind contribution. Japan International Cooperation Agency (JICA) was also considered a potential cofinancier. Progress of project preparation and implementation were shared with JICA from time to time. The project team also visited the JICA, Bhutan office in November 2019 to provide an update on TA activities. At closing, the TA disbursed \$678,789 or 45% of its total budget.

Conduct of Activities

The TA was to support the due diligence of DGPC's pre-feasibility studies and DPR and strengthen critical aspects required for engineering designs and assessments, commercial arrangements, financial structuring, safeguards, and procurement. The TA consultant worked with DGPC to finalize the DPR. The consultant reviewed the Nyera Amari hydropower project's feasibility studies and recommended to DGPC further aspects to be examined in preparing the DPR. An engineering firm, recruited by DGPC, conducted further technical investigation on the geological, hydrological, and safeguard details required to prepare the engineering design, site selection, and project costs.

While the target for submission of the DPR to DHPS was June 2017, the DPR was only finalized in October 2017 and submitted to DHPS for approval in January 2018. The preparation of the DPR was delayed on account of the large size and the associated complexities of the hydropower project which is located in a very remote area. While the engineering studies were basically completed, substantial due diligences and project structuring work still needed to be done. Upon review of DHPS, DGPC was instructed to complete all pre-construction investigation works for the Nyera Amari plant to enhance the robustness of the assessment of geological risks, and include the findings prior to the final submission of the DPR to DHPS. To allow adequate time to complete these activities, an extension of 1 year from 30 April 2018 to 30 April 2019 was approved on 25 April 2018.² Along with the DPR review and approval process, the TA was also to support DGPC in promoting procurement, institutional and commercial arrangements including incorporation of SPC, bid document preparation, and reaching the shareholders agreement and the power purchase agreement. Safeguard plans also had to be strengthened to meet ADB's safeguard requirements.

In June 2018, the location of one of the two powerhouses has to be changed due to an accident caused by the presence of methane gas in the tunnel. The accident occurred in the exploratory drift tunnel of Nyera Amari II during the drifting works while the geotechnical investigations were in advanced stages. Upon further investigation it was found that the rockmass was unsuitable to establish the powerhouse. As a consequence, the location of the powerhouse of Nyera Amari II had to be changed, leading to additional geological investigations and further delay in the finalization of the DPR. As per the government's latest DPR guidelines, DHPS will only review the draft DPR after all necessary studies have been completed.³ As the review of DHPS would take several months and the subsequent approval was expected in late 2020 after drifting and geological studies at the new site are completed, a second request for extension of TA completion date by 19 months from 30 April 2019 to 30 November 2020 was approved in April 2019 to enable the satisfactory completion of TA activities.⁴

Since project inception, over 15 major stakeholder consultation workshops took place, including multiple field visits by the technical and safeguard consultants to the project site. ADB has likewise fielded missions to review the progress of the TA activities and the Nyera Amari project. All these measures have contributed to robust preparatory studies for the project to be ready for subsequent implementation subject to the government's approval. The workshops enlightened stakeholders on various aspects such as power trade market assessment in South Asia especially in India and Bangladesh, renewable energy penetration and ancillary market assessment, off-take arrangement strategy, tariff regulations, financial and economic preliminary analysis, technical studies, etc. Field visits also contributed to the

² ADB (South Asia Department). 2018. Technical Assistance to the Kingdom of Bhutan for South Asia Subregional Economic Cooperation Green Power Investment Program - Extension of Completion Date. Memorandum. 25 April (internal).

³ Department of Hydropower and Power Systems, Ministry of Economic Affairs. 2018. *Guidelines for Development of Hydropower Projects*. Thimphu.

⁴ ADB (South Asia Department). 2019. Technical Assistance to the Kingdom of Bhutan for South Asia Subregional Economic Cooperation Green Power Investment Program - Minor Change in Implementation Arrangement. Memorandum. 29 April (internal).

preparation of good quality safeguard documents such as the environment impact assessment, social impact assessment, resettlement plan through field surveys, and community consultations.

However, the government decided to prioritize the development of two storage-based projects, the 2,585 MW Sankosh Reservoir Hydropower Project and the 2,640 MW Kuri Gongri Hydropower Project. Compared to standalone run-of-river projects, the storage projects provide greater overall value to the ecosystem in terms of meeting peaking requirements, participation in the ancillary markets, and ensuring supply of power during the lean season for both domestic consumption and export purposes. As such, during the country programming mission held on 4–13 March 2020, the government informed ADB that it would postpone the implementation of many hydropower projects in the pipeline including Nyera Amari. ADB agreed to drop the project from ADB's country operations business plan (COBP) for Bhutan, 2021–2023⁵ and closed the TA on 30 November 2020 before achieving all the envisaged objectives.

The TA was able to complete the technical due diligence, least cost estimates, environmental assessment, and resettlement plan. The climate change assessment, power purchase agreement, financial analysis and structuring, and economic assessment were only partially delivered. The institutional framework (i.e., SPC), shareholders agreement, and bid document preparation were postponed as the project was deferred and the detailed implementation arrangement could not be carried out. Bidding documents may only be prepared after the DPR is finalized/approved and implementation arrangements are fixed. The TA also aimed to study the project structuring options and development roadmap of DGPC's Dorjilung and Chamkharchhu hydropower projects. However, considering the sensitivity with the ongoing trilateral discussions among Bhutan, Bangladesh and India about these projects, it was suggested by DHPS and DGPC to resume the Nyera Amari project only after greater clarity and consensus had been reached regarding the development roadmap.

In the meantime, the government is considering to restart the Nyera Amari project to meet the increasing domestic demand and requested for the project to be included in the COBP for Bhutan, 2022–2024 during the country programming mission held on 6–23 April 2021. Although the timeline is still contingent on the progress of the trilateral dialogue among the governments of Bangladesh, Bhutan, and India, the government will revert with the timelines as and when confirmed. The project is to be reflected for processing in 2024 (standby) in the said COBP. While some updates may be required, the outputs of the TA shown above can contribute to processing the project efficiently.

Technical Assistance Assessment Ratings

Criterion	Assessment	Rating
Relevance	The TA is rated <i>relevant</i> . It was aligned with the Sustainable Hydropower Development Policy of the government, ⁶ and ADB's country partnership strategy (CPS) for Bhutan 2014–2018. ⁷ The ensuing investment program was included in the COBP 2016–2018. ⁸ The TA was also in response to the government's request for ADB support based on its letter dated 31 August 2015. The TA type and design were appropriate, and the rationale for the TA was clear at the time of appraisal. Given its experience in developing hydropower projects in Bhutan, DGPC is a suitable implementing agency for this TA. The minor change in scope and extensions were appropriate and justified in order to enhance the robustness of the DPR and mitigate delays caused by the accident. The government's decision to defer the ensuing project due to the change in priority among hydropower projects in Bhutan was outside the control of the TA. While the ensuing project was subsequently dropped from the COBP for Bhutan, 2021–2023, the government again requested ADB to include the project in the pipeline under the COBP for Bhutan, 2022–2024.	<i>Relevant</i>
Effectiveness	The TA is rated <i>less than effective</i> . The ensuing program was deferred due to the change in government's priority. Thus,	<i>Less than effective</i>

⁵ ADB. 2020. *Country Operations Business Plan: Bhutan, 2021–2023*. Manila. ADB has introduced the Indicative Country Pipeline and Monitoring (ICPM) Report to replace the COBP. For consistency in usage, the TCR will use COBP.

⁶ Government of Bhutan. 2008. *Sustainable Hydropower Development Policy*. Thimphu, Bhutan.

⁷ ADB. 2014. *Country Partnership Strategy: Bhutan, 2014–2018*. Manila.

⁸ ADB. 2015. *Country Operations Business Plan: Bhutan, 2016–2018*. Manila.

Criterion	Assessment	Rating
	<p>the TA was closed without completing some of the planned outputs in relation to the preparation of the ensuing program. Out of 11 consultant reports due, 4 were completed, 4 partially delivered, and 3 cancelled as the project was deferred and detailed implementation arrangements and preparation of bidding documents could not be carried out.</p>	
Efficiency	<p>The TA is rated <i>less than efficient</i>. Recruitment of consultant was initiated immediately after approval of the concept paper, and there were no start-up delays. Although the TA was extended twice by 31 months total, the second extension by 19 months was due to a fatal accident caused by unforeseeable extraordinary geological conditions, which led to the change in the powerhouse location and further investigations. This was beyond the control of the TA.</p> <p>The TA consultant performed well and provided the executing and implementing agencies with advice/guidance based on his expertise and international experience in various areas of this assignment, such as technical, commercial, and regulatory aspects. The executing and implementing agencies performed well in the preparation of the project especially in the local context utilizing their hands-on experience in Bhutan. The ADB project team contributed to overall coordination.</p> <p>There were no cost-overruns. While some of the outputs were not delivered due to the change in the government's shift, remuneration for each expert of the consulting firm was in line with the actual deliverables and there were no excess payments. Of the original \$1.5 million, only \$678,789 or 45% of the total budget was utilized. While the fund utilization was the result of the change in government priorities and beyond ADB's control, the TA is rated <i>less than efficient</i> in accordance with the TCR validation guidelines which require at least 80% of fund utilization as the condition for an <i>efficient</i> rating.</p>	<i>Less than efficient</i>
Overall Assessment	<p>Overall, the TA is rated <i>less than successful</i> on account of the ratings of <i>relevant</i>, <i>less than effective</i>, and <i>less than efficient</i>. Due to a change in the government's priority, the ensuing program was deferred. Thus, the TA was closed before delivering some of the expected outputs. However, after the TA had been closed, the government requested ADB to include the ensuing program once more into the pipeline. The deliverables of this TA can be utilized in the preparation of the program.</p>	<i>Less than successful</i>
Sustainability	<p>The envisaged program is back on the government's priority list and is to be included in the COBP for Bhutan, 2022–2024 as a standby project. DGPC's experience in the development, operation and maintenance of hydropower plants also provides evidence of the likely sustainability of the envisaged program.</p>	<i>Likely sustainable</i>

Lessons Learned and Recommendations

Design and/or planning	<p>Careful planning and thorough analysis of hydropower complexities at appraisal are essential to avoid delays in implementation. The TA was extended by 12 months (first extension) due to delay in the preparation of the DPR on account of the large size and the associated complexities of the hydropower project. Although DGPC has sufficient experience in developing hydropower projects in Bhutan and had already carried out a pre-feasibility study before this TA, the</p>
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	preparation of the DPR required more time than expected for proper examination of geological features at the dam, head race tunnel and powerhouse area due to complex geology, and for experts' review of all results obtained through geological/geotechnical investigations. It is recommended that TAs should be carefully designed and planned based on thorough analysis and due consideration of the circumstances to avoid delays in implementation. At the same time, one needs to bear in mind that certain geological risks cannot be fully eliminated for large scale hydropower projects, irrespective of the level of preparations.
Implementation and/or delivery	It is important to ensure project readiness so that TA activities can commence at the earliest. Consultant recruitment was initiated immediately after the approval of the concept paper, which allowed for timely mobilization of the consulting firm. It is recommended to closely coordinate with the government regarding any potential political/geopolitical sensitivities, in order to effectively deliver the intended outputs.
Management of staff and consultants	Close communication/collaboration among the ADB project team, executing and implementing agencies, and consultants throughout the implementation period is crucial to ensure continuity of activities. It is recommended to hold periodic/regular meetings to share the latest status and achieve common understanding of project progress, even on a virtual basis as physical missions cannot be held frequently.
Knowledge building	Meetings and workshops are critical for knowledge-sharing and help build capacity of executing and implementing agencies. During these events, the TA enlightened the executing and implementing agencies on various aspects such as power trade market assessment in South Asia, renewable energy penetration and ancillary market assessment, off-take arrangement strategy, tariff regulations, financial and economic preliminary analysis, and technical studies, etc.
Stakeholder participation	Regular engagement with stakeholders through workshops and meetings is crucial to elicit feedback and ensure common understanding on expected results. Stakeholders were informed of the various aspects and issues on power trade market, renewable energy market, off-take arrangement strategy, tariff regulations, financial and economic preliminary analysis, and technical studies, etc. This process allows to incorporate feedback from various stakeholders.
Partnership and cofinancing	Cofinancing arrangements, if any, are key elements in the preparation of large investment projects. JICA, a potential cofinancier, was regularly informed of the status of project preparation.
Post-TA financial resource	Continuous engagement with the government is crucial to ensure that the ensuing program is pursued. The ensuing program was originally planned to be financed by ADB (51%), the Government of Bhutan (10%), and a cofinancier (39%). Although the project was once dropped from the COBP, the government proposed to include the project again in the COBP for Bhutan, 2022–2024. The discussion shall be resumed in due course to confirm the financial arrangements.

Follow-up Actions

The ensuing program was deferred due to a change in government priorities among possible hydropower projects in Bhutan and consequently dropped from the COBP for Bhutan, 2021–2023. However, the government requested ADB to include the project again in the pipeline for 2022–2024. Thus, close coordination and continuous dialogue with the government are essential. This will ensure engagement in the project and an opportunity to utilize the outputs of this TA.

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TECHNICAL ASSISTANCE COST

Table A1: Technical Assistance Cost by Activity
(\$'000)

Item	Amount		
	Original	Revised ^a	Actual
1. Consultants	1,329.8	000.0	651.5
2. Equipment	1.0	000.0	0.0
3. Training, seminars and/or conferences	15.0	000.0	0.0
4. Studies	30.0	000.0	27.3
5. Miscellaneous TA administration	13.8	000.0	0.0
6. Pilot testing	0.0	000.0	0.0
7. Contingency	110.4	000.0	0.0
Total	1,500.0	000.0	678.8

^a No additional financing or reallocation of funds.

TA = technical assistance.

Source: Asian Development Bank estimates.

Table A2: Technical Assistance Cost by Fund
(\$'000)

	JFPR	Total Cost
1. Original	1,500.00	1,500.00
2. Revised	0.00	0.00
3. Actual	678.79	678.79
4. Unused	821.21	821.21

JFPR = Japan Fund for Poverty Reduction.

Source: Asian Development Bank estimates.