Report Number: ICRR0022775

1. Project Data

Project ID P126832	**Project Name** CH GEF Municipal Solid Waste Management
Country China	**Practice Area(Lead)** Environment, Natural Resources & the Blue Economy

L/C/TF Number(s)	Closing Date (Original)	Total Project Cost (USD)
TF-18479	31-Dec-2019	11,439,697.59
Bank Approval Date	**Closing Date (Actual)**	
14-Nov-2014	31-Mar-2021	

	IBRD/IDA (USD)	Grants (USD)
Original Commitment	12,000,000.00	12,000,000.00
Revised Commitment	11,439,697.59	11,439,697.59
Actual	11,439,697.59	11,439,697.59

Prepared by	Reviewed by	ICR Review Coordinator	Group
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2. Project Objectives and Components

a. Objectives

As per the Grant Agreement (GA, 2015) and the Project Appraisal Development (PAD, 2014), the Project Development Objective (PDO) and its Global Environmental Objective (GEO) of the China Municipal Solid Waste Management Project was to ***"build capacity and demonstrate best available techniques and best environmental practices in Municipal Solid Waste (MSW) incineration in accordance with the Stockholm Convention".***

b. Were the project objectives/key associated outcome targets revised during implementation?
Yes

Did the Board approve the revised objectives/key associated outcome targets?
No

c. Will a split evaluation be undertaken?
No

d. Components

Component 1: Capacity Building for Improved Operation and Regulation of MSW Incinerators (Appraisal cost: US$27.44, including GEF grant of US$9.83; Actual cost: US$34.94, including GEF grant of US$9.38)

Sub-component 1A. Capacity Building for Improved Incinerator Operations and Emissions Control. The project would build capacity of selected demonstration incinerators in Kunming City to improve their operations and reduce dioxin and other pollutant emissions in line with Stockholm Convention (SC) Best Available Techniques (BAT)/Best Environmental Practice (BEP). The project intended covering three of a potential four candidate demonstration incinerators (Dongjiao, Xishan, Konggang and Wuhua) that were already operating in Kunming. Out of the four, the project would support three demonstration incinerators that fulfilled financial eligibility criteria and agreed to participate in the program. Key activities included: (i) preparation of Operations and Environmental Performance Audits (OEPAs) to collect baseline information on the operational conditions of the incinerators, identify gaps with the SC BAT/BEP, and recommend improvements to reduce dioxin emissions; (ii) dissemination of lessons learned from the audits of two widely used incinerator technologies (circulating fluidized bed and grate bed technologies) to share with regulators and incinerator managers in other cities across China; (iii) preparation of Operational Improvement Plans which would include grant funding to procure equipment to help reduce dioxin emission; and (iv) training for about 250 MSW incinerator managers and operators in the two cities (Kunming and Ningbo), as well as other incinerators across China.

Sub-component 1B. Capacity Building for Improved Regulation of MSW Incinerators. Under this sub-component, the project would support the following activities: (i) introduction on a pilot-basis facility specific operating license (i.e., Integrated permit) to support the regulators to monitor incinerator operational conditions for reducing emissions from dioxin and other pollutants; (ii) building capacity of the regulators through procurement of IT hardware and software for Kunming and Ningbo Urban Management Bureau (UMB) and Environmental Protection Bureau (EPB) for online access of real-time incinerator operating and emission data, dioxin stack testing, and enhancing Ningbo dioxin laboratory's capacity through technical assistance and equipment support; (iii) training of regulators through international study tours to cities where BAT/BEP for MSW incineration were implemented; and (iv) public awareness raising and disclosure of incinerator operating and emission data.

Component 2: Capacity Building for Improved MSW Management Planning (Appraisal cost: US$1.75, including GEF grant of US$1.57; Actual cost: US$3.66 million, including GEF grant of US$1.26 million). The project would support the following key activities to reduce solid waste going to MSW incinerators: a) study on regional planning of MSW disposal that would identify cost effective disposal options at a regional scale; b) national level study on the system of statistical indicators and MSW classification; c) twinning of Kunming and Ningbo on MSW segregation to learn lessons; and d) assessment

of the impact of MSW segregation on dioxin emissions in Ningbo. Project results monitoring and dissemination activities would also be supported under this sub-component.

Component 3: Project Management (Appraisal cost: US$3.72, including GEF grant of US$0.6 million; Actual cost: US$3.98 million, including GEF grant of US$0.8 million). This component would fund project management cost related to implementation, procurement and financial management, and safeguards.

e. Comments on Project Cost, Financing, Borrower Contribution, and Dates

Project costs: The project cost at approval was US$32.91 million (ICR, Annex 3). The actual project cost at completion was US$42.58 million (129 percent of appraised estimate). In communication with IEG, the project team informed that the higher amount at project closing was due to the "establishment and operation of a provincial 'Automatic Monitoring Center of Key Polluting Sources' developed by the Yunnan Environmental Protection Department. This monitoring center received a total investment of USD10 million (including construction, hardware, software, operation, and maintenance), all stemming from government finance. The monitoring center was partly motivated by the GEF-MSW project, which provided the proof of concept for online, real time monitoring from which Yunnan decided to extend its own online environmental monitoring network to all MSW incinerators in the province. This investment significantly facilitated the regulatory monitoring of the MSW incineration sector in Yunnan, in terms of improved coverage, efficiency and quality. The investment also manifests the value of GEF grant in leveraging recipient's inputs to scale up project interventions and sustain project impact on institutions and capacity beyond the project lifecycle".

Financing: Per the Grant Agreement (December 14, 2014), GEF grant of US$12 million financed the project. At project closing, the GEF financing amounted to US$11.44. The Trust Fund was 95% disbursed.

Borrower Contribution: The actual Borrower Contribution was US$31.14 million, higher than the planned commitment of US$20.91 million.

Dates: The project was approved on November 14, 2014 and became effective on May 29, 2015. The Mid-term Review (MTR) was conducted on February 02, 2018. The project's original closing date was December 1, 2019, which was extended, and the project closed on March 31, 2021.

Restructurings: The project went through one restructuring (Level-2) in December 2019. At the time of the restructuring, the project had disbursed US$7.93 million (69 percent of Bank financing). The rationale for the restructuring and the key changes made were as follows:

- The project had planned to cover three out of four potential demonstration incinerators (Dongjiao, Xishan, Konggang and Wuhua) that were operating in Kunming city. However, in 2017, Yunnan government decided to relocate the Wuhua incinerator outside Kunming which led to the final selection of three incinerators. Out of the three remaining incinerators, Dongjiao was shut down by the Government in August 2019. The ICR (paragraph 24) stated that following months of uncertainties, the Government eventually decided to shut the plant permanently due to its non-compliance with country emission standards. According to the Restructuring Paper (Paragraph 14), this action from the Government was "to demonstrate determination to enforce compliance with environmental standards".

- The restructuring revised the PDO indicator by reducing the number of incinerators to be covered in the project to a total of two (out of the initial three incinerators). The PDO indicator and supplemental indicator's baseline and targets that were not included earlier were added as planned. A few new activities were added in Konggang.
- Due to project delays related to the technical complexity of the project and the uncertainties that resulted from the shutdown of the Dongjiao incinerator, an extension of project closing date was warranted to provide adequate time to complete all activities. As a result, the project was provided a 15-month extension with a new closing date of March 31, 2021.

Split Rating. Despite the changes in the PDO indicator and sub-indicators due to the closure of one incinerator (Dongjiao), this review did not find evidence that the project had reduced its level of ambition. Therefore, this review will not use the split rating methodology. The revised PDO indicator and sub-indicators will be used against which to assess this project's achievements under Section 4 of this review.

3. Relevance of Objectives

Rationale

Country and sector context. Since the late 1970s, China has experienced rapid economic development, improved standards of living, and growth in urbanization. Along with this growth, the country has faced increased environmental pollution and natural resources depletion, the costs of which approached 10 percent of GDP (Country Partnership Strategy, 2012). Environmental pollution was on the rise in cities, particularly those that resulted from Municipal Solid Waste (MSW) collected which increased five-fold nationwide from about 85 thousand tons per day in 1980 to about 430 thousand tons per day in 2009 (ICR, paragraph 1). Meanwhile, due to shortage of urban land for landfills, and with Government incentives (in the form of value added tax refunds, prioritized commercial bank loans, state subsidy etc.), cities were starting to depend on incineration as one of the methods for solid waste disposal.

According to the ICR (Paragraph 29), the number of MSW incinerators in China has been on the rise. In 2010, China had 104 incinerators in operation with a total capacity of 23.2 MT/day which increased threefold to 389 in 2019, with the capacity of 121.2 MT/day. MSW incineration is the third largest source of dioxin and furan release in China, which are highly toxic chemicals that can easily be transmitted through environment and food chain. At the time of project preparation, limited number of MSW incinerators in China comprehensively applied the Best Available Techniques (BAT) or Best Environmental Practices (BEP) in their operations as defined in the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs).

Government Strategy. At both appraisal and completion, the PDO remained in line with the Government of China's national and sectoral priorities. The project contributed to China's 13th and 14th Five-Year Plans (2016-2020 and 2021-2025), which included provisions for the improvement and strengthening of pollution prevention and solid waste management (ICR, paragraph 29). Recognizing the adverse environmental impacts in the country, at the time of appraisal, China had ratified various international conventions including the Stockholm Convention (SC) on POPs in 2004 and had prepared a National Implementation Program (NIP) in 2007. Relevant domestic policy and regulatory measures such as the 'Solid Waste

Pollution Prevention and Control Law' (2005), and the 'Circular Economy Promotion Law' (2009) were enacted.

Regarding incinerators as means for MSW, in April 2011, State Council-endorsed a policy titled 'Suggestions for Further Strengthening MSW Management' requiring MSW incinerators to comply with emission standards and required them to establish daily monitoring and submission of monthly reports to the Urban Municipal Bureaus (UMBs) and Environmental Protection Bureaus (EPBs). Furthermore, the Ministry of Housing and Urban-Rural Development (MOHURD) was also in the process of revising technical codes to make it consistent with the SC BAT/BEP for regulating the operations of MSW incinerators. As a result, MOHURD set aside USD 330 million under its 12th Five Year Program to support each city with an information technology (IT) based system to monitor every incinerator. Similarly, in 2014, the Ministry of Environmental Protection (MEP) issued a revised Standard for Pollution Control on Municipal Solid Waste Incineration, by reducing the emission limit tenfold, from 1.0 to 0.1 ng TEQ/m3 effective January 1, 2016.

Bank Strategy. The project was well-aligned with the Bank strategy at the time of appraisal. Its objectives contributed to the World Bank's Country Partnership Strategy (FY13-16) which included a pillar on Supporting Green Growth. Under this pillar, the project's PDO contributed towards achieving the outcome on "Improved sanitation, solid waste and other basic urban services in selected second-tier cities, while reducing pollution". In addition, the PDO was linked to the CPS's outcome in "Supporting efforts to reduce hazardous waste, through reduction of persistent organic pollutants (POPs), the byproducts of industrial production and the world's most toxic chemicals". The CPS (FY13-16) stated that "China's city governments were interested to seek Bank's support in these areas by drawing on the experience of other countries and adopting innovative service delivery technologies that mitigate pollution and conserve energy and natural resources". During project implementation, and at closing, the PDO remained relevant and would contribute to the achievement of the focus area of Promoting Greener Growth under the current CPF (FY20-25). Within this focus area, the project has a direct link to the objective of "Reducing Air, Soil, Water, and Marine Plastic Pollution". According to the CPF (FY20-25), capacity to monitor and enforce environmental regulations varies in the country, and there is limited clarity on the roles and responsibilities of various Government bodies. There is also limited capacity to gather, share, and report adequate environmental information, all of which are important features of the project.

In summary, the project's objectives were highly aligned with both the Government and World Bank strategies. The pilot nature of the project that aimed to build capacity in two cities and demonstrate, test, and adapt BAT/BEP in Municipal Solid Waste incineration to local conditions that would have the potential for replication in other cities in China was highly relevant considering that this was the first project of its kind supported by the Bank in China. Thus, Relevance of this project's objectives to Government and World Bank strategies in China at appraisal and at the project's closing were rated by this review as High.

Rating
High

4. Achievement of Objectives (Efficacy)

OBJECTIVE 1

Objective

Objective: To build capacity and demonstrate Best Available Techniques and Best Environmental Practices in Municipal Solid Waste incineration in accordance with the Stockholm Convention.

Rationale

Theory of Change: At project appraisal, a Theory of Change (ToC) was not required. However, the ICR (Figure 1) provided a retrospective ToC for the project which was clear.

To achieve the PDO, the project would build capacity of all key stakeholders: Incinerator Operators, Regulatory agencies, Communities, and the Public. MSW incinerator operators would be trained on BAT/BEP, which would be scaled up to additional incinerators across China. Training would be provided at the Municipal level to improve regulatory capacities of EPBs and UMBs. A permit system for MSW incinerators would be piloted, along with an establishment of a system of monitoring based on real-time operating and emission data for improved oversight by the regulators. Technical standards would also be updated for MSW incinerator operations. Efforts would be made to publicly disclose information on incinerator operations and emissions data. These activities would lead to improved capacity on operation and regulation of MSW incineration and MSW management planning, which would enable reduction in dioxin emission. The lessons learned from these capacity building measures would be widely shared within the cities as well as across China. The activities included in the ToC were found to be well linked to the PDO in a valid causal chain.

The ToC outlined the following key assumptions that underpinned the achievement of the PDO: (i) China is shifting to incineration to meet soaring demand of waste disposal; (ii) regulatory enforcement for incineration pollution control is strengthened; and (iii) incinerators have multiple drivers to adopt BAT/BEP (i.e., compliance, better operating stability, and cost savings).

Outputs

The following outputs were achieved to build capacity and demonstrate BAT/BEP compliance in MSW incineration in accordance with the SC (ICR, pages 13-17):

- Operations and Environmental Protection Audits (OEPAs) were prepared by 3 demonstration incinerators in Kunming city to improve operations and emissions controls. Based on the OEPAs, Operational Improvement Programs (OIPs) for BAT/BEP were prepared to help reduce dioxin emission. Only two incinerators (Xishan, Konggang) implemented the programs.
- Tailored BAT/BEP training was designed and delivered to MSW incinerator managers and operators nationwide, in three phases: (a) development of training materials based on experiences in Kunming; (b) training of eight trainers; (c) training to 281 managers and operators in 67 incinerators nationwide through six training events in Ningbo, Xi'an, Chengdu, Shenzhen, Wuhan, and Beijing. The training materials on lessons learned in Kunming were disseminated to experts across the country.
- A new state-of-the-art Supervisory Control and Data Acquisition (SCADA) system was established which gathered and analyzed real-time data to monitor the combustion process of the Kunming and Ningbo incinerators. This data helped avoid dioxin formation. National guidelines and framework for harmonizing online monitoring systems of incinerator operations for EPBs, UMBs at the national, provincial and city levels were also developed.

- A process was adopted by which dioxin levels were measured to assess emissions on a quarterly basis through a sampling method by a certified lab. Prior to the project, it was done on an annual basis without sampling which took time and was costly.
- The pilot Integrated Emission Permit contributed to an official launch of national permitting standards and procedures for MSW incinerators. Four Directives related to Permitting procedures system were prepared.
- Thirty-six regulators from Kunming and Ningbo EPBs/UMBs and the Ministry of Housing and Urban-Rural Development (MoHURD) participated in six international study tours to learn from leading-edge companies and environmental departments in Europe, Japan, and the Unites States of America.
- Dioxin Laboratory in Ningbo EPB was strengthened through improvements in the standard operating procedures, training, and domestic/international study tours for staff.
- Three existing technical standards on MSW incineration related to Operations, Maintenance and Safety, MSW Incineration facilities, and MSW Incinerator and Heat Recovery Boilers were updated.
- To raise public awareness, an online platform was developed on MSW incinerator operational information and emissions data. Public awareness of incinerator information which was at 14 percent (baseline), increased to 68 percent at the end of the project.
- Several analytical studies were completed to contribute towards the capacity of provincial and national level knowledge on MSW incineration. A framework and technical specifications were developed to provide guidance to MoHURD on MSW regional management planning. To better manage MSW segregation, indicators were developed for MoHURD.
- Four Knowledge exchange visits for 92 participants (incinerators and regulators) from Kunming and Ningbo were organized.
- Three studies were completed for Ningbo was useful in understanding the effect of waste segregation on dioxin emissions. A book titled “Exploration and innovations in the Environmental management of MSW Incineration in China was published

Outcome

The ICR (Paragraph 38) noted that at project closing, the PDO indicator on dioxin reduction for both the incinerators were monitored and verified by an accredited third-party monitoring agency. Both the incinerators fully met and outperformed the baseline of 0.1 ng TEQ/m3. The final dioxin level for Konggang (line 2) was 0.03 ng TEQ/m3, and for Xishan was: 0.0046 ng TEQ/m3 (line 1) and 0.0052 ng TEQ/m3 (line 3).

Along with the PDO indicator, the project met its supplemental PDO indicators. On the first supplemental indicator “A planned schedule of improvements in operating procedures established after measuring and evaluating the baseline situation at demonstration incinerators”, the ICR (Annex 7) provided evidence that the Operations and Environmental Performance Audit (OEPAs) were completed when baselines were measured. The OEPAs laid a solid basis for both incinerators to implement successful renovation. Based on the OEPA’s findings, Operational Improvement Programs (OIPs) were prepared which included targets and milestones for BAT/BEP implementation which proposed renovations of the incinerators’ hardware and operational systems. To improve their operational systems, Konggang incinerator undertook 35 additional renovations with co-financing of US$7.6 million. Similarly, Xishan incinerator implemented 16 additional renovations with a co-financing of US$5.2 million.

On the second supplemental indicator “Achievement of milestones set for the improvement of operating procedures as identified in the schedule of improvements in operating procedures at demonstration incinerators”, a post-project monitoring and verification was carried out by Foreign Environmental Cooperation

Center (FECO), Yunnan Project Management Office (PMO) and panel of experts. A third-party testing institution was involved for sampling at both the incinerators. The ICR provided the following evidence:

- In comparison to a baseline level of 72 percent compliance, at project end, Xishan incinerator achieved 90 percent compliance with SC BAT/BEP and met its target.
- Similarly, the Konggang incinerator also met its target, with 94 percent compliance against the baseline of 70 percent.

On the demonstrative impact of the project, the ICR pointed out in paragraph 83 that the "The parent company to which Xishan belongs has announced its plans to replicate the BAT/BEP approach to all its facilities (22 incinerators in total in 13 provinces)". Further, upon communication with IEG, the project team provided the following additional information about learning and replication of BAT/BEP that is happening nationwide from the demonstration incinerators in Kunming: (i) Since project completion, eight energy recovery companies from across the country visited *Konggang* and are now in various stages to build in BAT/BEP retrofitting. Among them, technical renovation has started in two companies including Guigang Beikong Water Env. Protection Co. (based in Guigang of Guangxi Province with total incineration capacity of 900 t/d) and Zhuhai Kangheng Env. Protection Co. (based in Zhuhai of Guangdong Province, 1000 t/d); (ii) Six group companies have visited Xishan since project completion to learn from the BAT/BEP experience. Among these are Chongqing Sanfeng Co. (Sichuan Province, 4500t/d), Qidong Tianying Co. (based in Nantong of Jiangsu Province, 1200t/d), CECEP Fuzhou (based in Fuzhou of Jiangxi Province, 1200t/d), Jinzhai Haichuang (based in Lu'an of Anhui Province, 300t/d). Four other incinerators have embarked on technical renovation.

Rating
High

OVERALL EFFICACY

Rationale
In summary, the project has met or exceeded all targets for its intermediate indicators and has achieved the PDO indicator. The evidence provided are found by this review to be sufficient. Therefore, the efficacy with which the PDO was achieved is rated as High.

Overall Efficacy Rating

High

5. Efficiency

Ex Ante

At appraisal, the project did not estimate an Economic Rate of Return (ERR). For the economic analysis, the PAD referred to secondary research from the World Health Organization (WHO) and other international studies on the short-term and long-term health impacts resulting from exposure to toxic chemicals, including dioxins and furans (PAD, Annex 6). The PAD stated that due to methodological challenges, it was difficult to establish a causal relationship between dioxin exposure and elevated incidence of cancer. However, several epidemiological studies from Europe provided evidence on the link between high dioxin emissions from MSW incinerators and the incidence of non-Hodgkin's lymphoma and soft tissue sarcoma. Thus, the economic rationale for the project was based on benefits from reduced exposure to toxic chemicals (including dioxins and furans) to some 25,000 people living close to the incinerators, due to project interventions leading to improved management of solid waste from incinerators. The PAD further stated that as this was a pilot project to demonstrate, test and adapt these BAT and BEP to local conditions, and adaptation of these solutions were site specific, no ex-ante cost analysis of the technical options was warranted but a cost effectiveness analysis would be factored while developing operational improvement program for each incinerator.

During appraisal, the project's financial analysis reviewed two aspects: (i) general financial health of the demonstration incinerators; and (ii) their ability to provide counterpart funding needed for project investments. According to the PAD, an important third factor (i.e., the incinerators' ability to cover recurrent costs of implementing BAT/BET) was considered but was not factored into the financial analysis due to incomplete information about operational practices of the incinerators (PAD, Annex 6). The analysis was conducted for all four candidate incinerators' financials as of early 2014. Similar analysis was also planned when OEPAs (Operational and Environmental Performance Audits) would be prepared for all the incinerators.

Ex Post

Economic Analysis: At project closing, a cost-benefit economic analysis was not carried out. The ICR (Annex 4, paragraph 3) stated that despite the data that was available on the two incinerators reduced final emissions due to their technical renovations, the method of how dioxin levels were measured within a short period on a steady state, did not capture full incineration cycle. Therefore, if a cost-benefit analysis was prepared, it would not adequately capture the project's results. Meanwhile, according to the ICR, China has seen important developments with its regulatory reforms consisting of stronger monitoring and enforcement on MSW incinerations' compliance to standards. If not complied, companies face high economic loss (for example, the shutdown of the Dongjiao incinerators). Based on the project's experience, China is now able to scale up its BAT/BEP SC compliance efforts which are expected to have the following benefits: (i) BAT/BEP and the technical methodologies, including an improved operating conditions of MSW incinerators would be replicated in other cities reducing the health risk of dioxin emissions to millions of people; (ii) real-time online monitoring system piloted in Kunming and Ningbo to link incinerators and regulators would enhance regulatory efficiency and reduce administrative cost; and (iii) public awareness and participation in pollution control would be increased (ICR, Annex 4).

Financial Analysis: Both the demonstration incinerators (Konggang and Xishan) were in good financial health at project-end (ICR, Annex 4). They were operating at capacity and had demonstrated that they were profitable with positive returns from their BAT/BEP investments because of efficiency gains and cost savings. Both reported higher electricity generation leading to increased revenue. Konggang used less inputs and had lower recurrent cost, while Xishan reported on energy savings. They also co-financed their technical renovations. Konggang incinerator invested double the amount of GEF grant (the project had funded US$3.6 million, and their co-finance amounted to US$7.6 million). Meanwhile, Xishan's co-financed 3.8 times more than the GEF

grant it received (the project had funded US$ 1.4 million while their co-finance amount was US$5.2 million). Further, Konggang reported that they were already covering the recurrent costs for BAT/BEP and were investing on the next phase. Based on the data provided on a voluntary basis by Konggang, the incinerator increased its revenues and Returns on Investment to CNY 8.3 million in 2019, and CNY 14.6 million in 2020 compared to the 2018 baseline year. The ICR also pointed out that based on counterpart's financial analysis, it was estimated that Konggang would recover its BAT/BEP investments within three years after project closing, and Xishan would recover its investments within five years (ICR, paragraph 43).

Administrative efficiency. The Project was implemented over a 7-year period, which included one restructuring. The ICR stated that due to the complex technical challenges considering that this was the first BAT/BEP demonstration project in China, the project preparation from concept to approval took two years. Following the restructuring, the project's closing date was extended. The project was implemented with stable staffing arrangements, though it faced period of uncertainty and delays during the process when the Government decided to permanently shut Dongjiao incinerator. The project also faced initial delays due to lack of familiarity with procedural requirements related to procurement (ICR, paragraph 75). As a result, the project's administrative cost amounted to 9 percent of total project costs.

In summary, the ICR provided adequate evidence on the economic and financial benefits from the project in the absence of a cost/benefit analysis. The project had high administrative cost, however considering that the project was the first BAT/BEP demonstration effort in China with an objective to build capacities of key stakeholders in the MSW incineration at various administrative levels of the country, this review agrees with the ICR and thus rates Efficiency to be substantial.

Efficiency Rating

Substantial

a. If available, enter the Economic Rate of Return (ERR) and/or Financial Rate of Return (FRR) at appraisal and the re-estimated value at evaluation:

	Rate Available?	Point value (%)	*Coverage/Scope (%)
Appraisal		0	0 ☐ Not Applicable
ICR Estimate		0	0 ☐ Not Applicable

* Refers to percent of total project cost for which ERR/FRR was calculated.

6. Outcome

The Relevance of Objectives in this project was rated high because they were well-aligned with both Government and World Bank strategies for China. A pilot project with an objective to build capacity and demonstration was found to be relevant given that this was the first project the Bank supported on BAT/BEP compliance in China. The overall Efficacy of the project was rated high. The project met or exceeded all targets for its intermediate indicators. The PDO indicator on dioxin reduction for both the incinerators were achieved

based on verification conducted by an accredited third-party monitoring agency. Efficiency was rated Substantial and the evidence provided on the economic and financial benefits of the project was satisfactory. In summary, this review concludes that the project's overall outcome is "Highly Satisfactory".

a. Outcome Rating
Highly Satisfactory

7. Risk to Development Outcome

Stakeholder ownership and capacity. According to the ICR, incinerators across the country have been motivated to reduce emissions to 0.1 ng TEQ/m3 based on the positive results (i.e., reduced dioxin levels and cost savings) achieved by the two participating incinerators. The ICR (Paragraph 83) stated that Xishan's parent company announced that it would replicate the BAT/BEP approach in 22 incinerators that they own in 13 provinces in the country. As referred in Section 4, there are additional evidence that learning and replication of BAT/BEP are happening nationwide. In addition, given that there will be a rise in number of incinerators in China as a mode for MSW, the Ministry of Environmental Protection's (MEP) revised Standard for Pollution Control on Municipal Solid Waste Incineration requiring incinerators to reduce emissions to 0.1 ng TEQ/m3 which is expected to be enforced post project.

Further, the project has built capacity of key stakeholders: Incinerator Operators, Regulatory agencies, Communities, and the Public which is expected to sustain over time. As communicated to IEG by the project team, post-training follow ups have found evidence that managers and operators of other incinerators have optimized their procedures and operations and have undertaken technical renovations leading to reduction in input costs and have also reported lower emission of pollutants. The project's focus on building capacity of trainers (e.g., local training firms, associations) is expected to help mainstream BAT/BEP for the long term in the incinerator sector. Thus, the stakeholder ownership and capacity risk are assessed as low.

Financial viability. At Project closing, both the incinerators (Konggang and Xishan) were operating at capacity with positive returns, and were financing their recurrent costs, which demonstrates their financial sustainability. Further, the technical and operational improvements that Konggang and Xishan have made to their plants were permanent and their ability to already co-finance improvements was a good evidence that the BAT/BEP approach will be continued. Both the incinerators are expected to recover their BAT/BEP investments, with estimates showing that Konggang could recover it as early as 2022 while for Xishan, it is projected within five years of its completion (ICR, Annex 4). The financial risk is therefore assessed as low.

One risk to development outcome that the ICR did not refer but this review would like to point out is that incineration is not viewed by the public as a favorable method of solid waste management. This risk was identified during appraisal, and the project put efforts in raising public awareness, by preparing outreach messages and disclosing air pollutant information. As per the ICR (Paragraph 92), these efforts helped mitigate the 'not in my backyard' syndrome'. However, this will continue to pose as a substantial risk which would need to be acknowledged and relevant mitigation measures should be in place going forward.

8. Assessment of Bank Performance

a. Quality-at-Entry

The ICR (Paragraph 54) stated that "project preparation was challenging as the project was the first BAT/BEP demonstration attempt in China for a complex sector". Considering that the Bank did not have prior experience working on BAT/BEP compliance, the project's scoping was carefully done to design a pilot project that developed capacity of demonstration incinerators in two cities, which would then be replicated to other cities in China. To select the cities and incinerators, a detailed evaluation was done of options based on demand, readiness, and geographic balancing (ICR, paragraph 55). An important aspect of the project preparation was the design of the technical methodology which was jointly designed by the World Bank team and key stakeholders. The agreed approach for the process of capacity building and demonstration which included the following process and results framework: pre-audit -> OEPA -> dioxin baseline monitoring ->OIP -> BAT/BEP investment plans, with targets and milestones were appropriate in meeting the objective of the project.

The project appraisal had undertaken a comprehensive analysis of risks (PAD, paragraph 53) and the mitigation measures incorporated at design were appropriate. The outreach program was key to raise awareness and transparency about the incinerators' operations and their pollutant discharges. Trainings were provided to the following key stakeholders: communication teams of the demonstration incinerators, municipalities, regulatory agencies as well as the residents in surrounding communities.

The project was well aligned with Government priorities. The project selected appropriate implementing agencies that were fully committed and were ready to implement the project. During the early phase of the project, while the project was implementation-ready, it still suffered from delays due to the technical complexity of developing BAT/BEP investment plans and procurement difficulties.

Overall, the Quality at Entry was Satisfactory.

Quality-at-Entry Rating

Satisfactory

b. Quality of supervision

The World Bank team brought in global experience and networks on MSW management and incineration, which was useful in supporting the OEPA and OIP processes that benefited in engaging international consultants, in organizing study tours and in conducting trainings (ICR, paragraph 60). Outreach and awareness-raising initiatives were central part of project implementation. Capacity gaps in MSW incineration were addressed through training activities targeted to multiple stakeholders (operators, regulators, policy makers, and the public) and by providing expert support to the implementing agencies (ICR, paragraph 58).

Project implementation was supported through missions every six months for a total of 12 during the project period. The Bank maintained a stable team with continuity of team leaders, and consisted of a relevant mix of technical, environmental, social, financial, and procurement skills. During the early stage of the project, there were procurement delays due to the client's lack of familiarity with Bank's procurement

rules, which was mitigated though trainings and closer monitoring. Following the Mid- term review, procurement issues were “addressed through an action plan which was critical in reviewing the BAT/BEP investment proposals for participating incinerators, approving the Konggang proposal, and issuing technical feedback to the Xishan and Dongjiao proposal” (ICR, paragraph 80).

During project implementation, ISRs provided candid assessments. For example, during a period of 14 months, Bank rated the project’s implementation progress as Moderately Unsatisfactory due to delays that resulted from the relocation of the Wuhua incinerator and shutdown of Dongjiao incinerator in 2019 leading to a period of uncertainty on the next steps (ICR, paragraph 61). This led to the restructuring of the project which allowed all key stakeholders (WB, FECO, Yunnan and Ningbo PMOs) to agree on the causes of the implementation delays. Soon after the restructuring was completed, the project started making progress and was back on track. The timely restructuring extended the project closing date by 15 months, which allowed adequate time to complete all activities.

In summary, the Bank task team adequately supported the implementation of the project and therefore this review rates Bank performance in Supervision to be Satisfactory.

Quality of Supervision Rating
Satisfactory

Overall Bank Performance Rating
Satisfactory

9. M&E Design, Implementation, & Utilization

a. M&E Design
The Results Framework was clear, and the list of intermediate indicators selected were simple, easy to measure which adequately captured project activities and outputs towards achieving the PDO outcome. However, the supplemental indicators’ link to PDO indicator could have been better defined. Alternatively, two sets of PDO indicators could have been considered, which separately captured results from the project interventions on capacity building and demonstration of BAT/BEP. The ICR (paragraph 62) had a similar assessment and pointed out that the single PDO-level indicator and its two supplemental indicators that captured two main aspects of the PDO on capacity building and demonstration could have been simplified, with clear set of indicators for the two parts of the PDO. Baseline data and values were included for most of the indicators, except for the PDO indicator and one of the supplemental PDO indicators which were added when the OEPAs were completed.

b. M&E Implementation

The Results Framework and the M&E methodology included in project design was continued through project implementation, except for a minor adjustment made of the RF during project restructuring. Due to the closure of one of the incinerators, its implementation plan was not implemented. Thus, the RF was revised to reflect this reduction in target numbers of demonstration incinerators. During restructuring, a new intermediate indicator was introduced to capture the results of the additional activities related to continuous sampling of incinerator's emissions which was carried out with the remaining funds from the shut-down of Dongjiao (Restructuring Paper, 2019).

As part of project intervention, real-time monitoring of operating conditions of incinerators by the regulators were set up for Kunming and Ningbo EPB/UMB. This resulted into a mandatory requirement for incinerators to install real-time monitoring equipment, which was connected to local and national regulatory agencies, and are expected to operate and sustain after project closing.

The ICR stated that FECO, Kunming, and Ningbo PMOs prepared monitoring reports on a timely manner based on the agreed reporting schedules. As planned, during project design, the baseline, and targets for PDO and one of the supplemental indicators were added based on the OEPAs. The PDO indicator on dioxin reduction for both the incinerators were monitored and verified by an accredited third-party monitoring agency.

Institutional arrangement for project M&E was well developed, with the Foreign Environment Cooperation Office (FECO) under MEE taking overall responsibility, with inputs (i.e., M&E reports) prepared by the Yunnan Project Management Office (PMO) and Ningbo Project Management Office (PMO).

c. M&E Utilization

According to the ICR (Paragraph 64), the M&E framework was useful for all three PMOs (FECO, Kunming and Ningbo EMB/UMB) and the Bank to assess progress and achievements of project results. Key M&E data were used to raise public awareness through online disclosure of operating and emission data of incinerators. This activity promoted transparency of information and was critical in seeking buy-in of communities living in the surrounding areas of the incinerators.

During project implementation, the various documents prepared (e.g., OEPAs, EMPs) for each of the incinerators in the two cities were fully utilized and contributed towards monitoring project's results. The M&E data that measured dioxin emissions both at baseline and end of the project was a critical evidence for achievement of the PDO indicator.

In summary, M&E is rated Substantial. The M&E framework was clear, which included baselines and targets, and had measurable indicators. Appropriate institutional arrangements were in place, and reporting was done on a timely manner. However, as described in the earlier paragraph, project's M&E could have benefited from supplemental indicators that separately captured capacity building and demonstration, which were two distinct issues covered by the PDO.

M&E Quality Rating

Substantial

10. Other Issues

a. Safeguards

The Project was classified as Category A (full assessment) due to the risk level of potential environmental impact. As a result, the Project triggered the Environmental Assessment (OP 4.01) policy. The PAD (Paragraph 85) pointed out that the key environmental risks identified were related to the operation of the demonstration incinerators that would generate air emissions from the use of solid waste and wastewater posing health and safety risks. The project did not trigger any social safeguards as the project did not acquire land or resettle people, and neither did it impact any ethnic minority groups in the project area.

At appraisal, the project undertook an environmental audit (EA) based on which an environmental management plan (EMP) for each incinerator was prepared. According to the PAD (Paragraph 86), "the EMPs included detailed information on organizational arrangements and responsibilities for environmental management and supervision, mitigation measures, a training plan, a monitoring plan, a public engagement plan, a risk management plan, and budget estimates for EMP implementation for construction and operation stages". The draft EAs and EMPs were disclosed locally in the country and were also released through the World Bank website on August 15, 2014. The EMPs for both the incinerators (Konggang and Xishan) were updated in 2018 and 2019 respectively to integrate the findings of the OEPAs and OIPs.

The ICR stated that during project implementation, environment management was integrated into the management structure within Foreign Environment Cooperation Office (FECO), provincial/local EPBs, and participating incinerators. Based on EAs, EMPs for the demonstration incinerators were satisfactorily implemented and the project did not face any environment, health, or safety incident/accident (ICR, paragraph 69). Training programs were organized, and a third-party external agency was hired to conduct regular environmental monitoring of the participating incinerators. Besides reduced level of dioxin emissions, the project reported reduced emission levels of air pollutants such as SO2, HCI and dust (ICR, paragraph 70). The project put efforts to increase public awareness to residents in the surrounding area by building capacity of the communication teams of the incinerators and sharing with them information on emissions on a timely basis.

b. Fiduciary Compliance

Financial Management: The ICR (Paragraph 77) noted that the project's financial management system worked well, with the implementing agencies submitting timely and accurate accounting and financial reports that were in line with the relevant Government regulations and grant agreement. Recommendations provided by the Bank during supervision missions were addressed. No significant financial management issues were noted throughout implementation and any minor weakness raised during supervision were resolved on time. Project audit reports were prepared as per the timeline and grants were disbursed on time. All project audit reports were received with unqualified audit opinions.

Procurement: Procurement functions were carried out by the PMOs' dedicated staff and the project faced minimal staff turnover during project implementation. The implementing agencies regularly prepared Procurement Plans which followed World Bank policies and procedures. During the early phase of the project, there were procurement delays due to the implementing agencies' lack of familiarity with Bank's

procurement rules which was mitigated through training and close monitoring. According to the ICR (Paragraphs 75, 76) the delays also occurred because of the technical nature of project activities, and lack of counterpart funds designated for contracts when final pricing came to be higher than what was originally budgeted.

c. Unintended impacts (Positive or Negative)

None

d. Other

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11. Ratings

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Highly Satisfactory	Highly Satisfactory	
Bank Performance	Satisfactory	Satisfactory	
Quality of M&E	Substantial	Substantial	
Quality of ICR	---	Substantial	

12. Lessons

The ICR listed several lessons that emerged from the project. Three of those lessons with a broader application are summarized below with adjusted language:

Bank intervention that is timed well and is in line with country policies/ regulations can have better results. When the project was being prepared in 2014, the Government of China introduced a new dioxin emission standard for incinerators to be implemented by January 2016. This regulation provided the basis for the project to set targets which were in line with the country's environmental regulations and enforced compliances from the implementing agencies.

The customized road map based on the logical framework for BAT/BEP compliance can lead to greater ownership from the demonstration incinerators and were a key to success. The following logical framework: pre-audit -> OEPA -> dioxin baseline monitoring -> OIP -> BAT/BEP investment plan -> implementation -> verification" that was developed and then adopted by the participating incinerators helped improve their operations, and brought in several benefits, including related to cost saving. The co-financing brought in by the incinerators for further technical improvements was a clear evidence of their ownership.

Community outreach and data disclosure based on detailed social assessments is critical in getting the public's support for environmental projects. During project preparation, detailed social assessment which was gender-informed was prepared. Based on the assessment, the project undertook training for the communication staff of the demonstration incinerators, developed targeted communication messages, specifically focusing on women who were found to have limited understanding and awareness of the emissions but had greater concerns of the health impacts of pollution levels. The ICR (Paragraph 92) indicated that "the disclosure of air pollutant information by incinerators helped build trust and accountability, improved the flow of communications between stakeholders, and allowed for early grievance redress".

13. Assessment Recommended?

No

14. Comments on Quality of ICR

The ICR provided comprehensive information about the implementation experience of the project. It presented the logical framework that described each step of the technical design process of the project (Annex 7). The content of the ICR demonstrated a good technical knowledge of the various activities supported by the project.

The M&E section was adequately presented covering the three aspects (M&E design, implementation, and utilization). Summary findings of the third-party monitoring which was critical in setting the baseline and project-end verification were provided in an Annex.

The project achieved its PDO and except for the implementation delays that it experienced during the early phase of the project, the project did not have any major shortcomings. However, given that this was a pilot project, the document could have been more candid in discussing any weaknesses it found in project design and/or implementation.

The ICR adequately presented the evidence in discussing the project's PDO. However, Section II.B could have benefited by including further evidence on the project's demonstrative impact on BAT/BEP roll-out in the incineration sector, including the impact of its training programs which were provided to IEG separately by the project team. On the other hand, Section II.C (Annex 4) that provided the evidence on the financial viability of the demonstration incinerators was useful, in the absence of a cost-benefit analysis.

The ICR included useful lessons based on evidence, which was critical for a pilot project.

Overall, the Quality of the ICR is rated Substantial with some minor shortcomings.

a. Quality of ICR Rating
Substantial