



1. Project Data

Project ID
P154672

Project Name
Hebei Air Pollution Prevention

Country
China

Practice Area(Lead)
Environment, Natural Resources & the Blue Economy

L/C/TF Number(s)
IBRD-86230

Closing Date (Original)
31-Dec-2018

Total Project Cost (USD)
500,000,000.00

Bank Approval Date
06-Jun-2016

Closing Date (Actual)
31-Dec-2019

	IBRD/IDA (USD)	Grants (USD)
Original Commitment	500,000,000.00	0.00
Revised Commitment	500,000,000.00	0.00
Actual	500,000,000.00	0.00

Prepared by
Ranga Rajan
Krishnamani

Reviewed by
Vibecke Dixon

ICR Review Coordinator
Christopher David Nelson

Group
IEGSD (Unit 4)

2. Project Objectives and Components

a. Objectives

The Project Development Objective (PDO) as stated in the Financing Agreement (Schedule 1, page 5) and the Project Appraisal Document (PAD, page 5) was:

"To reduce emissions of specific air pollutants in the key sectors in Hebei".



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

No

c. Components

This operation used a Program-for-Results (PforR) lending instrument, with seven Disbursement-Linked Indicators (DLIs), for supporting five of the seven subplans of the Hebei Action Plan (HAP) (discussed in section 3a). There were four results areas (PAD, pages 10 -13). The DLIs to measure the key results are discussed in section 3b.

1. Comprehensive control of industrial enterprises and reduced emission of multi-pollutant emissions (Sulphur Dioxide (SD₂), Nitrogen Oxides (NO_x), and Primary Particulate Matter 2.5 (PM 2.5) from key industrial sectors. The program financing for this area was US\$180.0 million. This area planned at ensuring that industrial enterprises in Hebei province met the government's reduced emissions standards on a daily basis, through installing a Continuous Emissions Monitoring system (CES). Activities in this area: (i) incentivizing the enterprises to invest in particulate removal equipment: (ii) providing CEM equipment to the provincial and municipal Environmental Protection Bureaus (EPBs): and (iii) training the staff of enterprises and the government on using the system.

2. Area Pollution control and dust control. The program financing for this area was US\$159.9 million. This area planned to control air pollution especially in rural areas. Activities in this area: (i) incentivizing rural households to use clean and efficient stoves: and (ii) promoting environment-friendly fertilizers based on soil testing results.

3. Prevention and control of emissions from mobile sources. The program financing for this was US\$78.7 million. This area planned to control emissions from mobile sources. Activities in this area: (i) improving fuel quality ((gasoline and diesel with lower Sulphur concentration): (ii) eliminating old high emission "yellow sticker" vehicles (vehicles that did not meet government standards) and promoting new energy vehicles (NEV) for public transport, city services and government agencies: and (iii) strengthening the environmental management of vehicles.

4. Establishment of monitoring systems and warning systems and planning tools. The program financing for this was US\$80.0 million. This area planned to establish monitoring and warning systems and policy tools for reducing ambient PM_{2.5} concentration in the province over the next 10 -15 years. Activities in this area: (i) strengthening the cooperation of the EPBs with meteorological departments through establishing weather monitoring and early warning systems: (ii) revising the province's environmental protection regulations and building capacity for environmental monitoring: and (iii) communication campaigns for controlling PM 2.5 and providing professional training on air quality management.

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

Project cost. The estimated cost at appraisal was US\$968.0 million. The actual cost was US\$1,175.0 million.



Project financing. The project was financed by an IBRD loan of US\$500.0 million. This amount was disbursed.

Borrower contribution. The borrower contribution (from central and provincial government earmarked funds) was estimated at US\$468.0 million. The actual contribution was 44% more than planned at US\$675.0 million.

Dates. The project was effective on October 11, 2016 and scheduled to close on December 31, 2018. The project closed an year behind schedule on December 31, 2019.

Other changes. The closing date was extended by a year when 75% of the loan was disbursed for providing additional time for collecting the data required for completing DLI 7 (a cost effective plan on air quality), and for completing disbursements of four DLIs that were either in the verification stage or awaiting approval.

3. Relevance of Objectives

Rationale

Country context. Rapid economic development under a resource-intensive growth model in the years before appraisal, had contributed to growing air pollution, with concomitant economic costs and health impacts. The World Health Organization (WHO) identified air pollution as the world's largest single environmental risk, with 4.3 and 3.7 million deaths occurring worldwide annually, due to indoor and outdoor pollution. In China, published estimates ranged between 350,000 to 1.3 million annual deaths. The objective of reducing air pollution was hence important in the country context.

Regional context. The JingjinJi Region comprising Beijing, Tianjin, Hebei, and neighboring provinces, was one of the highest polluted urban areas in the world, with annual average Particulate Matter 2.5 in the region, three times higher than the specified government standards. The source apportionment study, identifying the sources of ambient pollution and quantifying their respective contribution to pollution, indicated that industrial processes were the main source (contributing 54% of emissions), followed by residential emissions from burning coal (33%). The power sector accounted for 27% and 20% of Nitrogen and Sulphur dioxides respectively, and the transport sector for 26% of Nitrogen dioxide.

Provincial context. Hebei province was responsible for 70% of PM 2.5 emissions in the region. This apportionment reflected the high concentration of polluting industries in the province (a power sector almost entirely coal-fueled, and iron and steel, cement and flat glass production). Hebei was also the largest agricultural producer in the region and had emissions due to the high application of nitrogen fertilizers, that was 5.6 times higher than the national average (which was about 30% higher than the world average). The objective of decoupling emissions from economic growth was hence important in the provincial context.

Government strategy. At the national level, the State Council issued the *Air Pollution Prevention and Control Action Plan* (APPCAP) in 2013. This plan specified the goal of reducing ambient concentration of PM2.5 in China by 10% by 2017 (as compared to 2012). The plan also specified stringent measures for the three urban regions (including the JingjinJi region), and mandated the provinces to prepare timebound plans for reducing air pollution.



Provincial strategy. The Hebei province prepared the *Hebei Prevention and Control Plan* (HAP) for 2013-2017. The plan specified the goal of reducing ambient PM 2.5 in the province by 25% by 2017. This plan included a list of actions to address air pollution under seven main subplans.

- 1. Comprehensive control of industrial enterprises and reduced emissions of multi-pollutants.
- 2. Area pollution control and dust control.
- 3. Prevention and control of emission from mobile sources.
- 4. Establishment of monitoring and warning systems and planning tools.
- 5. Elimination of overcapacity and promotion of industrial transformation and upgrade.
- 6. Adjustment of the energy structure and increase of the clean energy supply. and
- 7. Supporting measures.

Bank strategy. The PDO was well-aligned with the Bank strategy for China. The strategic theme one of the Country Partnership Strategy (CPS) for 2013- 2016 specifically highlighted the need for "*supporting greener growth*" through "*demonstrating pollution control measures*". The second engagement area of the Country Partnership Framework (CPF) for 2020 - 2025, highlighted the need for " *promoting greener growth, by facilitating the transition to a low carbon energy, including through reducing air pollution*".

Bank's prior experience in China. The Bank has financed traditional lending operations in China on the key sectors covered by this operation (environmental management, energy, transport and agriculture) - and in some cases, using an integrated multi sectoral approach. This operation was the second operation using the PforR instrument in China and the first in the province. The operation supported five subplans of the HAP plan enumerated above (one to four and seven). Alongside this operation, the Bank had approved another PforR operation - the Innovative Financing for Air Pollution Control in the JingjinJi region and neighboring provinces (including Hebei), aimed at addressing air pollution through reducing coal consumption in the region. To avoid duplication among the two operations, the HAP's sixth subplan was excluded from this operation. The fifth sub-plan - elimination of overcapacity in the power sector - was excluded, as it was deemed to be not amenable for a PforR instrument based on environmental and social screening.

Rationale for PforR. The rationale for using this instrument for the HAP plan was: One, although Hebei government had devoted significant resources for implementing the HAP Plan, they were inadequate for achieving the goal of reducing air pollution by 25% in 2017. This was primarily due to the lack of technical quality and coverage of measures, compounded by budgeting issues that prevented the annual earmarked resources for the HAP plan to be spent on time: and two, a traditional investment lending operation focused only on upfront specific infrastructure investments, would have precluded the Bank from using a much larger opportunity to influence the entire HAP plan. The PforR s instrument provided opportunities for incentivizing key specific measures for reducing air pollution, introducing international good practices in the HAP, and providing incentives for the province to provide the earmarked resources to the operation through a sharper focus on results and linking Bank disbursements to independently verified results. There were seven DLIs (two each for results area one, two and four) and one for results area one (discussed below).



Rating

High

4. Achievement of Objectives (Efficacy)

Objective 1 Objective

To reduce emissions of specific air pollutants in the key sectors in Hebei.

Rationale

Theory of change. The results framework was logical. Incentivizing the industrial enterprises to invest in equipment for reducing emissions of multi-pollutants and installing CEMs that were integrated with the centrally managed CEM system of the EPBs, and training the staff of enterprises and government staff on using the system, were aimed at improving monitoring and enforcing air quality standards. Activities aimed at replacing coal stoves with clean stoves and providing incentives for promoting environmentally-friendly fertilizers were likely to control air pollution in rural areas. Activities aimed at increasing the number of clean energy electric buses (as opposed to diesel buses) were aimed at controlling pollution from mobile sources. These activities together were likely to reduce emissions of specific pollutants in key sectors, and thereby aid in realizing the HAP goal of reducing air pollution by 25% by 2017. The outcomes are however contingent on the implicit assumption that the clean stoves will continue to be used, the environmentally friendly fertilizers continue to be adopted, and the province has the technical skills and equipment for maintaining the electric buses. Activities aimed at developing a comprehensive inventory of air pollutants and preparing a cost effectiveness study for prioritizing investments in coming years were forward-looking, and aimed at controlling air pollution beyond 2017 in the province. The links between the activities, the DLIs and the outcomes were clear, and the intended outcomes were monitorable.

Outputs (ICR, pages 46 -47).

- 480 monitoring and enforcement staff of the EPBs, and 60 work safety supervision staff were trained, as targeted.
- A Grievance Redressal Mechanism (GRM) was established and a complaint hotline was made available to the public as targeted.
- Hebei province disclosed an official website describing its performance on air quality management, the 2017 work plan and its monitoring of data of air quality.
- Twelve EPBs at the provincial and prefecture level implemented standard protocols on CEM systems for emission of air pollutants as targeted. The integration of the centrally controlled CEM with the municipal CEMs enabled real time data-sharing among the levels of government.
- 100 enterprises in the state and municipal controlled lists (representing all the major enterprises in the province) were integrated in the improved CEM and enforcement system for monitoring air pollutants as targeted. The CEM data was made publicly available.



- 1,221,500 clean stoves (stoves using gas and electricity) were deployed to replace older polluting coal stoves. This exceeded the target of 800,000 clean stoves. Support was provided to Hebei to design international campaigns targeting stove manufacturers and existing and potential users at the county level. .
- Formula fertilizer based on soil testing were applied on 976,800 hectares of land under cultivation with seven crops. There were no targets for this indicator. Based on third party verification, nitrogen use efficiency increased to 37% (from 32%) before the program.
- 4,632 clean energy electric buses replaced diesel buses. This exceeded the target of 4,632 clean buses. The diesel buses were disposed of, in accordance with national regulations. The ICR (paragraph 78) notes that thirty five dismantling enterprises in Hebei were upgraded in compliance with Chinese environmental regulations. Decommissioned vehicles were sent to these dismantling enterprises for final disposal. The number of disposed vehicles was verified by the third party entity. Given that the operation and maintenance of electric vehicles is considerably lower than diesel vehicles, it is likely that the electric buses will continue to be operated in Hebei.
- A province-wide emissions inventory for 2015 was prepared following the technical guidelines from the Ministry of Ecology and Environment as targeted. The inventory was used by the province to determine the largest emissions sources in formulating its 2017 - 2020 strategy for controlling air pollution. The province has been regularly updating the inventory, as a tool for information and prioritization.
- The cost effective comprehensive plan on air quality control for the next five years was approved by the province. This analysis indicated that industrial emission improvements through data monitoring and tightening enforcement control (DLI 1 and 2) are the most cost-efficient to reduce mean population exposure, followed by fertilizer efficiency (DLI 4). The electric buses were the least cost-efficient (DLI 5) to reduce ambient PM2.5 concentration. This analysis also found that the implementation of Hebei's air quality management measures avoids seven percent of carbon dioxide emissions by 2020 compared with a baseline in which no air quality action plan is implemented.

Outcomes (ICR, pages 19 - 20 and pages 36 -39).

- There was a cumulative reduction of 454,000 tons of emissions of Sulphur dioxide (SO₂) in the province by December 2019 from industrial enterprises, as compared to in December 2013. This represented more than three times the target of 150,000 tons. The emissions of nitrogen oxide in the province from industrial enterprises reduced by 3,269 tons, as compared to the target of 1,300 tons. The emissions reductions were achieved in large scale, heavy industries such as power generation, steel production, cement and glass production. The baseline for this indicator was zero.
- There was a cumulative reduction of 3,269 tons of PM 2.5 emissions due to the clean stoves by December 2019, as compared to in January 2014. This exceeded the target of 3,269 tons. The baseline for this indicator was zero.



- There was a cumulative reduction of 51,272 tons of nitrogen oxides from the transport sector, due to the replacement of diesel buses by electric buses in December 2019, as compared to in January 2014. The baseline for this indicator was zero.
- With the four indicators far exceeding the targets, the mean population-weighted PM 2.5 in the JingjinJi region reduced by around 33% in 2019 and by about 35% in Hebei province (as compared to the goal of 25% in the HAP).

Given that the indicators were largely exceeded, efficacy is rated as High.

Rating
High

Rationale

Overall Efficacy Rating

5. Efficiency

Efficiency Rating

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 <input type="checkbox"/> Not Applicable
ICR Estimate		0	0 <input type="checkbox"/> Not Applicable

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



6. Outcome

Overall relevance to the Bank, the government and the provincial strategies is High. Efficacy of the single objective - to reduce emissions of specific key pollutants in the key sectors in Hebei is rated as High, as the quantitative targets far exceeded the set targets, and the tools for driving the government's reforms going forward were completed as targeted and the DLIs were fully relevant to the changing circumstances. Taking into account the ratings discussed above, overall outcome is rated as Highly satisfactory.

a. Outcome Rating

Highly Satisfactory

7. Risk to Development Outcome

Environmental risk. The ICR (paragraph 97) notes that many of the operation results are irreversible (such as, replacing coal stoves with clean stoves, diesel buses with clean buses and emission reduction in the industrial sector through implementation of CEM technologies). There is also the likelihood that other program results (such as use of the CEM system to monitor and control industrial emissions, agricultural practices to optimize nitrogen use, and the emissions inventory), would continue. It is however not clear whether the clean stoves will continue to be used and whether formula fertilizers will continue to be adopted, given that they depend on change in people's behavior. It is also not clear whether the province has the skill set and equipment required for maintaining the electric buses.

Government commitment. This risk is likely to be low, given that the province has approved the cost-effective plan for further air quality improvements. Government commitment at the national and provincial levels is also demonstrated by the level of counterpart funding for this operation, which was 44% more than planned at appraisal.

8. Assessment of Bank Performance

a. Quality-at-Entry

Resources secured by the preparation team from the Pollution Management and Environment Health Trust Fund (PMEH) and the Global Environment Facility (GEF) aided in preparing the technical design of the operation. The DLIs were appropriate in that they were science-based and aimed at driving the government reform process forward. As the project was funded through specific budget lines of the government, implementation could commence before Bank loan disbursements. The implementation arrangements were appropriate, with the Working Group's Office (WGO) established within the Hebei Environmental Protection Bureau (EPB) responsible for project coordination (PAD, paragraph 65). The EPB was already responsible for monitoring emissions reduction from different activities, using an evidence-



based approach (PAD, paragraph 68). Given that this was the first PforR in Hebei province, several risks were identified at appraisal, including substantial risks associated with the institutional capacity for implementation, and fiduciary and social risks. Several mitigation measures were incorporated, including capacity building for environmental supervision, establishing a Grievance Redress Mechanism at the provincial level and improving public participation through a publicly accessible website. The arrangements made at appraisal for fiduciary and safeguards compliance were appropriate (discussed in section 9). The project closing date was extended by a year. According to the clarifications provided by the team, this extension was granted to complete DLI 7, which was required for completing the Greenhouse Gas and Air Pollution interactions and Synergies (GAINS) model. Given that this important step for informing policies on air quality management in China for the next five years, the Bank performance at quality-at-entry is rated as highly satisfactory.

Quality-at-Entry Rating

Highly Satisfactory

b. Quality of supervision

Formal supervision missions were held twice a year. The missions were supplemented with frequent informal discussions with Hebei authorities and technicians working in the operation. The supervision team included experts from multiple disciplines. This aided in providing support and guidance to the program. There were two Task Team Leaders (TTLs) during the lifetime of the operation and transition in leadership was seamless, as the incoming TTL had been a team member from the beginning of the operation. The PMEH Trust Fund and the GEF provided critical support about the technical underpinnings and the research capabilities needed to implement the program. The Mid Term Review (MTR) held on January 29, 2018, was used to assess progress. The delay in the completion of DLI 7 was noted at the MTR and addressed when a formal program request was received from the Department of International Economic and Financial Cooperation of the Ministry of Finance, on December 6, 2018.

Quality of Supervision Rating

Highly Satisfactory

Overall Bank Performance Rating

Highly Satisfactory

9. M&E Design, Implementation, & Utilization

a. M&E Design

The results framework was logical and the key outcome indicators - reduction of Sulphur dioxides and nitrogen oxides from industrial enterprises, reduction of PM 2.5 emissions due to clean stoves and reduction of nitrogen oxides from the transport sector, were attributable to the operation activities. The baseline figures were set at zero to better estimate emissions and benchmark progress. The provincial Continuous Emissions Monitoring



(CEM) Center, as part of the Working Group Office, was responsible for data collection (PAD, paragraph 65). The consolidation of results and indicator values in one centralized Project Management Office (PMO), facilitated centralized oversight.

b. M&E Implementation

The operation completed reports for each DLI with the necessary data and evidence, and these reports were further reviewed for third party verification (ICR, paragraph 73). The ICR notes that M&E was implemented as planned. The ICR (paragraph 23) reports that M&E was implemented thoroughly, and was reported regularly as part of the client-prepared Program progress report.

c. M&E Utilization

The M&E results were used for monitoring performance and were also used strategically. For example, PDO indicators 1 and 2 on the reduction of Sulphur Oxide and Nitrogen Oxide emissions from enterprises included in the CEM depended on the implementation of the CEM upgrade, made by the province. Therefore, the Program's monitoring and evaluation efforts supported Hebei's monitoring efforts by designing methodologies to assess excess nitrogen fertilizer application and laboratory testing of emissions from stoves and vehicles. DLI 6 was also directly focused on strengthening Hebei's ability to monitor pollutant emissions.

In sum, the M&E framework was rated as High.

M&E Quality Rating

High

10. Other Issues

a. Safeguards

Environmental and social safeguards. The PAD (paragraph 109) notes that the PforR Program was to rely on the existing local legal frameworks and institutional systems for managing environmental and social safeguards. An Environmental and Social Systems Assessment (ESSA) was prepared for the program and publicly disclosed (PAD, paragraph 114). The ICR (paragraph 76) notes that the environmental and social management systems under the national framework were effectively implemented, and the PforR was compliant with environmental and social safeguards. The ICR (paragraph 80) notes that in the month before project closure, several public media platforms reported cases of carbon monoxide poisoning in Hebei due to the use of coal in new/clean stoves. The Hebei's Program Management Office confirmed that the cases had not taken place in the two municipalities where the PforR was implemented.



b. Fiduciary Compliance

Financial management. A financial management assessment of the HAP program system was conducted at appraisal. The assessment concluded that the HAP's systems were adequate to meet the Bank's PforR policy and Directive (PAD, paragraph 28). The ICR (paragraph 89) notes that there were no significant financial management issues during implementation, and that the Program audit reports were unqualified.

Procurement. The PAD (paragraph 98) notes that there were no large contracts valued at above current Operational Revised Committee thresholds (above US\$50.0 million). An assessment of the existing procurement management system was conducted at appraisal (PAD, paragraph 99). Measures to address procurement risks were included in the Program Action Plan. The ICR (paragraph 90) notes that procurement under the program was implemented in a timely manner and there were no procurement issues.

c. Unintended impacts (Positive or Negative)

d. Other

11. Ratings

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

12. Lessons

The ICR draws the following three lessons from the experience of implementing this PforR operation.

1. A robust results framework and robust mechanisms for monitoring are key to realizing results in a PforR operation. The PforR was applied for the first time in Hebei for managing air pollution in cooperation with government agencies. Linking results to indicators that were verified by external third parties enhanced the effectiveness of fiscal spending, besides increasing transparency and accountability.

2. Solid analytical underpinnings based on scientific knowledge can ensure success of the PforR instrument. Many disbursement-linked indicators in this operation were based on the source apportionment study that identified the sources of ambient air pollution and quantified their contribution to air pollution. This provided the scientific basis for choosing the relevant disbursement linked indicators.



3. Capacity building for preparing the Terms of Reference to the government counterparts prior to the start of implementation can help in avoiding delays during implementation for a PforR operation. In this operation, while the government's program progressed as planned, issues associated with Bank disbursements were mainly due to issues associated with third party verification of results.

13. Assessment Recommended?

No

14. Comments on Quality of ICR

The ICR is clear and provides a clear rationale for a PforR instrument. The theory of change articulated in the ICR is clear and provides clear linkages between the project activities, the output indicators and intended outcomes that were measurable. The disbursement linked indicators were based on scientifically supported data. The ICR draws good lessons from the experience of this project. The ICR adheres to the guidelines and provides a clear rationale for using the PforR as the lending instrument for this operation.

However, one problem with the ICR is its excessive length. The main body of the text at about 30 pages is almost twice the recommended length of 15 pages. The ICR could have benefitted from better editing and avoiding repetitions in the text.

a. Quality of ICR Rating

Substantial