

RISK ASSESSMENT AND RISK MANAGEMENT PLAN

Risk Description	Risk Assessment	Mitigation Measures or Risk Management Plan
<p>Technical Risks Scale-up of pilot-tested process may unexpectedly result in poor performance risk, including (i) low production scale, or (ii) low quality of end product</p>	<p>Medium to high</p>	<p>Staged scale-up between 2011 and 2014; technology first proofed at laboratory scale, and risks related to scale-up were tested in two subsequent pilot phases. Test results were reviewed and endorsed by independent third-party experts.</p> <p>DSC has strong partners, Shanghai Huayi Engineering^a and the Chinese Academy of Sciences Chemical Technology Company, for the testing of the new technology.</p> <p>The proposed level of scale-up is reasonable considering the expected development trajectory for a chemical process of this nature.</p>
<p>Cost Overrun Cost estimates are based on feasibility study; detailed design is ongoing</p> <p>Weak capacity of DSC to manage the implementation of new process technology</p>	<p>Medium</p>	<p>Reputable design institutes prepared the feasibility studies, which were rigorously reviewed by independent experts of the Chinese Academy of Sciences, the China Chlor-Alkali Association, the China Petroleum and Chemical Industry Federation, the Ministry of Industries and Information Technology, the Ministry of Environmental Protection, and the National Development and Reform Commission. Adequate contingency provisions for both physical and price factors were included in the project cost estimates.</p> <p>Subprojects' financial sustainability is not sensitive to cost overruns; the financial internal rate of return, even with substantial cost overruns and implementation delays, is higher than the weighted average cost of capital.^b</p> <p>DSC will hire capable implementation consultants, who will be supported by a special task force from CHC and from the China Chlor-Alkali Industry Association.</p>
<p>Implementation Delay</p>	<p>Low</p>	<p>Efforts have been made to avoid delays by incorporating lessons from the implementation of similar loans in other provinces (para. 10 of the main text of the report and recommendation of the President). The following factors contributed to these efforts:</p> <ul style="list-style-type: none"> (i) Each subproject's readiness was rigorously examined. All required approvals of feasibility reports and environmental impact assessments were available by July 2015. (ii) The project implementation unit has experience in implementing a loan from the European Investment Bank. (iii) The subprojects' financial sustainability is not sensitive to implementation delays.

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<p>Weak Capacity of Project Implementation Unit Huatai may have weak capacity to (i) manage and integrate a large number of projects, and (ii) screen and assess future subprojects</p>	Low	<p>Huatai has hired CHC core staff with many years of experience and access to industries in the sector.</p> <p>Huatai will negotiate options in energy savings performance contract to liquidate open position quickly.</p>
<p>Chemical Industry Accident. Chemical industry's inherent risk of occupational hazards to workers, local population, and the environment as a consequence of an unanticipated accident</p>	Medium	<p>An environmental audit was conducted under project preparatory technical assistance to assess (i) the compliance of the existing facilities with national requirements; and (ii) the effectiveness of environment, health, and safety management and emergency management.</p> <p>The two initial subprojects have adequate safety, health, and environmental management standards, and are either already GB/T24001-2004 (ISO 14001) and GB/T 28001-2001 (OHSAS 18001) certified or about to be certified (in the case of DSC).^c</p> <p>During future subproject selection, Huatai will be required to conduct environmental impact assessment and due diligence of candidate subprojects. The environmental and social management system requires future subproject companies to have strong management commitment, excellent environmental, occupational health and safety management systems and preferably have valid GB/T24001-2004 (ISO 14001) and GB/T 28001-2001 (OHSAS 18001) certifications (footnote c).</p>
<p>Loss in Financial Sustainability of Huatai</p>	Medium	<p>Extensive business modeling and strategic planning, including preparation of a market survey, during project preparation confirmed the large market potential of the chemical industry-specific energy savings performance contract.</p> <p>Huatai staff capacity has been strengthened during project preparation.</p> <p>During loan implementation, Huatai's capacity for project screening and investment analysis will be strengthened.</p>
<p>Equipment Risk Poor performance of key equipment or contractors causes plant to operate at less than designed capacity</p>	Medium	<p>Vinyl chloride monomer synthesis reactor is a fixed bed reactor, which is a well-established platform in the chemical industry for catalytic reactor unit operations. Adjusting the reactor design as needed is assessed to be well within the capabilities of the contractors and implementation team.</p> <p>The performance-based operation and maintenance contract will be implemented in the critical first 2 years of operation to ensure long-term satisfactory performance of the project.</p>

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Poor performance of the plasma incineration equipment	Low	The proposed technology is the same (with some technical improvements), which CGY has been using to abate fluorocarbon emissions from the smallest of its chlorodifluoromethane production chain for the treatment of fluorocarbon emissions.
Poor performance of energy efficiency equipment	Low	Proposed energy efficiency investments are cutting-edge, proven technologies used in most advanced chemical industries.
Complicated Onlending and Funds Flow Arrangement Multiple layers of onlending complicate and delay project implementation	Medium	Financial intermediary loan and state-owned enterprise structures have been applied previously in ADB projects and have worked effectively if stakeholders are well trained. Project implementing agencies will be trained in ADB guidelines for disbursement, procurement, reporting, and auditing.
Procurement Capacity Assessment Huatai may have weak capacity to (i) manage procurement for the CGY subproject, (ii) monitor procurement plan implementation by DSC, and (iii) coordinate reporting on procurement to ADB	Medium	Huatai will be supported by a procurement agent. All mitigating measures will be implemented by agents who will be selected on a competitive basis and who will have to demonstrate strong experience in externally funded projects. Huatai has hired experienced core staff of CHC.
Financial Intermediary Risk Weak capacity of financial intermediary bank in managing revolving escrow fund and interest differential account	Low	The selected financial intermediary, China Construction Bank, is listed on the Hong Kong Stock Exchange and is the fifth largest commercial bank worldwide. Integrity due diligence showed no negative indications. The China Construction Bank's Beijing branch has substantial experience in onlending and escrow account management.
Overall	Medium	

ADB = Asian Development Bank, Huatai = Beijing Zhonghao Huatai Energy Technology, CGY = Zhonghao Chenguang Research Institute of Chemical Industry, CHC = China Haohua Chemical Group, DSC = Dezhou Shihua Chemical, ISO = International Organization of Standardization, OHSAS = Occupational Health and Safety Assessment Series of Standards.

^a Shanghai Huayi Engineering is a major participant in the Chinese engineering, procurement, construction, and management sectors established in 1985. It has delivered numerous large-scale process projects, many in the chlor-alkali sector and specifically related to polyvinyl chloride and vinyl chloride monomer.

^b Financial analysis of switching values shows that to become financially unsustainable, DSC's project investment costs would have to overrun by more than 150%, and CGY's by more than 250%.

^c GB standards are the Chinese national standards issued by the Standardization Administration of China, the Chinese National Committee of the International Standardization Organization and International Electrotechnical Commission. GB/T24001-2004 concerns environmental management systems and is equivalent to the international standards ISO 14001. GB/T 28001-2001 concerns occupational health and safety and is equivalent standard OHSAS 18001.

Source: Asian Development Bank.