CLIMATE CHANGE RISK ASSESSMENT NOTE

A. Overview

1. The proposed Chemical Industry Energy Efficiency and Emission Reduction Project will use the financial intermediation loan (FIL) modality to finance energy efficiency improvements and reduce emissions from various plants belonging to the China National Chemical Group (ChemChina), the largest state-owned enterprise in the chemical industry and a major producer of basic chemicals, plastics, fine and specialized chemicals, and petrochemical products in the People's Republic of China (PRC). Under the project, a new industry-specific energy service company (ESCO) fully owned by China Haohua Chemical Group (CHC), will serve as a platform for disseminating technologies that will address major challenges faced by the PRC's chemical industry. The Asian Development Bank (ADB) has classified this FIL project under environment category FI.

2. Two subprojects have been identified. The first subproject will involve technology upgrading and innovation in vinylchloride monomer (VCM) and polyvinyl chloride (PVC) production at Dezhou Shihua Chemical (DSC). The subproject will demonstrate mercury-free PVC production technology, which is intended to replace current PVC production using mercuric chloride as catalyst.

3. Under the second subproject, greenhouse gas emission abatement and energy efficiency measures will be carried out at the Zhonghao Chenguang Research Institute of Chemical Industry (CGY). The subproject will consist of the following: (i) installation of two plasma incinerators at CGY to treat the fluoroform (HFC-23) emissions from fluoropolymer production; (ii) implementation of process optimization, automation, and supervisory control measures; (iii) equipment modernization; and (iv) waste heat recovery and reuse.

4. Both subprojects will involve existing facilities. No new infrastructure, such as factory buildings, will be constructed.

B. Risk Assessment (from the Aware™ Report)[1]

5. ***Dezhou Shihua Chemical*—**Overall risk rating: MEDIUM.

6. Categorical risks: Flooding (HIGH; see notes above); water scarcity (HIGH). The data suggest that the region where the subproject will be located could experience water stress sometime in the 2020s–2050s. High exposure from the Aware standpoint implies either extreme water stress or high seasonal temperatures coinciding with relatively low rainfall.

7. Comment: There is a need to examine the plant location vis-à-vis existing demarcated floodplains or zones of historical flooding to the extent that these can be identified.

[1] Aware™ is an online, climate risk screening tool, designed to help identify and understand the potential risks from climate change to companies and investments. The tool uses millions of global data points to support its risk screening methodology. It assesses climate risks based on the geographic location and basic project and project company information. Climate risks are classified as high, medium and low-level risks.

8. ***Zhonghao Chenguang Research Institute of Chemical Industry—***Overall risk rating: MEDIUM.

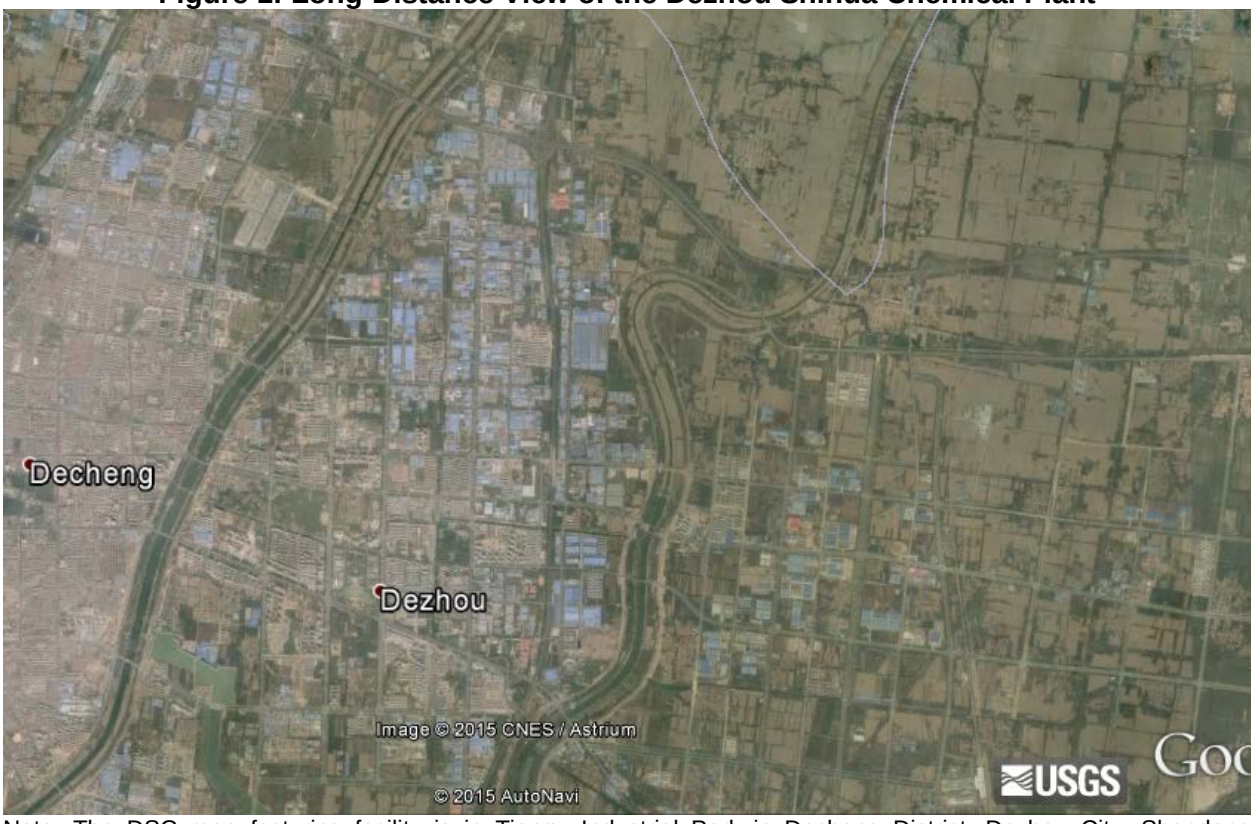
9. Categorical risks: Flooding (HIGH). High exposure from the Aware standpoint implies that between 1985 and 2010 there was more than one significant, large-scale flood event in the region. This assumption is based on post-processed data from the Dartmouth Flood Observatory at the University of Colorado.

10. Comment: There is a need to examine the plant location vis-à-vis existing demarcated floodplains or zones of historical flooding to the extent that these can be identified (same as for Dezhou Shihua Chemical case above).

C. Project Locations

Subproject 1: PVC Production Technology Transformation at Dezhou Shihua Chemical

Figure 1: Long-Distance View of the Dezhou Shihua Chemical Plant



Note: The DSC manufacturing facility is in Tianqu Industrial Park in Decheng District, Dezhou City, Shandong Province, 8 kilometers north of the city center.
Source: Google Earth.

11. **Comments**.

(i) Overall flat terrain, at about 20–25 meters above sea level (masl). River corridors seem confined between roadway embankments. Flood risk appears moderate at best, although upstream conditions must be ascertained, and the flood history of the area (if any) determined.

(ii) Closer inspection (Figure 2) indicates that the site is surrounded by roadways with embankments and appears not to be at immediate risk of riverine flooding from the river system to the east (slightly over 1 kilometer [km] away). Besides, the river (18 masl) appears to be behind levees of around 26–27 masl, although the site is at a lower elevation—roughly 18 masl (all elevations based on Google Earth and thus approximate).

(iii) Since toxic materials are also produced, and toxic wastes and by-products are stored and processed, on this site, many of the comments on subproject 2 are likewise applicable to this subproject.

Figure 2: Closer View of the Dezhou Shihua Chemical Plant

Source: Google Earth.

Subproject 2: Energy Efficiency and Emission Reduction Project at Zhonghao Chenguang Research Institute of Chemical Industry

Figure 3: Long-Distance View of the *Zhonghao Chenguang Research Institute of Chemical Industry* Plant

Note: The subproject will be located in Sichuan Province, southeast of Zigong City, at Fushun.
Source: Google Earth.

12. **Comments**.

(i) The general area of Fushun lies on an alluvial plain near the confluence of a major river (Tuojiang) and a minor tributary (Fuxi). Flooding is thus a hazard in principle. CGY is located immediately to the south of the location identified as Ganbangzi in Figure 3. The CGY manufacturing facility is on the northern bank of Tuojiang River, 1.4 km west of the closest border of the Fushun County urban area and 1.6 km away from Fuxi River to the west. The CGY plant covers about 200 hectares of land. Its approximate geographic coordinates are 29°N, 105°E. The site sits at 275–290 masl, above the river at 265 masl (see Figure 4). The riverbank is vegetated and there appears to be no flood control levee as such protecting this section. In the event of a large flood sufficient to inundate the plant site (or portions of it) and to mobilize toxics, it is not clear how these would be prevented from entering the main river.

(ii) Para. 175 of the Environmental Impact Assessment and Due Diligence Report states: "The Tuojiang River basin is a cut-off basin, within which the rainstorm center mostly lingers on the windward slopes on the boundary between upstream mountainous areas and the plain. Flood prone season is between June and September, focusing between July and August. Frequency of occurrence of serious flood is approximately once in around 22 to 24 years. According to the data of Lijiawan Hydrologic Station on the trunk stream of Tuojiang River within Fushun County, the average flow of Tuojiang River is 416 m^3/s [cubic meters per

second] and the maximum flow recorded was 12,000 m^3/s and the minimum flow was 15.6 m^3/s. Average river width during low water season is 180 m [meters], average depth is 9.4 m, and average gradient is 0.32%. As the CGY plant is located on the north bank of Tuojiang River with elevated terraces, no flood impact was recorded."

(iii) Para. 108 of the Report further states: "Hazardous wastes are properly stored in designated areas on the site. Some hazardous wastes are treated on site, and those that cannot be are collected and disposed of by licensed contractors." Storage sites are located in locations of the plant that minimize the vulnerability to flood inundation Therefore, risks that flooding would result in the mobilization of toxic materials that might then enter the watercourse are minimized. (Note: Para. 116 of the Report further clarifies that "Examples of design features noted in the visit were the containment area around the tanks to mitigate a potential spill, the water deluge system to prevent acid vapors from migrating away in the event of a release, and the nitrogen purge and vapor recovery systems used for bulk unloading." Also, para. 129 of the Report: "For some tank areas, such as the HF [hydrofluoric acid] tank and HCL [hydrochloric acid] tank, CGY has configured spare (reserve) tanks, cofferdams and emergency accident collecting pools to timely perform relative treatments in case of leakage occurrence. In major tank areas, there are a number of accident tanks with total capacity of 5,000 m^3; two emergency floodgates (cofferdams); and also 10 emergency accident collecting pools and three accident pools with combined volume of about 2,500 m^3.")

(iv) Para. 113 of the Report also provides the information on power supply: "Electricity is provided to CGY by the local utility, through five power substations at the CGY site perimeter."

Figure 4: Closer View of the Zhonghao Chenguang Research Institute of Chemical Industry Plant

Source: Google Earth.

13. **Overall Comments.** The following overall comments on the project are made in no particular order:

(i) As these are described as “high-risk chemical facilities,” climate risk assessment is not just an academic exercise. To the extent that project facilities involving toxic substances are placed at greater risk as a consequence of the likely impact of climate change, climate change–related risks must be understood and assessed to the extent feasible. However, the project will not primarily involve the development (financing) of any new infrastructure (e.g., buildings, access routes, energy grids); rather it will implement new technologies at existing facilities to reduce the risks to the environment and populations from the release of toxic substances.

(ii) Even in the absence of new infrastructure, there is a need to take the potential climate-related impact on the financed interventions into account. For example, if the intervention in question is the establishment of new plasma incinerators to treat emissions of hazardous or toxic materials, and if the loss of power to the incinerator creates a hazard in the form of unmediated emissions that might not otherwise occur, and further, if climate change impact might result in such interruptions (such as derating of transformers as a result of high temperatures, or flooding of substations), then a climate risk has been identified and should be addressed.

(iii) It is likely that the design lifetimes of the technologies financed by the project will not exceed 20 to 30 years. In part this is a general consideration applied to manufacturing technology subject to wear and a periodic replacement cycle. The implication insofar as climate change is concerned is that climate risk management activities are focused on the next 2 to 3 decades, so that the more extreme climate change scenarios (e.g., significant increases in the 20-, 50-, or 100-year flood), which are more likely to emerge late in the 21st century, are not necessarily directly applicable to this project. The historical behavior of flooding and extreme weather in the project areas is more relevant and suggestive of the conditions under which the projects will perform, with allowances for events near or possibly outside the envelope of historical climate.

(iv) The primary climate change risk identified by the Aware tool is a change in the frequency or magnitude of flooding in the project area (presumably an increase). Potentially at risk are the following components of the chemical manufacturing facility: (i) locations where hazardous materials are stored, handled, or processed; (ii) locations where hazardous waste products are stored, handled, or processed (e.g., waste lagoons); and (iii) power grid infrastructure, including substations and transformers. Technologies financed under the project do not themselves appear to present new risks, since they will be housed in existing structures and will not introduce new toxic substances or involve the movement or storage of such substances. However, it is useful to consider how these new technologies can be made increasingly resilient to the impact of flooding through such measures as (i) elevating critical equipment to reduce exposure to floodwaters; (ii) dry flood-proofing buildings with watertight windows and doors; (iii) making pumps submersible and protecting electrical equipment with watertight casings; (iv) constructing external flood barriers; and (v) providing backup power generation.

(v) If any chemical processes are temperature dependent, and in particular are characterized by critical temperature thresholds, redundant methods should be considered to ensure that elevated temperatures (which may become more

frequent and severe because of climate change) do not cause harmful releases in the event of power failure.