INNOVATIVE ENERGY EFFICIENCY AND EMISSION REDUCTION TECHNOLOGIES FOR THE FIRST BATCH

1. From more than 40 candidate subprojects, three representative ones with significant energy efficiency and emission reduction outcomes have been selected and evaluated for the first financing batch. Following evaluation, one out of the three has withdrawn from the investment program. The remaining two subprojects, chosen for first batch, contain or supplement large-scale applications of the state-of-the-art energy efficiency/renewable energy technologies with large demonstration effects. These subprojects are introduced below.

2. Golden Yimeng Group Inc. (Golden Yimeng) is one of the large chemical manufacturers in the People’s Republic of China (PRC). The company has two listed technologies in the 2008 National List of Priority Energy Saving Technologies\(^1\) which is proposed to be implemented as part of the project. The main engineering components proposed under the Golden Yimeng subproject include:

(i) Expansion of biogas capturing system for power generation and heat supply,
(ii) Utilization of biowaste as fuel and for production of organic fertilizers,
(iii) Waste heat recovery and solar thermal utilization,
(iv) Energy conservation in organic aldehydes systems, and  
(v) Energy conservation in acetate esters production systems.

3. The Golden Yimeng subproject will expand the biogas capturing system and the methane captured will be used to fuel two biogas boilers that are modified from the existing coal-fired boilers, to generate 39,744 megawatt-hour electricity per year. The exhausted low-pressure stream of 1,500,000 gigajoule heat value per annum will be sent to the industrial end users within the industrial park and domestic users in the adjacent communities.

4. The flue gas from the methane gas boilers will be used to dry the biowaste from the wastewater treatment system with high moisture contents. The dried sludge of over 40,000 ton per year (t/year) (dry weight) will then be used as boiler fuel, cofiring with coal used by the existing coal-fired boilers, which can replace coal consumption by 12,757 ton of standard coal equivalent per year (tsce/year). Meanwhile the biowaste from alcohol distillation system of approximately 50,000 t/year (dry weight) will be used to produce organic fertilizers.

5. A particular innovative feature is an integrated waste heat recovery and solar thermal system using solar parabolic concentrators that will recover the heat from warm wastewater to preheat the boiler feed water (approximately 220 t/hour) from approximately 40°C to 80°C; the solar thermal system will further raise the temperature to 140°C to feed the coal-fired boilers and to 104°C to feed the biogas boilers, respectively. The solar parabolic concentrators will be the first such large-scale industrial solar application in PRC and this component will result in savings of coal fuel by 12,732 tsce/yr.

6. Upgrades of organic aldehyde production systems include (i) retrofits of evaporation pans, heater exchangers and adsorption towers (with better heat transfer efficiency) and air blowers (with VFD motors); (ii) condensate recovery for softened water; (iii) heat recovery from

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\(^1\) It is a technology promotion list to recognize those technologies that are advanced as of 2008 to be promoted in the Eleventh Five-Year Plan in order to guide the industry to adopt advanced energy saving and energy efficiency equipments and/or technologies. The listing also indicates that the technologies have been assessed by a panel of national experts and therefore does not entail any technical risks.
process liquid/wastewater recirculation; and (iv) upgrade of oxidation furnace and associated offgas treatment system with better combustion and heat exchange efficiency. The proposed upgrades on the organic aldehydes production systems will result in savings of electricity by 1,666 megawatt-hour/year, mid-pressure saturated steam by 30,000 t/yr, low pressure superheat steam by 37,000 t/year, softened water by 36,060 cubic meter per year and other energy savings equivalent to 7,050 tsce/year.

7. The upgrade of the acetate ester system includes primarily upgrades of esterification column and dehydration tower, which will result in a savings of low pressure superhot steam by approximately 200,000 t/year.

8. A breakdown of the above energy saving and emission reduction figures is provided in the table.

9. According to the 2007 energy audit report, Golden Yimeng’s total fuel consumption in 2006 was 233,994 tsce. The projected annual energy savings resulted from the above proposed subproject components would be equivalent to 40% of the total fuel consumption in 2006.

### Energy Efficiency and Emission Reduction Estimates of Golden Yimeng Subproject Components

<table>
<thead>
<tr>
<th>Project Components</th>
<th>Total Engineering Costs</th>
<th>Net Energy Saving</th>
<th>Emission Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas power generation and heat supply</td>
<td>132.20</td>
<td>43,450</td>
<td>530,461</td>
</tr>
<tr>
<td>Heat recovery and solar thermal system</td>
<td>75.26</td>
<td>12,656</td>
<td>32,273</td>
</tr>
<tr>
<td>Sludge utilization</td>
<td>32.11</td>
<td>6,576</td>
<td>16,769</td>
</tr>
<tr>
<td>Upgrade of organic aldehyde and acetate ester systems</td>
<td>100.24</td>
<td>32,766</td>
<td>83,553</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339.81</strong></td>
<td><strong>95,448</strong></td>
<td><strong>663,056</strong></td>
</tr>
</tbody>
</table>

CO₂ = carbon dioxide, CNY = yuan, SO₂ = sulfur dioxide, t/yr = ton per year, tce/yr = ton of standard coal equivalent per year.

Sources: Feasibility study report and Asian Development Bank estimates.

10. Dongying Lufang Metallic Materials Co. Ltd. (Lufang) is one of the large copper producers in PRC. The flue gas heat recovery for power generation and heat recovery during sulfuric acid absorption by Lufang are listed technologies in the 2008 National List of Priority Energy Saving Technologies which is proposed to be implemented as part of the project. More importantly, the proposed work supplements and supports the full-scale zero coal copper ore smelting furnace—a new innovative technology known as oxygen bottom-blown smelting (OBBS) technology devised by Lufang and China Enfi Engineering Company. Enfi’s first industrial-scale trial of the OBBS technology, in copper production, was at the Tai Lung copper smelter plant in Vietnam, with a nominal processing capacity of 10,000 t/year. Lufang smelter was the first full-scale application of the OBBS technology in copper production. Through its first phase process of optimization, the smelting/reaction furnace of 50,000 t/year design capacity has now become a virtual zero coal process. Unlike other conventional blister copper smelting technologies which require a mix of 3%–6% coal or coke to the ores in the feedstock as fuel, the Enfi zero coal technology requires virtually no coal/coke mix with the ores in the feed stock, with the exception of the fire-up period. The second phase of OBBS furnace is the first zero coal blister copper smelting furnace in the world. Without the need for coal/coke addition as fuel, the zero coal technology reduces direct carbon dioxide (CO₂) emission by 110 to 220 kilogram (kg)
CO₂/t ore or 800 kg/t blister copper. As well, the elimination of coal addition will further reduce the oxygen demand which would consume electricity to generate, resulting in indirect reduction of CO₂ and sulfur dioxide (SO₂) emissions. This technology will set the new market entry standard for future copper smelters with profound impact on the energy efficiency and emission reduction efforts.

11. With the implementation of the proposed flue gas heat recovery and emission reduction subproject, the total energy savings are expected to reach 62,423 tsce/year. This would represent a recovery of over 45% of the overall energy inputs to the smelting plant. In addition, the electric power and steam generated through the waste heat recovery can also avoid CO₂ emission by 159,986 t/year and SO₂ emission by 318 t/year. This does not account for the CO₂ emission reduction that will result from the zero coal technology applied in the main production process. A flue gas desulphurization process is proposed which will see further reduction in SO₂ emission and will emit 544 t/year. The applicable national standard (GB16297-1996 Class II emission limit) is 871 t/year. Therefore, a reduction of 327 t/year can be achieved over the regulatory compliance limit. Overall SO₂ emission reduction resulting from the subproject is estimated to be 645 t/year.