Green and Low-Carbon Growth

Green development is one of the important dimensions of a company’s core competitiveness. In August 2011, Sinopec officially made green and low-carbon growth one of its corporate strategies.

Relying on technology innovation and application, we use less energy, give out less GHG, cause less impact on the environment, and make greener and cleaner products. It is our aspiration to develop into a resource-efficient and environment-friendly company.
4.1 Green Operation

As a responsible energy and petrochemical company, we pay great attention to environmental protection. With a clean management system covering the whole process from production to consumption, we keep striving to achieve green growth and contribute to clear waters, green land and a blue sky.

Sinopec's Whole Process Clean Management System

- **Comprehensive Utilization**
  - Byproducts
  - Massive reduction of NOx, CO, hydrocarbons and particles in car exhaust
  - Flue gas de-SOx and de-NOx
  - Waste water treated and recycled. Less discharge of COD, NHx and effluents
  - Industrial residue made harmless, reduced and reused
  - Massive reduction of NOx, CO, hydrocarbons and particles in car exhaust

- **Clean production**
  - Green process technologies applied to generate less or no pollutants
  - Hydro-desulfurization and Hydro-dearomatization technologies applied to produce clean fuels

- **Consumption**
  - Three wastes
  - Three wastes

In 2011, we signed responsibility documents of major pollutants discharge reduction target with the government and delegated the target among our subsidiaries. We also developed the 12th Five-Year Plan for Sinopec environmental protection work, which deploys key environment-related tasks in the future.

In 2011, we continued to improve environmental protection regulations and tighten environmental performance assessment. We carried out serious EIA for all projects, strictly followed the regulation that HSE facilities and the main project are synchronized in terms of design, construction and commissioning, and made major efforts in promoting clean production and comprehensive utilization of resources. Pollution control was intensified and positive outcome was achieved. Compared with last year, industrial effluent discharge dropped by 8.7%, on-spec rate of discharged waste water went up by 0.4 percentage points, and COD discharge fell by 16.9%. SO2, NOx and NHx emissions went down by 9.8%, 3.4% and 34.9% respectively.

<table>
<thead>
<tr>
<th>COD Discharge Reduction from 2009 to 2011</th>
<th>%</th>
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<tbody>
<tr>
<td>2009</td>
<td>3.58</td>
</tr>
<tr>
<td>2010</td>
<td>2.17</td>
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<tr>
<td>2011</td>
<td>16.90</td>
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<table>
<thead>
<tr>
<th>SO2 Emission Reduction from 2009 to 2011</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>13.97</td>
</tr>
<tr>
<td>2010</td>
<td>6.85</td>
</tr>
<tr>
<td>2011</td>
<td>9.80</td>
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<tr>
<th>NHx Emissions Reduction Compared with Last Year</th>
<th>%</th>
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<tbody>
<tr>
<td>2011</td>
<td>34.9%</td>
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<tr>
<th>NOx Emissions Reduction Compared with Last Year</th>
<th>%</th>
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<tbody>
<tr>
<td>2011</td>
<td>3.4%</td>
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</table>
Clean Production and Pollution Reduced from the Source

Sinopec lays particular emphasis on clean production in the whole process and strives to control formation of pollutants from the source.

We continued to tighten control of potential environmental hazards. In 2011, Sinopec invested RMB 425 million for 125 potential hazard control projects. Key projects are those that aim at controlling oily sand, waste water in oil and gas production, aquifer pollution, biochemical sludge/bottom sludge/top scum, air pollution, water body risk and at improving environment monitoring system.

We continued to recover gasoline vapor. In 2011, we added gasoline vapor recovery facilities in four oil tank depots and 313 service stations. By far, we have done the same to 41 oil tank depots and 2,961 service stations in Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang and Guangdong.

We intensified key technology R&D. We made a new round of efforts to integrate R&D capacities of the company, carried out four waste gas control projects and five flagship R&D projects focusing on waste water treatment. We made conspicuous progress in PO/SM waste gas control project. Odor control projects of refineries and chemical plants, FCC regenerator flue gas de-SOx, de-NOx, and dust removal projects and waste water control projects of key plants are going on very well.

In 2011, we started a new round of clean production inspection and assessment of production subsidiaries including six tier-2 subsidiaries like Sinopec Qingdao Oil Refining & Chemical Company. By the end of 2011, 21 refining and chemical subsidiaries, or 52.5% of total in Sinopec, passed the inspection.

Sinopec Guangzhou Petrochemical Credited as Contributor to Green Universiade

The 26th Universiade was held between 12 and 22 August 2011 in Shenzhen, Guangdong. During the Universiade, Sinopec Guangzhou Petrochemical ensured supply of clean oil products for Pearl River delta area and contributed to a Green Universiade by improving facility management, optimizing product slate and strengthening monitoring on environment-related facilities.

Facts and Figures of Clean Production from 2005 to 2011

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<table>
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<tr>
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<tbody>
<tr>
<td>Number of clean production plans</td>
<td>4,684</td>
</tr>
<tr>
<td>Investment deployed</td>
<td>RMB 1,434.64 million</td>
</tr>
<tr>
<td>Waste water reduced by</td>
<td>39,880 ktpa</td>
</tr>
<tr>
<td>COD in waste water reduced by</td>
<td>4,341 ktpa</td>
</tr>
<tr>
<td>Waste gas reduced by</td>
<td>871.3 million m³</td>
</tr>
<tr>
<td>SO₂ in waste gas reduced by</td>
<td>23,229 ktpa</td>
</tr>
<tr>
<td>Industrial residue reduced by</td>
<td>18,341 ktpa</td>
</tr>
</tbody>
</table>
Making Clean Products and Reducing Pollution in Consumption

We also pay high attention to making clean products, and discharging fewer pollutants in downstream business and consumption.

Steady improvement has been made in oil product quality upgrading. All gasoline products met GB III standards in 2010. Since July 1st, 2011, Sinopec has started to supply the diesel products on GB III standards.

Sinopec’s Environment-Friendly Rubber Opens up EU Market.

According to EU’s Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) effective in end 2006, oil extended rubber made in China was not allowed for export to EU market due to environmental reasons.

To retain the second largest market for tyres made in China, Sinopec took the following measures to guarantee supply of environment-friendly oil-extended SBR to major tyre producers.

On the one hand, Sinopec refineries and rubber plants imported environment-friendly rubber process oil from international market and carried out industrial production tests of rubber process oil.

On the other hand, production, marketing and R&D are well integrated and coordinated to make breakthroughs in environment-friendly aromatic oil processes and industrial production. In November 2010, we succeeded in producing environment-friendly aromatic rubber process oil and obtained the certification by authoritative institutions in April 2011.

We sold 10689 tons of environment-friendly oil extended rubber in 2011.

Three Wastes Treatment Improved and Emission/Discharge Standards Met

We attach great importance to the treatment of waste gas, waste water and industrial residue (three wastes), try our best to meet emission and discharge standards, and mitigate their impact upon the environment to the minimum.

In 2011, we set up process, equipment and environmental protection expert groups, who made EIA and follow-up assessment of many subsidiaries, helped them identify main problems and put forward solutions.

In June 2011, an environmental protection conference was organized and requirements were made in terms of meeting waste water discharge standards and disposal of process waste gas, dust and hazardous solid wastes.

Sinopec Qilu Company Directed 47 Local Plants to Meet Environmental Standards

On 28 September 2011, Waste Water Treatment Plant of Sinopec Qilu Company hit a historical high of 340 successive days of meeting discharge standards. 10% of the industrial effluents discharged by the company came from the adjacent 47 chemical plants.

Before that, the 47 plants were frequently given punitive warnings by local environmental protection authorities.

Since the second half of 2007, Qilu has started to collect and treat waste water generated by adjacent chemical plants, and made random inspection of the 47 plants, and provided visiting instruction and technical training on a regular basis. More investment was made to improve the facilities in the plant.

Zeng Shaohua, Vice President of Zibo Lingzhi Chemical Company, one of the 47 plants, said, "There were few cases of exceeding discharge standards since 2009. With the help of Sinopec Qilu Company’s technicians, we discharge much less waste water—from 2300 tons to 700 tons every month, and use much less water. We are now enjoying a much better environment."
Relying on technology improvement, Sinopec Tianjin Company is able to save a larger amount of water by treating more than ten million tons of waste water and producing 2.25 million tons of reused water. All oily waste water is reused to provide 140,000 tons of water for refining facilities every month. 80% of COD is removed with optimized anaerobic units that use new technologies.

With an associated gas collection, transportation and desulfurization system, Sinopec Northwest Oilfield Company is able to produce 400,000 m$^3$ of associated gas per day with H$_2$S content down to less than 20mg/m$^3$, produces high value-added LPG and stable light hydrocarbons, reduces discharge of pollutants, and helps to ensure clean waters and a blue sky for the Tarim River.

Holding a highly responsible attitude, Sinopec Zhongyuan Oilfield is devoted to a balance between land development and environmental protection. By means of advanced and environment-friendly drilling technologies and land rehabilitation technologies, there is less pollution caused to the soil in surface operations, and rehabilitation is timely made to the contaminated land. With strong awareness to preserve the environment, every employee is committed to being a messenger of green development who cares about the environment in his daily work.
4.2 Fighting against climate change

Climate change is a major global issue for all humankind. As a responsible energy and petrochemical company, Sinopec regards it as its due responsibility to fight against climate change. We make efforts to shift the pattern of growth, optimize energy structure, develop and utilize low-carbon energy resources and promote energy saving and consumption reduction. We are speeding up study on commercial test of CO2 recovering, in order to reduce GHG emissions and better prepare to combat climate change.

⑤ Industrial Restructuring and More Efficient Use of Energy Resources

We continued our efforts in industrial restructuring and integrating production capacities and operations. Energy and material consumption went down considerably and there were less CO2 emissions.

On the one hand, we increased and integrated production capacities by building up new facilities and expanding and upgrading existing ones. In 2011, the Changling Chemical revamping project came on stream. By the end of 2011, we have 10 1-MM tpa ethylene production sites.

On the other hand, we increased average production capacities and cut down consumption by phasing out small and inefficient capacities. From 2006 to 2011, we shut down and phased out small and less environment-friendly refining capacities by 16.2 million tpa. Dozens of small chemical facilities and oil-fired boilers were closed. Optimization and volume adjustment were made to more than 500 oil tank farms.

With the above parallel measures, average capacity of our refineries rose by 25.7% and that of ethylene facilities went up by 13.2% from 2006 to 2011.

⑥ Saving Energy and Cutting CO2 Emission

Saving energy is the most immediate and effective way to reduce CO2 emission at present. Giving priority to conservation, we try to develop into a resource-efficient enterprise.

For many years, while the production capacities kept growing, Sinopec achieved good results in energy saving and consumption cut with enhanced management, new technologies and equipment, and special emphasis on energy saving in production process. In 2011, energy intensity of refining and ethylene production went down respectively by 2.0% and 4.3%. We save 540,000 tons of standard coal equivalent, which equals cutting 1.33 million tons of CO2 emissions or planting 12 million trees (a thirty-year-old fir absorbs 111 kg of CO2 ).

In 2011, Refining Energy Intensity Dropped by 2.0%

In 2011, Ethylene Energy Intensity Dropped by 4.3%

In 2011, we saved standard coal equivalent (10,000 tons)

Equals Cutting CO2 Emissions (10,000 tons)

54

133

Equals Planting Trees

From 2006 to 2011, Average Capacity of Our Refineries Rose by 25.7%

From 2006 to 2011, Average Capacity of Ethylene Facilities Rose by 13.2%
We made important progress in water saving with measures for leak checking and fixing, condensate recovery, utilization of low temperature residual heat and reuse of waste water. In 2011, Sinopec continued to promote water conservation and emission reduction. Major indicators were included in economics accountability assessment. Compared with last year, industrial water withdrawal went down by 1.95%, and water withdrawal per tonne of crude oil processed dropped by 7.69%. In 2011, we saved a total of 19.95 million tons of water, which is 1.4 times of the volume of the West Lake (14.29 million m$^3$).

### Decrease of industrial water withdrawal in 2009-2011  \(\text{y-o-y, \%}\)

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>3.33</td>
<td>2.01</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1.95</td>
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### Water saved in 2009-2011 \(\text{ten thousand tons}\)

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tr>
<td></td>
<td>3,600</td>
<td>2,100</td>
<td>1,995</td>
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Sinopec Yangzi Company Fulfilled the Annual Target of Saving 200,000 Tons of Coal Equivalent in Advance.

Energy intensity is the most important factor in production, coming second only to feedstock. Through effective management and technology application, Sinopec Yangzi Company reduced both energy intensity and pollutant discharge and CO$_2$ emission.

The company saved up to more than 200,000 tons of standard coal equivalent, which equaled reducing 500,000 tons of CO$_2$ emission, meeting the year’s target three months ahead of schedule.


Sinopec is active in developing low-carbon energy and improving energy structure. A complete low-carbon energy business chain covering R&D, industrial production and marketing has taken shape. Our plan is to build up low-carbon energy capacities by 2020 that can supplement main business operations and contribute to long-term and sustainable development of the company.

We strive to increase natural gas production and facilitate LNG import. In 2011, we produced 15.6 billion m$^3$ of natural gas at home and abroad, signed new LNG procurement agreements totaling 4.3 million tpa, started construction of Shandong LNG project, and kicked off initial work of LNG projects in Guangxi, Tianjin, Lianyungang, Wenzhou and Huangmao Island.

We make great efforts in developing coal-bed methane (CBM) and shale gas. In 2011, we made firm progress in shale gas E&P, and fixed capacity building locations for CBM.

We devote major efforts in producing natural gas from coal. We are speeding up preliminary work for coal to natural gas and pipeline projects in Xinchang. We have also started the first phase of the coal-electric power-chemicals integrated project in Zhijin, Guizhou.

Bioethanol consumption and sales are expanding. In 2011, we used 910,000 tons of modified fuel ethanol and sold 9.1 million tons of ethanol gasoline.

Since November 2010, we have started pilot sales of B5 biodiesel in Chengmai County and Lingao County, Hainan Province. In 2011, we sold 4,000 tons of B5 biodiesel and used 200 tons of B100 biodiesel.

E-power service station. We plan to establish refilling and recharging service networks in 13 provinces and cities for both regular autos and electric autos. By far, we have built up 2 recharging stations in Beijing and Shenzhen, and 6 refilling and recharging demo stations in Shanghai and Anhui.
More Efforts in R&D to fight against the Climate Change

Our objective is to enhance our ability of low-carbon growth by reinforcing our mid-term and long-term strategic low-carbon technology preparation. We plan to focus on R&D of technologies that help with energy saving and efficiency improvement, development of renewable and alternative energy sources, emission control, treatment and utilization of GHG like CO₂ and CH₄, biological and engineering carbon sequestration, clean and efficient development and utilization of coal, oil and natural gas, CO₂ capturing and sequestration, CO₂ flooding, comprehensive utilization of high purity CO₂ and fuel production via microalgal CO₂ fixation.

Sinopec’s self-developed CO₂ capturing technologies account for 90% of the market shares in China. Following the successful start-up and operation of a 30 ktpta demo unit, we have developed CO₂ capturing process package up to 1 mtpa.

We also succeeded in test of CO₂ usage in enhanced oil recovery (EOR). Sinopec Shengli Oilfield has injected a total of 62,400 tons of liquefied CO₂ and enhanced oil recovery by 12,900 tons. The 100 ktpta CO₂ capturing project in the coal-fired power plant of Huaneng Shanghai Shidongkou Power Generation Company, of which we are the EPC contractor, have came on steam.

We will continue our efforts on CO₂ capturing, purification and application technologies, develop cost-effective supporting technologies, and build up 1 mtpa CO₂ capturing and application projects.

Low-Carbon Lifestyle

To preserve and ameliorate the environment is regarded by Sinopec as an important social responsibility and a major way to improve production and living conditions for employees. Aiming to build up a garden-like energy company, we motivate our staff to take part in activities for public good like national mandatory tree-planting campaign. In 2011, 520,000 person times in Sinopec took part in the campaign, planted 1.56 million trees, and thus 90% of our tree-planting obligations fulfilled.

We spread information about climate change among employees, consumers, suppliers, contractors and other stakeholders, calling for changes in mode of production, way of life and habit of consumption, and for stronger sense of social responsibility and keener awareness to protect the environment.

We only purchase materials and equipments in conformity with green, energy-saving and low-carbon standards. In this way, we are trying to lead our suppliers and contractors on the right track of green and low-carbon growth.
Conclusion

The concept of green and low-carbon growth is now deeply rooted in all Sinopec employees and reflected in their daily life. To be environment-friendly and low-carbon-oriented is our mission, responsibility and the cornerstone of balanced and sustainable development.

Many years of experience show that it is sound environment management that can win us new competitive edges and customers' trust, and secure a sustainable development in a complex and changing world.