in our manufacturing processes, and where chemicals must be used, to reduce the usage of hazardous chemicals. Among these programs is our focus on the usage and waste reduction of sulfuric acid. Another is our goal of using general diluted chemicals to substitute copper etching chemicals to lower impact on environment. We have also set a high priority on reducing the quantity of calcium fluoride sludge produced at wastewater treatment plants due to very limited number of landfills in Taiwan. This effort includes the separation and collection of higher concentrations of hydrofluoric acid for offsite recycling, thus reducing the quantity of calcium chloride and sodium hydroxide used for neutralization treatment at wastewater treatment plant. This recycling of used hydrofluoric acid is a world first and was jointly developed by TSMC and our supplier to make pure calcium fluoride used as a flux in the steel manufacturing process. We also plan to set up drying equipment at all sites to reach our target of reducing the weight and volume of sludge. In addition, we continuously develop knowledge with our suppliers to recycle our chemical wastes. Our suppliers have advanced recycling capabilities to reclaim and reuse CMP wastewater to reduce consumption of natural resources. In addition, the recycling of developer chemicals is also a major focus that will bring a substantial contribution to environment. We hope to make even more significant progress in the programs above in 2011.

TSMC Fabs in Taiwan Waste Generated

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical waste (Metric ton)</td>
<td>20,093</td>
<td>22,629</td>
<td>28,381</td>
<td>35,511</td>
<td>67,272</td>
</tr>
<tr>
<td>Solid waste (Metric ton)</td>
<td>14,530</td>
<td>15,196</td>
<td>14,628</td>
<td>13,594</td>
<td>20,908</td>
</tr>
<tr>
<td>Total waste quantity (Metric ton)</td>
<td>34,623</td>
<td>37,825</td>
<td>43,009</td>
<td>49,055</td>
<td>88,180</td>
</tr>
</tbody>
</table>

8.4 Green Building, Green Fab
The U.S. LEED and Taiwan EEWH
TSMC began a “Green Fab Program” in 2005 to improve energy efficiency in buildings and minimize damage to the environment. The standards are the U.S. Green Building Council’s Leadership in Energy and Environmental Design (known as LEED) certification, and Taiwan’s Ecology, Energy Saving, Waste Reduction, and Health (known as EEWH) certification. The intention of this program is to achieve certification by national and international green building standards for all new fabs.

Sharing Green Building and Green Fab Experience with External Parties
TSMC acquired LEED Gold and EEWH Diamond certification for its Fab 14 Phase 3 in 2008 and Fab 12 Phase 4 in 2009. TSMC believes that greater involvement by industrial enterprises in green buildings will lower operation costs and raise building performance. Therefore, in 2008 we held a “Green Forum” in 2008 on the “Present and Future of Green Factories”, and shared hands-on experience in obtaining our U.S. LEED certification and applying for Taiwan’s EEWH. TSMC also invited organizations including China Steel, AU Optronics (AUO), National Cheng Kung University (NCKU), National Taipei University of Technology (NTUT), and the Architecture and Building Research Institute (ABRI) of the Ministry of the Interior, to extend discussion of green building topics.

Furthermore, TSMC also worked with the International SEMATECH Manufacturing Initiative (ISMI) to publish the “Application Guide for the Leadership in Energy and Environmental Design Rating System in New Construction of Semiconductor Manufacturing Facilities” for semiconductor enterprises worldwide. TSMC presented our research on “Proposal For An Optimized LEED Green Fab Model for Semiconductors” in the 6th ISMI Symposium on Manufacturing Effectiveness to encourage other companies to participate the course.

Collaboration with Industry, Government and Academia – Promoting the Establishment of a “Green Factory” Standard
In 2009, TSMC proposed working with green building experts to draft guidelines for green industrial buildings in Taiwan, helping more domestic companies construct their own green factories and promote green manufacturing. ABRI gave its support to TSMC, The Southern Taiwan Science Park Administration, NCKU, NTUT, Delta Electronics, AUO, Chimei Optoelectronics and United Microelectronics Corp. in a joint initiative to establish a “Green Factory Standard”. In 2010, we also extended this program to work with the Ministry of Economic Affairs Industrial Development Bureau (IDB), NTUST and NCKU to establish a “Green Factory CDM (Clean Development Mechanism)” to provide a challenging, differentiated, and practical performance index that can be revised and applied to other industries.
Taiwan’s government recognized these efforts and agreed that collaboration between industry, government and academia is a good model and pledged to continue its support, with the hope of promoting this model to other industries to help the government reach national environmental goals. In 2010, the third committee meeting of Executive Yuan Vice Premier Eric Chu’s “Executive Yuan Carbon Emissions Reduction Committee” instructed government agencies to promote intelligent green buildings in the industrial and manufacturing sectors. Under these instructions, the “Green Factory Standard” and “Clean Manufacturing” evaluation systems were integrated with national policy and are now a promising part of Taiwan’s national energy conservation and carbon reduction programs. For this plan, TSMC and industrial partners continue to participate in this project through the Taiwan Semiconductor Industry Association. We expect to complete the “General Principles of Clean Production Assessment System” and “Semiconductor Clean Industry Association. We expect to complete the “General Principles of Clean Production Assessment System” and “Semiconductor Clean Production Assessment System” in 2011.

Introduction of TSMC’s Green Building
TSMC’s green fabs, Fab 14 Phase 3 and Fab 12 Phase 4, use innovative systems designs as well as energy and power-conserving technologies and equipment, and have reduced energy consumption to 20% below standards set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 90.1). TSMC promises to obtain green building certification for all new fabs, and will use the experience of green building guidelines to reduce energy consumption and carbon emissions for existing buildings.

The U.S. LEED and Taiwan’s EEWH are aimed at improving a site’s sustainability, enhancing resource recycling and water conservation, raising energy efficiency and reducing impact on the environment. TSMC has taken the following measures to meet various LEED and EEWH requirements:

- **Sustainable Site**: The Science Park’s existing detention ponds are integrated in our solution for stormwater runoff control. Particulates in stormwater are stored in the detention pond, preventing erosion and sedimentation in downstream waterways. This design controls post-development stormwater runoff control volume and maintains pre-development conditions. Rainwater retention tanks were set up to provide for landscape irrigation according to rainfall behavior and rainwater recovery volume, and white concrete tiles, which have high solar reflectance, are paved on the roof. All parking spaces are located in the basement, reducing the heat island effect caused by the hard paving, and conserving air-conditioning energy.

- **Energy and Atmosphere**: Energy consumption requirements were taken into account at the design stage for building envelope, refrigerating and air-conditioning systems and lighting systems. TSMC uses DOE2/eQUEST software, developed by the US Department of Energy, to simulate and analyze its energy consumption requirements for a typical design in TSMC’s new fabs.

- **Water Efficiency**: A rainwater recovery system was designed to provide for irrigation of landscape greenery, and water condensation from make-up air handling units accounts for remaining irrigation demand, eliminating tap water consumption. Twenty-five wastewater segregation designs for process water were adopted, and wastewater was recycled and reused through recovery systems to achieve a water recycling rate of 85%. Water-efficient equipment, verified with Water Conservation Marks and Environmental Protection Marks, are used throughout the plant. Water condensation from make-up air handling units is also recovered for toilet flushing and cooling tower water. Tap water consumption was reduced by 56%.

- **Construction Materials and Use of Local Resources**: Construction waste is classified, and 91% of the waste was recycled. Construction material used in the project contained 42% recycled materials. In addition, 60% of construction materials are local materials (materials evacuated or produced within 800km from the site), reducing transportation demand.

- **Indoor Environmental Quality**: Indoor Air Quality (IAQ) complies with the requirements of the ASHRAE 62.1 standard. Indoor carbon dioxide monitoring facilities were established, and when carbon dioxide concentration is above 1,000 ppm, the supply of fresh air is increased in order to maintain good indoor air quality. For hazardous gas or chemical storage areas, ventilation and negative pressure designs were enhanced, to ensure the safety of the staff. Measures were taken to prevent the diffusion of pollutants during construction, and the building was flushed out with fresh air before occupancy to ensure the air quality and the health of personnel.

- **Innovation and Design Process**: TSMC has introduced clean-air reclaim methods in its high-tech cleanroom for energy conservation that complies with the requirements of LEED’s green building rating system. Thirty percent of reclaimed air is currently used in secondary cleanrooms, and air reclaim systems has are now a typical design in TSMC’s new fabs.

Above that, TSMC implements the following guidelines:

- **Building Energy Model simulation and conservation analysis**
- **Vegetated roofs and use of high-reflectance roofing materials**
- **Use of glass curtain walls, evaluation of sunlight and heat transmission for energy savings**
- **Use of daylight and energy-saving lighting**
- **Recycling and reusing low-temperature condensed water for non-clean room air conditioning systems, and reusing energy from reheating coils**
Integrating renewable energies
91% recycling ratio of construction waste
Air reclaim system installation from clean room general exhaust to degrading area
Reusing energy recycled from exhaust of volatile organic compounds
Recycling water from rainfall

Over forty groups and as many as 1,800 visitors from industry, government, academia and the community have contacted TSMC to learn more about our green factory practices and conduct mutual technical exchange. TSMC believes if a thing is worth doing, it’s worth doing well in order to protect our planet from exhaustion.

8.5 Environmental Management and Green Promotion

8.5.1 Environmental Management System and Compliance Record

Environmental Management Vision
TSMC aims to be a world-class company in environmental protection. Our environmental performance complies with legal requirements and also measures up to recognized international practices.

ESH Policy, Goals and Strategies
In 2010, our ESH policy was renewed and endorsed by Chairman and Chief Executive Officer Dr. Morris Chang. The policy aims to reach the goals of “sustainable development”, and to make TSMC a world-class company in environmental management.

Our strategies for reaching these goals are to: comply with regulations, strengthen recycling and pollution prevention, manage environmental risks, instill environmental protection culture, build a green supply chain, and fulfill our related corporate social responsibilities. We implement environmental management in our manufacturing sites internally but also are responsible for supporting our suppliers’ environmental management externally. We also believe that our communication and cooperation across industry, academia, and government are essential parts of our environmental management, which help us to improve our understanding of stakeholder perceptions and contribute to our sustainability investment programs.

Recognition for Our Environmental Performances
In 2010, TSMC was honored to be included in the Dow Jones Sustainability Index (DJSI) for the tenth consecutive year, and recognized as DJSI’s worldwide leader in the semiconductor sector. We received the best score in the “Environmental Dimension”.

Connection between Corporate Environmental Protection and Social Investment
TSMC Chairman and CEO Dr. Morris Chang believes that a corporation’s most important responsibility to society is to help bring about healthy and positive changes. We bring our successful environmental protection experiences to society and our suppliers through participating into external initiatives across our supply chain, industry, academia, and government. We actively find opportunities for environmental improvement and provide solutions. We believe our contribution can benefit more workers in the industry as well as our living environment.

Environmental Management System
TSMC environmental management organization consists of the central planning unit, the Operational Organization Technical Board, and the designated departments in each manufacturing facilities. These organizations work together collaboratively with clearly defined responsibilities.

We use ISO 14001 and QC 080000 standards to manage environmental performance at all our manufacturing facilities. It is mandatory for all new manufacturing facilities, including LED and solar energy facilities, to receive these certifications within 18 months of installing the first manufacturing equipment.

To achieve our environmental targets, we focus on:
- Air and water pollution prevention and control
- Waste reduction and recycling
- Greenhouse gas reduction (energy efficiency and perfluorinated compounds emission reduction)
- Resource conservation (water savings and chemical substances use reduction)
- Energy-saving products and use restriction of hazardous substances

To sustainably mitigate enterprise risks and to fulfill our corporate social responsibilities, we also collaborate with our suppliers proactively on managing global ESH risks identified in the company and work towards supply chain sustainability, including:
- Carbon footprinting
- Water footprinting
- Conflict Minerals management
- Hazardous substance restriction management

Information on TSMC supply chain sustainability management can found in Chapter 6 of this report.

Environmental Accounting
Environmental accounting categorizes a company’s environmental costs, and is useful in implementing cost-efficient environmental programs and aiding external communication about environmental efforts.