MOEA

Overview and Case Studies on Green Factory in R.O.C. 2013

APO Center of Excellence on Green Productivity

Center of Excellence on Green Productivity
Asian Productivity Organization

About the APO

The Asian Productivity Organization (APO) is a non-profit, non-political international partnership of Asian countries established by its member countries to provide technical and management service to industrial, agricultural and service sectors in order to promote economic prosperity and improve the living standards of people living in those countries.

The APO was established in Tokyo on May 11, 1961. The organization currently includes twenty member countries: Bangladesh, Cambodia, Republic of China(ROC), Hong Kong, Fiji, India, Indonesia, Iran, Japan, Korea, Laos, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam (Hong Kong 1997 suspension). Member countries are represented through each country's National Productivity Organization (NPO). The ROC representatives participate in APO projects through China Productivity Center (CPC).

About the APO COE GP

In 2013 the Asian Productivity Organization established the Center of Excellence on Green Productivity (APO COE GP) in ROC. ROC is a founding member of APO and has been pursuing success in the field of green productivity for a long time. The Government of ROC commits to share with member countries in the pursuit of this aspiration and would like to be a catalyst through hosting the APO COEGP.

We look forward to using this platform to share ROC's experience, contribute to the green growth of other member countries, promote regional innovation and sustainable development, and jointly with member countries to enhance green productivity and competitiveness.

The APO Center of Excellence will ensure ROC's long-term cooperation with member countries in APO projects and domestic and foreign investment experts. Through training exercises and benchmarking visit exchanges, APO will assist Member Countries in enhancing green productivity and innovation to create a sustainable green economy.

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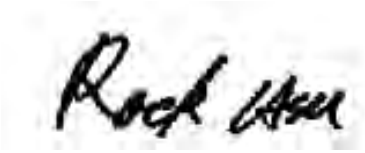
Foreword

The 55th session of the Asian Productivity Organization (APO) Governing Body Meeting in Tokyo in May 2013 approved the establishment of the APO Center of Excellence (COE) on Green Productivity in the Republic of China. Managed by the China Productivity Center, this center supports the APO in promoting and implementing related projects and is an example of the importance of the Green Productivity issue across the world.

At a time when environmental awareness is becoming increasingly important and consumers favor environmentally friendly products and services, this manual looks at ways to support APO member countries in the implementation of GP models in the fields of Resource Recycling, Green Energy, Green Factory and Ecological Agriculture Innovation, including the diffusion of related tools and techniques for GP models.

I would like to take this opportunity to thank the APO and the local implementing organizations for their hard work in making this manual available. My special thanks also go to the R.O.C. government's Ministry of Economic Affairs, Ministry of Foreign Affairs, Council of Agriculture and Environmental Protection Administration for their guidance and support.

The implementation of the COE GP plan is of great significance in terms of the effectiveness of industrial upgrading and international linkage. We hope to use this opportunity to share the results of the promotion of Green Productivity and to promote the sharing of knowledge and cooperation opportunities. It is hoped that through close interaction with APO members, all stakeholders worldwide will jointly improve Green Productivity in the Asia-Pacific region.



Mr. Sheng-Hsiung Hsu
December 15, 2013
Chairman of the APO Center of Excellence on Green Productivity Advisory Committee
APO Director for Republic of China (R.O.C.)
Chairman of China Productivity Center

Message

Against simmering concerns over climate change and energy resources, the world is being driven to go green. Governments across the world now promote low-carbon economies and industrial upgrades while fine-tuning domestic energy and trade policy decisions. It remains to be seen how the world facilitates the synergy of industrial growth, improvements in entrepreneurship and leverages competition in the name of sustainable development.

As one of the Asian Productivity Organization (APO) founding members, the Republic of China (R.O.C.) is active in relevant events and has witnessed the socioeconomic development of member countries for five decades. The APO Center of Excellence (COE) on Green Productivity (GP) symbolizes the arrival of a new era in green technology, one in which R.O.C. and other APO members will play key roles in the green economic development of the Asia-Pacific region.

The Industrial Development Bureau (IDB) is proud to have received the affirmation of the APO and its members by having the APO COE GP established in R.O.C. and has given its full support. We aim to use this platform to engage in close cooperation with the APO Secretariat and APO members, especially in the fields of Resource Recycling, Green Energy, Green Factory and Eco-Agriculture. It is also hoped that these publications encourage businesses worldwide to work together to promote green productivity for future sustainable development.

We would like to express our sincere thanks to everyone who has been involved in creating this manual and we appreciate the invaluable support from APO and R.O.C.'s cross governments. In the near future, the IDB looks forward to bridging the cooperation opportunities with member countries and working closely with industry to jointly promote green productivity for industrial development.

Industrial Development Bureau
Ministry of Economic Affairs, R.O.C.
December 15, 2013

Acknowledgments

This manual was made possible by the vision of individuals in both the public and private sectors who recognize the importance of Green Factory development in the emerging economies of Asia. In particular, we would like to express our deepest gratitude to the following corporations and organizations that have assisted in editing the case studies in this manual: Advanced International Multitech, AU Optronics, Champion Building Materials, Delta Group, Eternal Chemical, Everest Textiles, Formosa Plastics Group, Minnesota Mining and Manufacturing Company, MitraStar Technology Corporation, LCY Chemical Corporation, Qisda Corporation, Unimicron Technology, Taiwan Semiconductor Manufacturing Company Limited, The Dow Chemical Company and United Microelectronics Corporation. We would also like to thank those who supported on this manual, Ms. Christine Chiang, Dr. Oliver Hao, Ms. Yi-hua Tang and Ms. Nelly Chen.

Asian Productivity Organization, China Productivity Center and Foundation of Taiwan Industry Service co-hosted the Workshop on Development of Model Project for Green Productivity in Taipei on Nov. 4-8, 2013. The presentations and insights from the workshop have been invaluable to this project. We are also grateful to all the foreign and local speakers who contributed to the discussions.

It is with great pleasure that we publish this Green Productivity manual as tangible representations of the continuing concerted efforts of the Asia-Pacific region to contribute to more sustainable development by promoting the concept of green technology and productivity.

1. Introduction

The Republic of China (hereafter "R.O.C.") is recognized as a global leader in sustainable development and has been awarded the honor of hosting the Center for Excellence (COE) on Green Productivity (GP) by the Asian Productivity Organization (APO). The COE on GP was launched in June 2013 with the mission of enhancing, demonstrating and sharing with other APO member countries the experience of the R.O.C. on GP. In order to fulfill this goal, a series of activities including workshop learning, dispatch of expert delegates and research have been and will be implemented from 2013 to 2015.

"The Overview and Case Studies" in R.O.C. series manuals contain technological information and applications of four separate themes: Resource Recycling, Green Energy, Green Factory and Agricultural Innovation. The manual includes the global situation, technological development and corresponding policies of the individual themes. The 2013 manual is based on independent study by leading research institutes of R.O.C. The case studies therein demonstrate the best practices on policy implementation and technology application of public and private establishments of R.O.C.

With the publication of the 2013 "Overview and Case Studies" manual on Green Factory, COE on GP wishes to convey its utmost sincerity in leading the international community toward a more productive and sustainable future.

2. Global Situation and Trend on Green Factory

With the increasing public awareness of environmental protection, sustainability and corporate responsibility in recent years, more and more local and oversea organizations have published or are developing their own procurement policies with regard to environment protection as well as ethical code of conduct. These organizations often include national and local governments, public sector institutions, non-profit organizations, and most of all many large businesses and multinational enterprises.

The environmental protection issues were usually subject to the end-of-pipe treatment in the past. However, following the rise of technology development and environmental consciousness, manufactures start thinking the environmental issues from life cycle perspective and achieve the maximum benefit in terms of business, society and environment via reduction from the source and cleaner design to decrease consequent costs of treatment.

This environmental protection trend results from the development and international environmental standards, in which the end-of-pipe treatment standards in the past had been replaced by the ecological design related standards. With a series of influential international legislations instituted in the last decade, eg., European Union (EU) Restriction of Hazardous Substances (RoHS), P.R.C. RoHS, EU Registration Evaluation and Authorization of Chemicals/Energy-related Product (REACH/ErP) and US The Consumer Product Safety Improvement Act (CPSIA), governments, non-governmental organizations, media and the general public have paid close attention to the environmental sustainability issues related to the industries, specially electronic and electrical industries and large multinational corporations. In this connection, despite higher product premium cost and lack of uniform selection criteria for various types of product, many large organizations are quickly adopting the concept of environmental sustainability into their business and daily purchasing activities.

Through green purchasing, manufacturers can not only better achieve compliance to mandatory regulations, build up positive public image, reduce environmental footprint, assist development of local community, but also gain tangible benefit in terms of business bottom-line. For example, eliminating toxins or increasing recyclable contents in a product may lower the fees related to end-of-life product recycling and disposition. In additional, ethical treatment to employees, business partners and other stakeholders can help cooperation and reduce business risk.

To fulfill the global trend on Green Procurement, the “Green Factory Label” innovated and developed in R.O.C. emerges. It encourages industries to reconstruct the plants to green buildings and promotes conservation of energy resources, green manufacturing process, pollution controls, eco-design, green management and social responsibility. The “Green Building” and “Cleaner Production” are integrated to take both environmental protection and sustainable industrial development into consideration. Refer to Figure 2-1 for trends and challenges of sustainable development

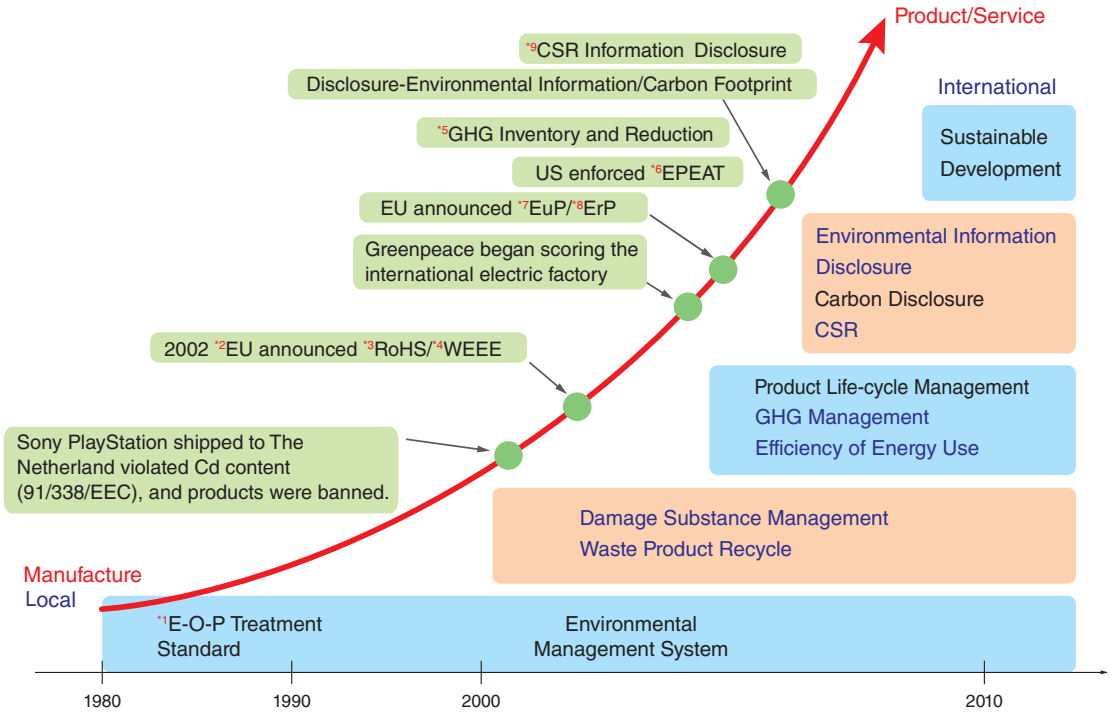


Figure 2-1: Trends and Challenges of Sustainable Development

(Source: FTIS compilation)

*1 E-O-P: End-of-Pipe
*2 EU: European Union
*3 RoHS: Restriction of Hazardous Substances Directive
*4 WEEE: Waste Electrical and Electronic Equipment
*5 GHG: Greenhouse Gas
*6 EPEAT: Electronic Product Environmental Assessment Tool
*7 EuP: Energy Using Product
*8 ErP: Energy Related Product
*9 CSR: Corporate Social Responsibility

2.1 Cleaner Production

In recent years, the environmental management trend has been converted from original administrative control of “end-of-pipe treatment” to present “source control”. Moving forward, it will be headed to Cleaner Production and Industrial Ecology such as low-carbon economics and eco-resources recycling.

In 1997, the United Nations Environment Programme (UNEP) delineated the latest definition for Cleaner Production as “the continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment”. Generally speaking, Cleaner Production mainly comprises of the three aspects of processes, products, and services.

The current Cleaner Production Evaluation System is founded upon the definitions discussed earlier. At the same time, it is also created after consulting the environmental performance evaluation criteria of the ISO 14030 environmental management standard (EMS). P.R.C.’s Cleaner Production Evaluation Index System for the Global Reporting Initiatives G3 Guidelines, along with other international standards, regulations and stipulations.

2.2 Green Building

The green building holds the sustainable environmental concept, such as resources saving and pollution control, use of recycled materials, and design for the entire life cycle of building from planning, construction, use, maintenance to abandon and demolishing to reduce the impact of building to environment.

Over 26 green sustainable assessments currently applied to buildings worldwide, including the first green building assessment - Building Research Establishment Environmental Assessment Method (BREEAM) proposed by England in 1990, the Leadership in Energy & Environmental Design (LEED) established by America in 1996, Green Building Tool (GBTool) of Canada in 1998, green building assessment - Ecology, Energy Saving, Waste Reduction and Health (EEWH) established by R.O.C. in 1999, Comprehensive Assessment System for Built Environment Efficiency (CASBEE) of Japan in 2001, US Energy Star in 2000, Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB)- German Sustainable Building Certificate (GSBC) in 2007, National Australian Built Environment Rating System (NABERS) of Australia in 2008, EcoProfile of Norway in 2011, CECALE of France in 2007, Korea Green Building Certification (KGBC) of Korea in 2000, The Hong Kong Building Environmental Assessment Method (HK-BEAM) in 2007, Green Olympic Building Assessment System (GOBAS) of P.R.C. initiated in 2002, etc. Refer to Table 2-1 for the green building assessment system in the different countries.

Region	Country	Assessment System
Europe	UK	BREEAM
	France	HQE CECALE
	Germany	DGNB LNB
	Italy	Protocollo ITACA
	Netherlarnds	Eco Quantum
	Norway	Eco Profile
	Finland	Pronis E
	Sweden	Eco Effect
	Russia	LEED-Russia
Oceania	Australia	Green Star NABERS
	New Zealand	Green Star-NZ
America	US	LEED Energy Star Green Globe
	Canada	LEED-Canada BREEAM-Canada Green Globe GBTool
	Mexico	SICES
	Barazil	LEED-Brazil GBTool
Africa	South Africa	Green Star SBAT
Asia	Japan	CASBEE
	Singapore	Green Mark
	Korea	CBCS KGBC GBTool
	Hong Kong	HK-BREEAM CEPAS
	P. R. C.	GBEL
	R. O. C.	EEWH

Table 2-1 Green Building Assessment System in Different Countries

(Source: Tseng , 2011)

The Earth Summit held by United Nations (UN) at Rio De Janeiro in 1992 not only announced the coming of green building generation allowing the green building gradually to become sustainable building internationally, but also released The United Nations Framework Convention on Climate Change (UNFCC) as the fundamental law of Clean Development Mechanism (CDM). Therefore, the "Green Building" and "Cleaner Production" with pollution prevention concept have become the issues drawing continuous attentions internationally. Refer to Figure 2-2 for the development of international green issue in manufacture industry.

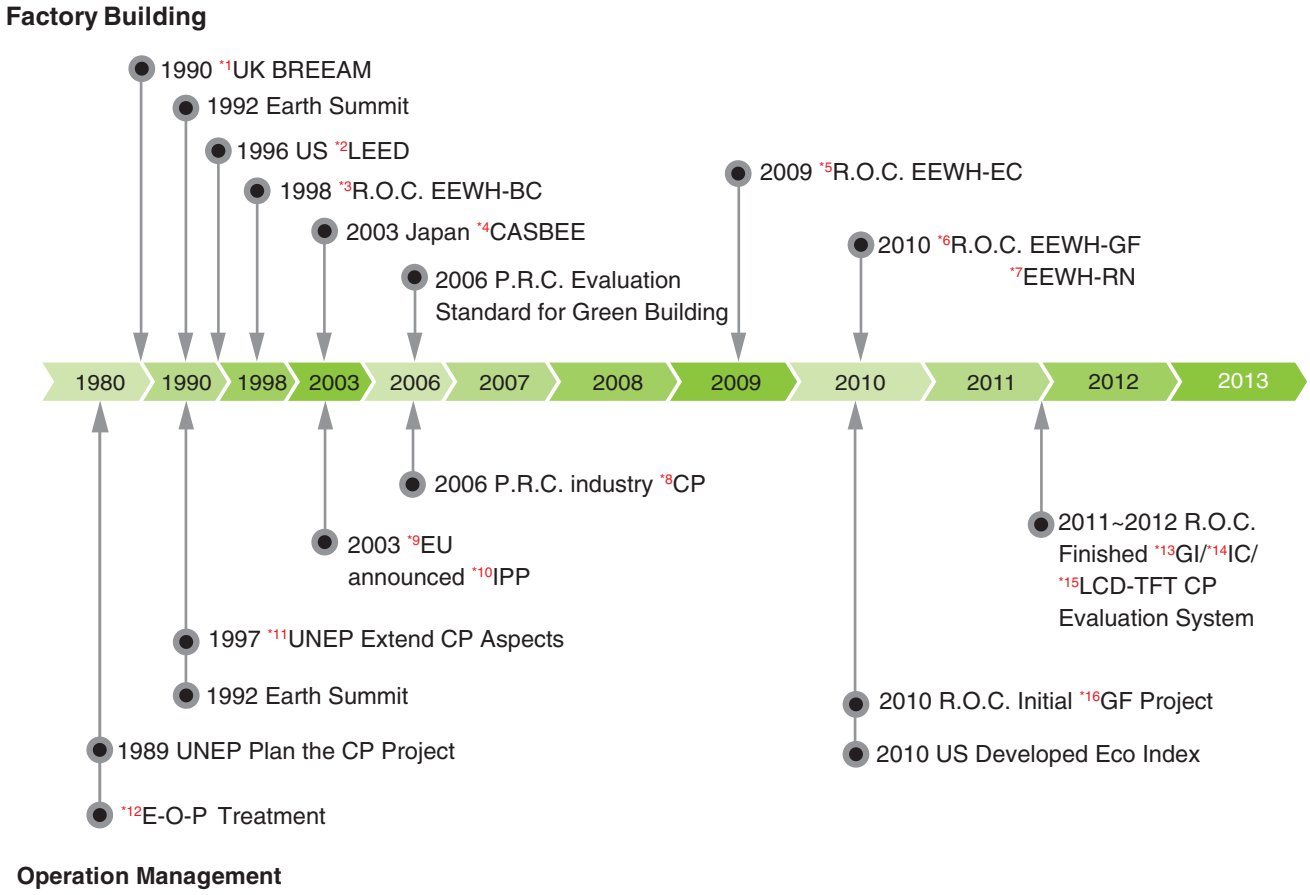


Figure 2-2 The Development of International Green Issue in Manufacture Industry

(Source: FTIS compilation)

*1 UK: United Kingdom
*2 LEED: Leadership in Energy & Environmental Design
*3 EEWH-BC: Ecology, Energy Saving, Waste Reduction and Health – Basic Version
*4 CASBEE: Comprehensive Assessment System for Built Environment Efficiency
*5 EEWH-EC: Ecology, Energy Saving, Waste Reduction and Health – Eco-Community
*6 EEWH-GF: Ecology, Energy Saving, Waste Reduction and Health – Green Factory
*7 EEWH-RN: Ecology, Energy Saving, Waste Reduction and Health – Building Renovation
*8 CP: Cleaner Production
*9 EU: European Union
*10 IPP: Integrated Product Policy
*11 UNEP: United Nations Environment Program
*12 E-O-P: End-of-Pipe
*13 GI: General Industry
*14 IC: Integrated Circuit
*15 LCD-TFT: Liquid Crystal Display - Thin Film Transistor
*16 GF: Green Factory

3. Understanding R.O.C. Green Factory Expectation

R.O.C. initiatively integrated Green Building and Cleaner Production promoting the voluntary Green Factory Label in 2011. Companies are from then on encouraged to obtain certifications of Green Building and Cleaner Production to substantiate their management perspectives on factory buildings and production operation. The requirement includes conservation of energy resources, green manufacturing process/product/service, green management and social responsibility.

R.O.C. expects to conform to international fashion of environment and takes the lead of green factory building in the hopes of achieving the above noble goals. Such initiatives of Cleaner Production will facilitate the realization of industrial upgrade and transformation, as shown in Figure 3-1.

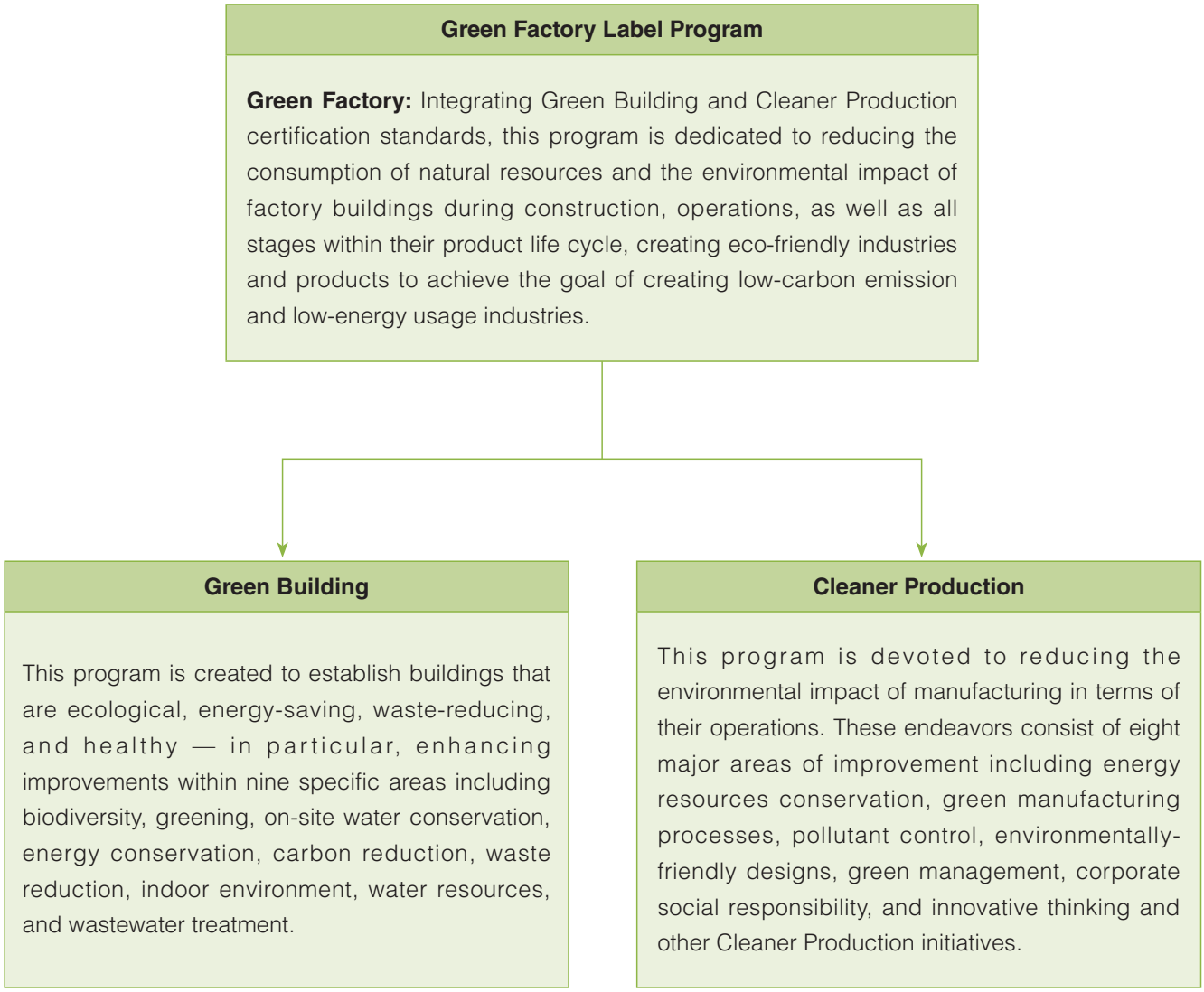


Figure 3-1: R.O.C.'s Green Factory Framework

(Source: Industrial Development Bureau, Ministry of Economic Affairs, R.O.C., 2011)

4. Key Elements of R.O.C. Green Factory Requirement

4.1 Green Building

The Green Building certification system was launched in 1999. It is founded on EEWH (Ecology, Energy Saving, Waste Reduction and Health) which is an unprecedented evaluation system of energy saving evaluation exclusively designed for sub-tropical architecture and also the first Green Building valuation system in Asia. The 4-in-1 system provides instructions in different construction phases, including design, construction, use, maintenance, and demolition of buildings, aiming at energy saving, resource reservation, reduction of waste and pollution. Table 4-1 demonstrates details of the EEWH framework.

Green Building	
Ecology	Greenery
	Water conservation
Energy Saving	Energy saving
	Green transportation
	Renewable energy
Waste Reduction	Green architecture
	Construction pollution
	Water resource indexes
	Household sewage and waste indexes
Health	Indoor air quality
	Acoustics
	Illumination
	Ventilation
	Indoor finishing building materials
	Employee health & fitness indexes
	Remedies

Table 4-1: R.O.C.'s Green Building Label Framework

(Source: Architecture and Building Research Institute, Ministry of the Interior, R.O.C., 2010)

4.2 Cleaner Production

The Green Factory is a system that adopts the official definition of Cleaner Production by UNEP as its own, encompassing international environment standards, regulations, and sustainable development trends.

According to UNEP the last definition for Cleaner Production is defined as "the continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to human and the environment". Generally speaking, Cleaner Production mainly comprises of the three aspects of processes, products, and services, as explained below:

- Processes: Pairing low-hazardous raw materials with waste-minimization production and high-efficiency manufacturing facilities, the overall process is intended to decrease various kinds of harmful effects along with destructive intermediate products in the course of production and to reduce the amount of waste and toxicity in order to achieve optimal utilization of energy resources.
- Products: Adverse effects on and dangers to the ecological environment resulting from the creation and usage of products should be diminished as much as possible. After losing their functionalities, products should be easily recoverable, recyclable, and reusable. At the same time, the complete product life cycle (from research and development, planning, design, raw material processing, creation, usage and eventual disposal) must be given serious consideration, adopting various essential measures for each life cycle stage, thus consuming the least amount of natural resources and energy resources throughout the entire product life cycle.

- Services: Companies should take environmental factors into account by incorporating them into the planning, designing, and offering stages of their services, ultimately reducing environmental harms generated as a result of offering the services.

R.O.C. establishes Cleaner Production regime on the basis of the above dimensions, applicable international environmental standards, regulations, and sustainable development trends. It leads factories to navigate their efforts towards Cleaner Production on the basis of four indexes of factory operation as shown below. Table 4-2 shows the essence of Cleaner Production.

Production and Manufacturing
Conservation of Energy Resources
• Reducing the volume of industrial waste generated and greenhouse gas emissions. • Reducing the use of raw materials and water resources. • Improving energy efficiency and increasing energy recovery rate. • Improving recycling rate of raw material, industrial waste and wastewater.
Green Manufacturing Process
• Improving production efficiency of manufacturing process • Developing the technology of Cleaner Production in manufacturing process
Pollution Controls and End-of-Pipe Treatment Processes
• Adopting the proper method of the industrial waste treatment. • Improving end-of-pipe facility/equipment capacity. • Establishing best procedures for handling equipment malfunctions.
Eco-Design
Eco-friendly Design
• Conducting the concept of material-saving and designs, energy-saving designs, as well as design for disassembly parts, waste reduction and recyclable scheme.
Green Management and Corporate Social Responsibility
Green Management
• Using the concept of controlling hazardous substances, international certifications and greenhouse gas management systems. • Emphasizing communication with stakeholders as well as green supply chain management and following green procurement.
Corporate Social Responsibility
• Improving employee working environment. • Developing and disclosing of sustainability information • Sharing green experiences and results.
Innovative Thinking
Innovative Thinking
• Sharing experiences of the innovative practices.

Table 4-2: R.O.C.'s Cleaner Production Framework

(Source: Industrial Development Bureau, Ministry of Economic Affairs, R.O.C., 2011)

5. Case Studies

5.1 Ecology

A green building is a structure that is designed to create and sustain mutually beneficial relationships with all of the elements of its local ecology. Green building accentuates many dimensions of ecology to preserve biodiversity and water resources, including community greenery, soil retention, holding basins, ecological water systems, ecological slopes, ecological fences, porous settings, and infiltration pavement on top of greenery; all comparable with artificial and natural surroundings. Employees and visitors are exposed to a comfort and health place that is evergreen.

Project: On-Site Greenery Planning
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

UMC has devised two detention basins as an extension from an adjacent spillway for providing scenic view and emergency use of water. In addition, detention basins may conserve rainfall as recycled water for plants watering. Originally grown on the facility were plants such as Flame Gold-rain trees, *Cyclobalanopsis glauca, Lantana montevidensis* to attract birds and butterflies for both ecological and beautification purposes. Additional plants attracting honey bees and birds were also planted, e.g., Da-Ann Hygrophila, lotus, blood-flower milkweed, *Eupatorium clematideum var. gracillimum*, and *Gymnocoronis*.

The workplace at UMC is also directed towards nature with artificial garden soil retention, meadow slopes for natural water infiltration, substitution of tile pavement with better water permeability for asphalt concrete pavement, on-site greenery and water conservation programs.

UMC On-Site Greenery
(Source: Green Factory Label, 2013)

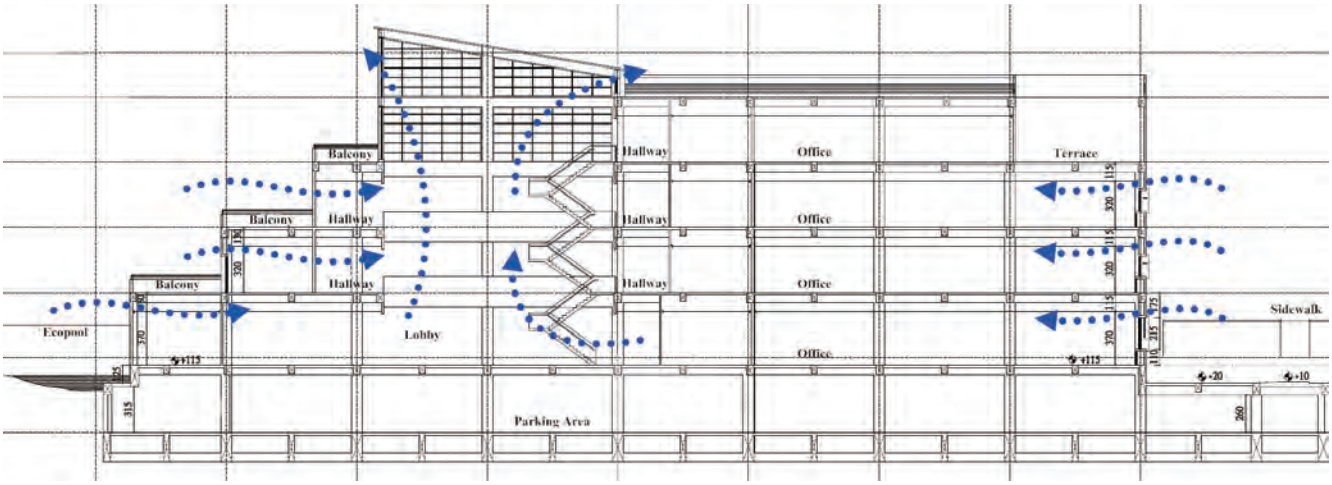
5.2 Energy Saving

The efficiency of energy consumption reduction may be defined in architectural envelope, air conditioning and illumination. The envelope of an edifice can be enhanced by improving the heat insulation function of the rooftop, windows and out walls. The initial stage of architectural design is centered upon climate tuning, reducing waste of air conditioning consumption by substituting high-efficiency lamps and control systems. In addition, the plant also establishes renewable energy sources to save energy.

(1) Case of Micro-Climate Architecture Design

Project: Establishment of Buoyancy-Driven Ventilation Tower for Efficient Air Conditioning
Company: Delta Group (Delta)/Electricity Facilities Manufacturer

Delta uses the natural ventilation by setting a buoyancy-driven ventilation tower, introducing warm air on the rooftop to trigger air infiltration by indoor-outdoor differences in temperatures and wind speeds. This results from good exchange of indoor and outdoor air, leaving greater workplace air quality and reducing energy consumption due to efficient air conditioning



Delta Buoyancy-Driven Ventilation Tower

Tips: Natural ventilation can be achieved in two ways: wind pressure and buoyancy. The former allows exchange of indoor air with outdoor through difference of wind pressure as a result of different speeds of wind flow, while the latter facilitates vertical flow and circulation by means of temperature differences between indoors and outdoors.

(Source: Green Factory Label, 2013)

(2) Case of Envelope Buildings Design

Project: Reduction of Energy Consumption Through Window Design
Company: The Dow Chemical Company (DOW)/Chemical Manufacturer

Thermal passage through sash window accounts for the main energy consumption in a building. Dow adopts low-emissivity (Low-E) glass panes to minimize the passage of indoor heat to outdoors to achieve energy savings. The Low-E glass panes are affixed in casement windows that swing outward to allow natural ventilation.

DOW Low-E Glasss

DOW Out-Pushing Windows

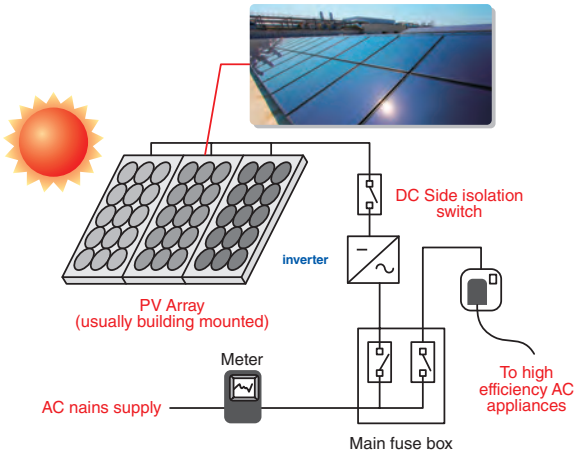
(Source: Green Factory Label, 2013)

(3) Case of Alternative Energy

Project: Rooftop PV System Installation
Company: Delta Group (Delta)/Electricity Facilities Manufacturer

Solar energy is one of clean and renewable energy featured with no noise and no greenhouse gas emissions in using phase. Delta's Tainan Plant adopted Delta's own rooftop photovoltaic (PV) system including high-efficiency PV inverters. The PV system could provide partial energy for air conditioning and illumination in daily operations.

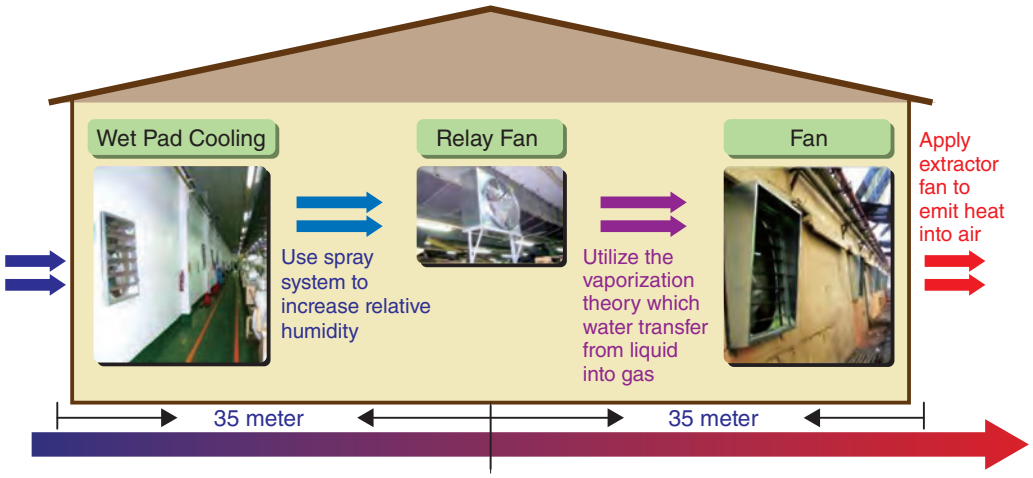
Delta Schematics of Solar Roof



Delta Solar Roof
(Source: Delta Group)

Project: Indoor Temperature Adjustment by Introducing Weaving Plant Natural Cooling System
Company: Everest Textile (Everest)/Textile Manufacturer

Everest replaces its original cooling system with "Weaving Plant Natural Cooling System" to adjust indoor temperature. Weaving Plant Natural Cooling System makes good use of downward water flow driven by gravity and prolongs contact of water and the cooling pad so that the water entering the plant can be vaporized to achieve cooling effect. A detention bucket is placed underneath the cooling pad for further reuse and recycles. The indoor heat is exhaled using ventilation facilities, which produce inverse pressure. Compared with traditional cooling system, it could save USD 600,000 of electricity expense annually.



Everest Introducing Weaving Plant Natural Cooling System
(Source: Everest Textile Sustainability Report, 2013)

(4) Case of Lighting Energy-Saving Design

Project: Lighting Improvement
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

UMC replaces traditional T8 illumination with light-emitting diode (LED) light bulbs to achieve lower electricity consumption. Such bulbs are applied to facility street lights, clean rooms, and offices. Areas that do not need to be constantly lit. e.g., pantries, toilets, are equipped with automatic motion sensors. Switches that control illumination above individual office cubicles are also established. This lighting improvement project is expected to achieve electricity saving by USD 60,000 annually.

UMC LED Street Lights

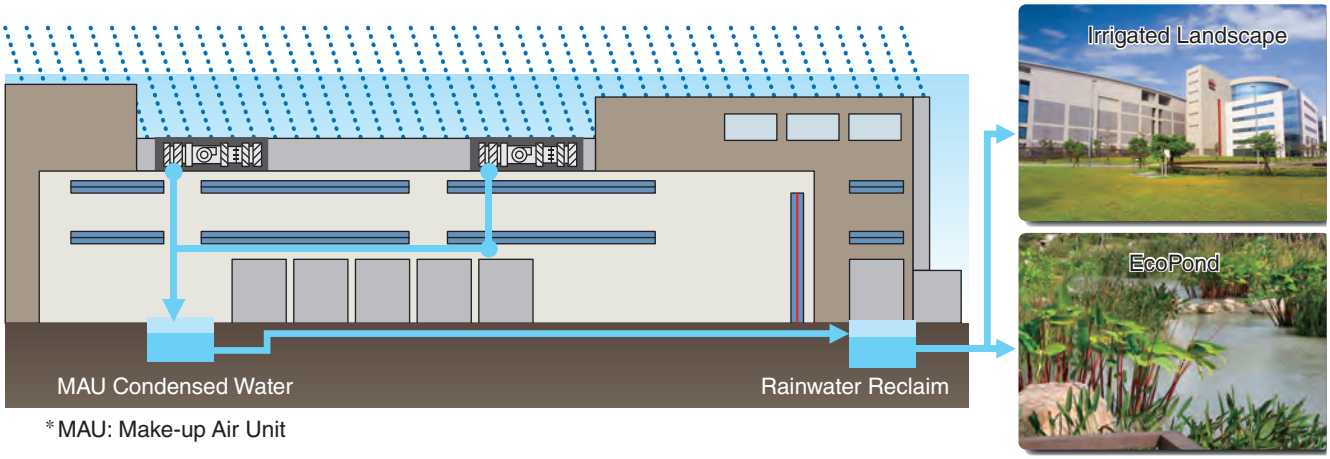
UMC String Switches for Office Lights

(Source: Green Factory Label, 2013)

(5) Case of Water-Saving

Project: Rainwater Recycling System
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

TSMC has established rainwater storage system on roofs to supply plant irrigation systems, toilets, and wet scrubber water use. Condensation water will be used to supplement the rainfall to satisfy water requirement. With the new system, the annual total amount of water saved is approximately 15,000 tons.



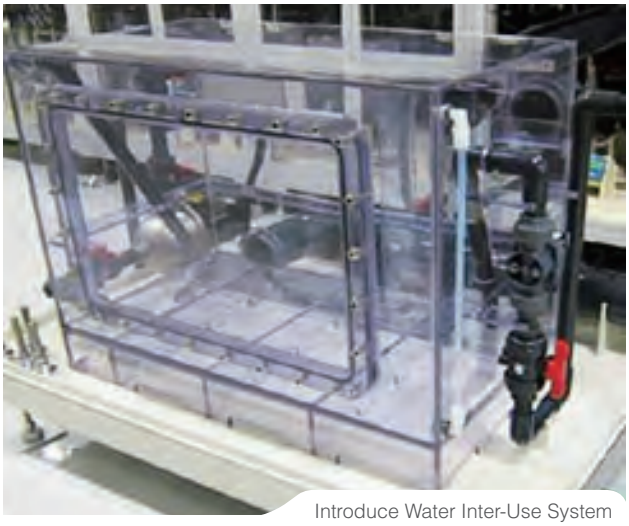
*MAU: Make-up Air Unit

TSMC Rainwater Recycling System

(Source: Green Factory Label, 2013)

Project: Water Inter-Use System
Company: AU Optronics (AUO) /Computers and Accessories Manufacturer

AUO has set-up a water saving measurement that applied to daily life and landscape water use in the company. In additional to saving more water, AUO to introduce a new system called " Water Inter-use System" (WIS) which is allowing reuse of water resource even without reprocessing of recycled water. The total amount of water saved by WIS can be achieved more than 100,000 tons annually, and saved additional cost by USD 45,000 annually.



Introduce Water Inter-Use System

(Source: Green Factory Label, 2013)

5.3 Waste Reduction

Green Building features water saving and reduction of material for construction. Sewage is unavoidable whenever water resource is accessed, landing particular importance on saving water in day-to-day lives. Green Building is one that also reduces transportation energy waste, aiming at "rationalized" structure, light weight construction, durability, and use of recycled materials.

Project: Waste Reduction Design in Facility Construction
Company: The Dow Chemical Company (DOW)/Chemical Manufacturer

DOW takes advantage of light weight, incombustibility, earthquake resistance, and efficient installation of metal glass curtain walls, which provide an outer covering with significantly less use of reinforced steel bars and concrete, thus economizing energy consumption. The metal glass curtain wall is beneficial because of its easy reusability, which is crucial for sustainable development. Dow's facility construction is centered upon soil, construction waste, demolition waste, and air pollution, which are evaluated and calculated based on equal weight. The different types of waste must be lower than the minimum threshold for waste reduction, which is a prerequisite for green building. Dow is constantly in pursuit of cleaner and more eco-friendly construction to alleviate its impact on the environment and improve the living quality.

Dow Dry Compartment Construction

Dow Precast Columns Construction

Dow Metal Glass Curtain

(Source: Green Factory Label, 2013)

5.4 Health

Indoor air quality, radiation and heat island in the building are very important factors in building plants. The concentration of CO_2 and CO, anti-radiation and heat resistance capacity should also be taken into consideration.

(1) Case of Insulation Design

Project: Minimization of Plant Heat Island via Architecture Design
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

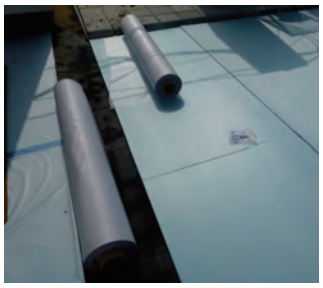
To avoid short-wave radiation from the sun in urban settings that have higher temperatures than the surrounding suburbs, TSMC minimizes the effect of heat island by:

- Decreasing the use of wooden plates and replacing them with metal plates. Metal system plates are attached to the first floor. The building adopts composite floor decks, while the third floor is adorned with Fiberglass Reinforced Plastic system plates.
- Using recycled concrete, with 15% of cement replacement ratio.
- Paving white concrete insulation tiles on the roof with potent sunlight reflection capability and using white metal roof.

In order to avoid land heating effect from off-street parking pavement, TSMC arranges car parking in the basement.

TSMC FRP System Plates

TSMC Metal System Plates



TSMC Non-Woven Cloth and Insulation Tiles

TSMC White Metal Roof

Tips: Solar Reflectance Index (SRI) indicates amount of sunlight reflected back by the material. The higher the index, the lower the temperature and the less the amount of cumulative heat on the material surface exposed to direct sunlight.

(Source: Green Factory Label, 2013)

(2) Case of Indoor Air Quality Control

Project: Controlling Air Quality in Workplace by CO_2 Sensor
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/ Semiconductor Manufacturer

In order to manage and monitor the concentration of CO_2 status in the offices, TSMC use the CO_2 sensor for purpose of monitoring indoor air quality. Whwen the level is too high, the system will automatically makes adjustments of ventilation rate to provide decent workplace environmental and increase productivity at work. With the CO_2 sensor, TSMC offices indoor air quality is improved.

TSMC CO_2 Sensor

(Source: Green Factory Label, 2013)

5.5 Conservation of Energy Resources

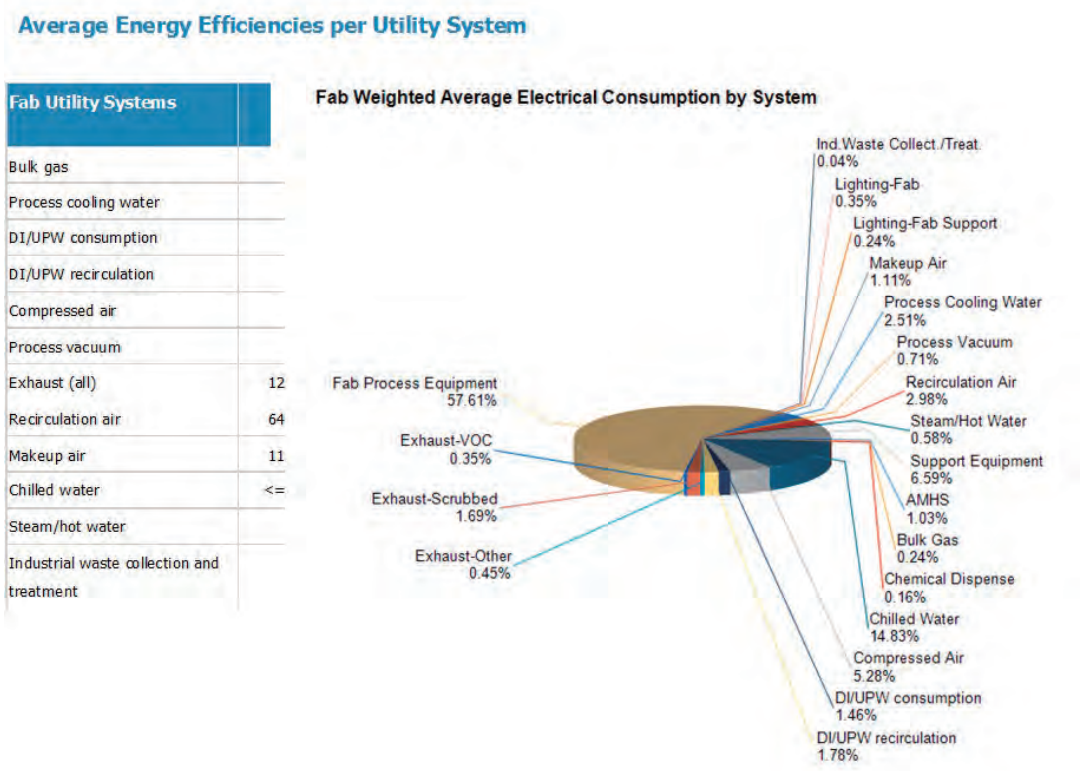
Decreasing the use of resource and elevating its efficiency of usage affect the operation costs; they are the key to sustainable resource use. One of the advantages is that factories may glean sufficient quantitative data to analyze the use of all kinds of resources and emission of waste on factory property, which may serve as a basis for continuous improvement plan.

Factories are advised to promote the efficiency of resource use by advancing production facilities, reducing the waste in manufacturing procedure, elevating the reuse of recycled materials, recycling waste heat and treated wastewater from factories.

(1) Case of Improvement of Public Facilities

Project: Introduces an EMS system
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

UMC introduces an Energy Monitor System (EMS), collecting data of energy consumption using Safety Integrity Level 2 (SIL2) framework, which greatly minimizes the need for labor force and lessens unreasonable consumption of power and air conditioning by 1%. This translates to saving of 1.4 million kilowatts and USD 100,000 annually. In addition, the system provides an integrated platform combing Human Computer Interaction and a systemized Internet Explorer interface, which grants users convenient access to energy information online. The integrated data platform not only increases the convenience and reliability of data collection but also provides instant warning of abnormal energy consumption and boosts applicability of the spreadsheets.



UMC EMS System

(Source: Green Factory Label, 2013)

Project: Improvement of Motor Equipment
Company: Formosa Plastics Group (FPG)/Chemical Material Manufacturer

FPG replaces the direct current motors on the propylene mixing granulators with alternating current (AC) motors, promoting its output power from 70% to 90% and enlarging motor conversion efficiency.

FPG High-Volt Variable-Frequency Drive

FPG AC Motor

(Source: Green Factory Label, 2013)

Project: Modified Dryer Reduces Energy Consumption of Air Pressure System
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

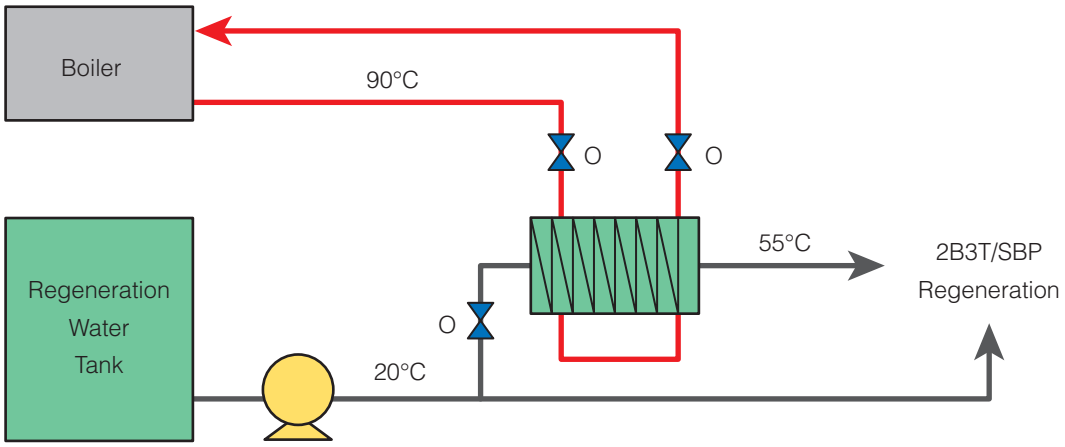
Humidity is detrimental to compressed air. Air pipelines rust because of dampness, causing possible leaks. A dryer is crucial when it comes to protecting air pressure systems. Generally, heatless dryers require 20% of compressed air for recycle use of the drying tower. Because compressed air requires enormous power consumption, UMC replaces heatless dryers with external thermal dryer. The latter uses heat to dry the adsorption tower and takes advantage of additional electrical heat and blowers, saving more power than the former.

UMC Heating Dryer

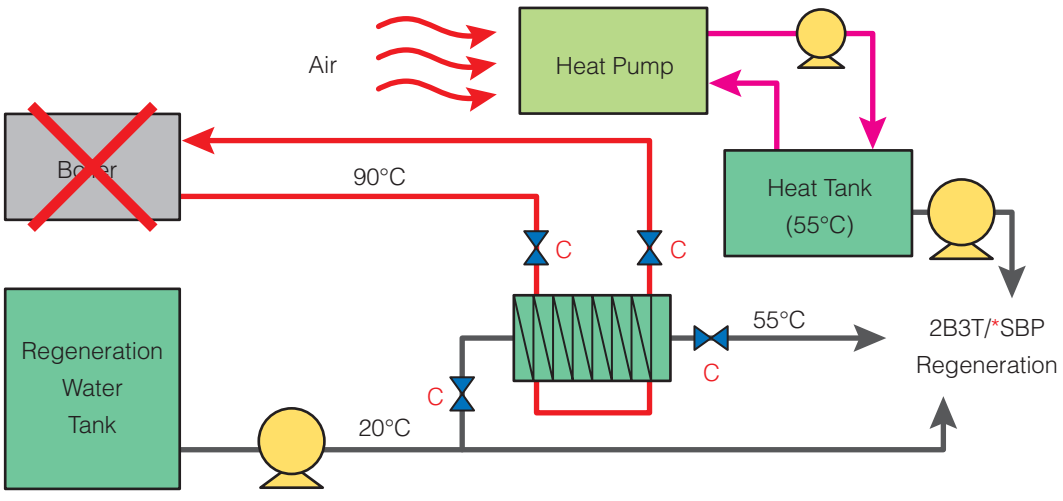
(Source: Green Factory Label, 2013)

Project: Introduction of Heat Pump System
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

In the past UMC used natural gas boiler to satisfy the hot water requirement for preheating hot de-ionized (DI) water and resin regeneration system - Two-Bed-Three-Tower (2B3T). For more reduction of energy consumption, UMC replaces natural gas with heat pump and conducts 2-way heating of DI water that needs to be reach 90 ℃. Lukewarm water from heat pump is used in the first stage, which provides suitable temperature for revival of resin. All these measures is contributed on cost saving by USD 360,000 annually.



UMC Boiler



UMC Heat Pump System

(Source: Green Factory Label, 2013)

*SBP: Strata Bed Polisher

Project: Improvement of Air Condition System
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

TSMC promotes its energy efficiency by adopting a double-temperature iced water system and cooling its back-up ice water generator. The system is composed of double-temperature iced water generators supplying iced water of 5 ℃ and 13 ℃.

The colder water facilitates dehumidification, while the warmer iced water provides a dry cooling coil and cooled water, saving 7.5 million kilowatts every year. The system is equipped with a valve that switches between two temperatures.

The organization also replaces the one-time/two-time pump-activated iced water supplier with a one-time AC system, which helps save significant utility expenses.

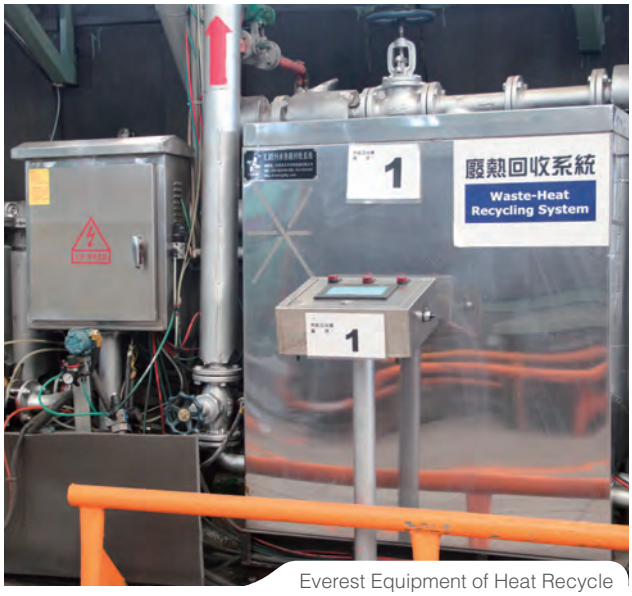
TSMC Double-Temperature Chiller System

(Source: Green Factory Label, 2013)

(2) Case of Improvement of production equipment

Project: Dyeing Wastewater Heat Recycle
Company: Everest Textile (Everest)/Textile Manufacturer

Everest directs hot wastewater ejected from dyeing and finishing machines into plate heat exchangers, fully blending hot wastewater and cool clean water for heat exchange and lowering the temperature of wastewater to less than 45 ℃. By doing this, Everest saves USD 500,000 from treating wastewater and converting cool water into warm water for machine processing.

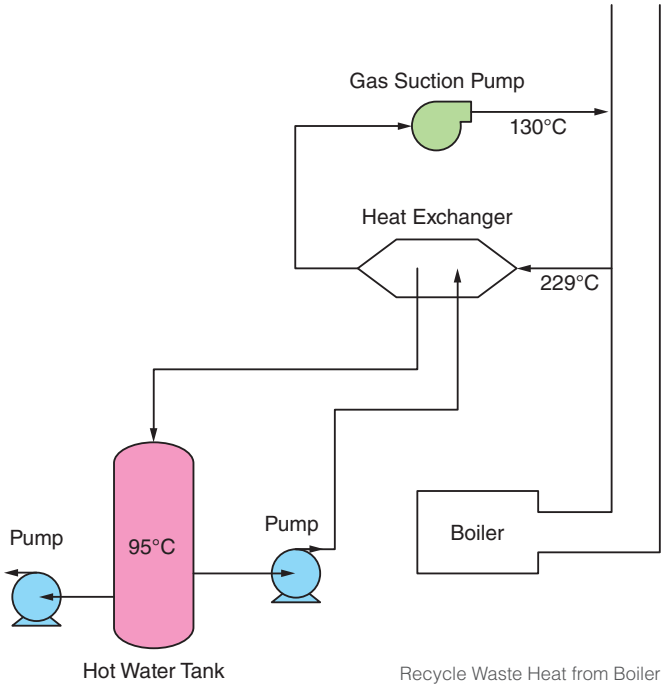


Everest Equipment of Heat Recycle

(Source: Green Factory Label, 2013)

Project: Recycle Waste Heat for Preheating the Boiler
Company: Champion/Porcelain Bathroom Manufacturer

Champion conserves energy using heat exchanger, directing hot exhaust gas back to the furnace to facilitate combustion. This can increase the temperature from 30 ℃ to 130 ℃. Waste heat can be recycled for preheating use, saving USD 15,000 and enormous gas expenses annually.



Recycle Waste Heat from Boiler

(Source: Green Factory Label, 2013)

Project: 3-Way VOC Recycle
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

In general, a 2-stage way is used in the incineration process for recelying volatile organic compounds (VOC) for heat recovery, which elevates end-of-process gas and air temperature. UMC adds a third-stage exhaust gas recycling to increase the temperature of the exhaust gas into the burner, saving cost by USD 130,000 annually as well as reducing the temperature of the waste heat emissions.

3-Way VOC Recycling Equipment

(Source: Green Factory Label, 2013)

5.6 Green Manufacturing Process

The spirit of green manufacturing process is to support factories to add equipment which is relevant to Cleaner Production based on existing production environment in conjunction with plant development planning. Green manufacturing process also means that the plants optimize their production flow by introducing appropriate technologies and methods, such as waste organic solvent purification and separation and developing lead-free technology. Essentially, factories could enhance production performance, reduce energy and resource use, and reduce emissions.

(1) Case of Promotion of Production Capacity

Project: Introducing Technologies of Riprap and Digital Printing
Company: Champion/Porcelain Bathroom Manufacturer

Champion has initiated three-dimensional printing, dry particulate deposition facilities, and special polishing particles in the tile manufacturing process. They have also employed digital inkjet printing technology to replace the plate printing process, to toughen and thin the tiles, and lower the use of materials, such as silicone, roll barrel materials, ink, scraper and mesh cloth. Fuel consumption following tile firing process is also kept low and thus increasing production efficiency, plus reducing packaging materials and transportation costs.

Champion Digital Printing Equipment

(Source: Green Factory Label, 2013)

(2) Case of Saving Energy

Project: Introducing Laser Perforation Technique to Cut Back Waste from Source
Company: Unimicron Technology (Unimicron)/Printing Circuit Board Manufacturer

In the mechanical perforation process of printed circuit boards, aluminum and urea plates are used as a buffer in order to avoid burs and plate deformation. Unimicron uses CO_2 laser perforation technology to carry out waste reduction from source, reducing the quantity of industrial waste and its related waste disposal costs.

CO_2 Laser Perforation Technelogy

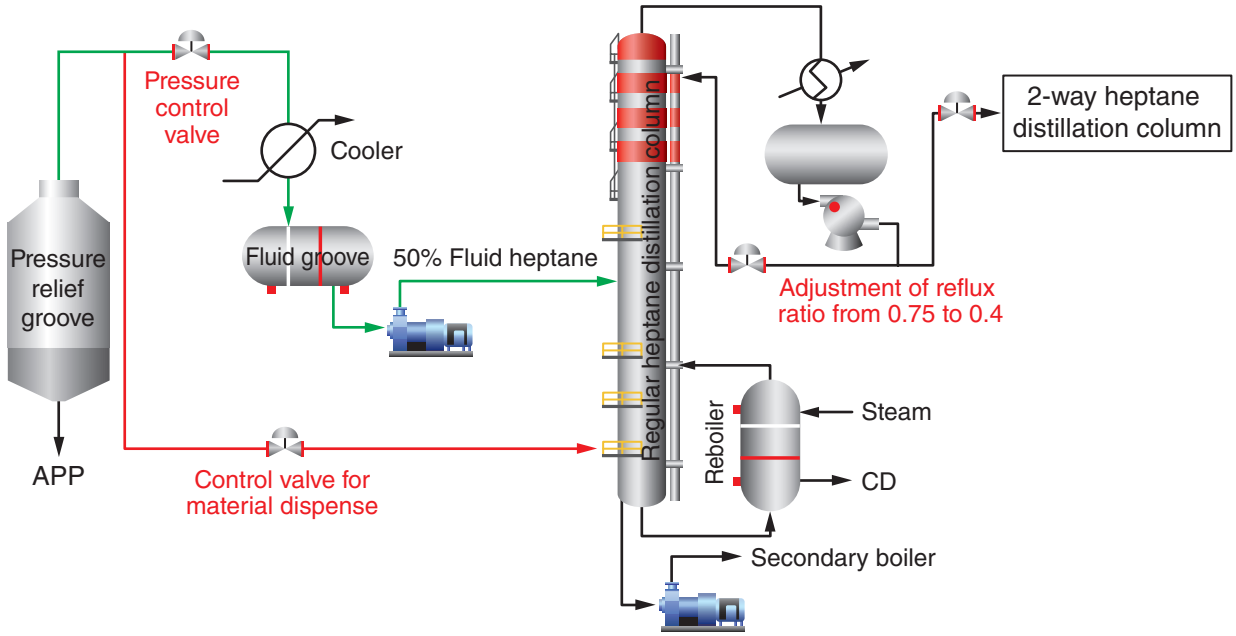
Unimicron Equipment of Mechanical Perforation Process

(Source: Green Factory Label, 2013)

Project: Improvement of Distillation Volumn for Effective Energy Saving
Company: Formosa Plastics Group (FPG)/Chemical Material Manufacturer

FPG achieves energy savings by improving operation of the polypropylene plant distillation column. High temperature gaseous heptane deprived of polypropylene through recycling and heating was previously condensed to the fluid status before it could be delivered for distillation, which led to consumption of steam.

The improvement aims to release 50% of gaseous heptane directly into the bottom of a pressure relief groove, replacing steam heat with heptane energy, which saves up to 2.9 tons of steam per hour. Also, adjustment of reflux ratio from 0.75 to 0.4 can save up to 1.4 tons of steam per hour without affecting the catalytic activity with saving USD 900,000 annually.



FPG Improved Operation for Distillation Column

(Source: Green Factory Label, 2013)

Project: Water Regulator Established to Lower Water Consumption
Company: Advanced International Multitech (Advanced Group)/Metal Manufacturer

The water used for cleansing production used to be controlled manually. However, the operation leads to constant flow of waste because of varying operating conditions.In order to save more water, Advanced Group now uses regulator to control water flow, which activates the inflow of water only when needed and therefore reduces human operation negligence.

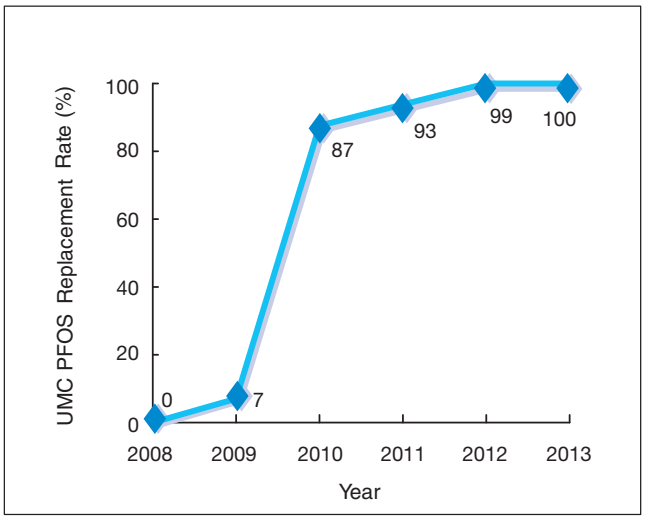
Advanced Group Water Regulator

(Source: Green Factory Label, 2013)

(3) Case of Pollution Reduction

Project: Perfluorooctane Sulfonate (PFOS) Replacement
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

PFOS is present in living species, especially in fatty organs. The substance is hazardous for human and animals and therefore is flagged by multiple countries as hazardous compound. In fact, it has been added to Annex B of the Stockholm Convention on Persistent Organic Pollutants. Hence, UMC takes the initiative of reducing the use of PFOS by subsituting suitable compound. The substitution rate was reached 100% in 2013.



PFOS Replacement Rate
(Source: Green Factory Label, 2013)

Project: Improvement in Polyester Polyol Production Improvement
Company: Eternal Chemical (Eternal)/Chemical Material Manufacturer

Eternal improves polyester polyol manufacturing process by developing and optimizing operating conditions to enhances the reaction rate, which can effectively save the amount of raw materials usage and decrease wastewater organic content. Given that way, wastewater pollutants can be treated through anaerobic biological treatment system. Because of the improvement of polyester polyol manufacturing process, Eternal saves wastewater treatment costs about USD 30,000 annually.

Eternal Anaerobic Biological Treatment Systems
(Source: Green Factory Label, 2013)

5.7 Pollution Controls and End-of-Pipe Treatment Processes

Proper treatment of production waste has always been a central issue of environment protection. Factories shall devise comprehensive management procedure regulating end-of-pipe facilities, emphasizing employee training, and conducting management tracking, which shall help reduce and/or eliminate the emission of pollutants such as waste gas, wastewater, waste and hazardous substance in the production processes. The minimum objective for the company is in compliance with applicable regulations and standards.

(1) Case of Air Pollution Control

Project: Cost-effective Exhaust Gas Treatment
Company: Minnesota Mining & Manufacturing Company (3M)/Electronic Parts and Components Manufacturer

A variety of pollution control technologies were evaluated and utilized to control and reduce 3M's air emissions. In 3M Tainan Site, 3M has developed biofiltration system to treat air contaminant which is the most suitable method for the profile of low concentration levels in high volumes of exhaust air and is environmentally friendly (no secondary air pollutants and wastewater generated). 3M maintains rigorous preventative maintenance schedules to ensure proper operation and ongoing air pollution control effectiveness of VOCs, as well as the odor.

3M is also looking to reduce energy and natural resource usage of pollution control equipment, while still providing required air pollution control efficiencies.

Biological air pollution control system is a feasible solution to control VOC emissions in certain 3M processes. In pilot and some full scale installations, 3M has demonstrated that technology can adequately reduce VOC emissions while significantly reducing operating costs, odor emissions, and eliminating energy usage.

3M has merged all its 22 on-site flue gases into one and then treated by biofilter (around 80% of VOC removal efficiency) with emitted VOCs only 4 ppm. The annual cost saving is USD 100,000 including the utilities, maintenance and periodic inspection of flue, etc.

3M Flue Gas Convergence

(Source: 3M Sustainability Report, 2013)

Project: Separation and Treatment of Exhaust Gases
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

TSMC's wafer fabrications emits three major types of exhaust gases: acid exhaust, base exhaust, and VOCs. Air pollution control systems depend on various categories and characteristics of pollutants. TSMC installs scrubbers to treat toxic, flammable and perfluorocarbon (PFC) gases. High temperatures or other physical and chemical measures are used to significantly reduce the concentration of pollutants in exhaust gas. The gas is then inducted to central waste gas treatment equipment for endpoint treatment. Endpoint treatment includes zeolite-rotary-wheel absorbing equipment for VOC treatment and wet scrubber equipment for acid or base gases.

The benefits for the separation of different exhaust gases are that chemical reactions due to mixture of gases in the pipe can be avoided and easy treatment of respective gas with the corresponding facilities.


General Exhaust (GEX)


Scrubber Exhaust System (SEX)


Ammonia Exhaust System (AEX)


VOC Exhaust System (VEX)

TSMC Various Exhaust Gas Treatment Facilities

(Source: TSMC Corporate Social Responsibility Report, 2012)

(2) Water Pollution Control

Project: Wastewater Recycled
Company: Champion/Porcelain Bathroom Manufacturer

Champion has collected wastewater, directed it to a wastewater station, and purifies it through the treatment processes including filtration, precipitation, aeration and dehydration of sludge. The purified water is then led to the manufacturing circulation for reuse. The annual recycled volume in total is 4 million tons, which greatly reduces wastewater emission and saves tap water use consumption.


Champion Wastewater Recycled System

(Source: Green Factory Label, 2013)

Project: Wastewater Collection, Treatment and Recycle
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

TSMC's ultra-pure water system turns raw water into ultra-pure water, mainly used for cleaning chemical residue on wafer surfaces. To reduce total water usage, TSMC's backwash water from ultra-pure water systems and cleaning process are graded by purity. The cleanest is reused in the manufacturing process; the secondary grade taken from the recycling is employed in secondary uses such as cooling-tower water. Wastewater that cannot be recycled is discharged to treatment facilities for final wastewater treatment.

Wastewater from wafer fabrication can be divided into various categories: fluoride, copper, general acid, and various polishing wastewaters. All types of wastewater are strictly categorized at its process its process unit, and collected to wastewater treatment facilities through separated piping.

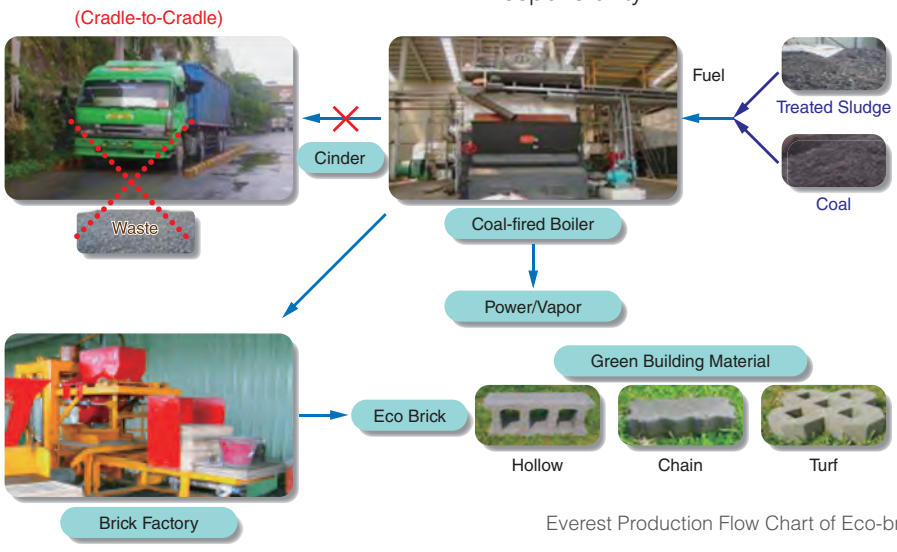
TSMC Wastewater Collection & Treatment Systems
(Source: TSMC Corporate Social Responsibility Report, 2012)

(3) Case of Waste Reduction

Project: Waste Cinder Recycling for Production of Green Construction
Company: Everest Textile (Everest)/Textile Manufacturer

Everest's coal boiler generates 10 tons of cinders per day. The cinders are non-toxic, harmless and suitable to process to produce cement products. Everest uses the special high pressure forming process to make the cinders into eco-bricks.

Turning waste into gold, Everest uses water permeable turf eco-bricks to replace the existing asphalt surface internally and sell the bricks on the market. This practice achieved the sustainability concept in terms of economy, environmental protection and social responsibility.



Everest Production Flow Chart of Eco-brick
(Source: Everest Textile Sustainability Report, 2010)

5.8 Eco-design

Eco-design is based its thinking on life cycle and eco-friendliness. Factories shall take eco-design into consideration and assess potential impact on the environment in different stages of a complete life cycle, while incorporating factors of impact into the design to eliminate adverse effects on the environment. In the end, eco-design can also increase process efficiency.

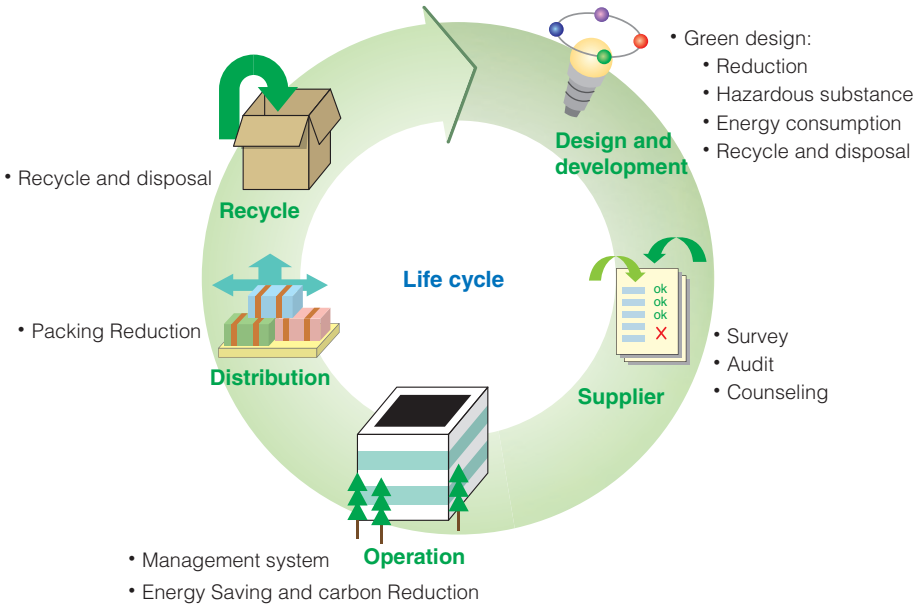
(1) Case of Green Management System

Project: Establishment of Green Management System- IEC 62430
Company: Qisda Cooperation (Qisda)/Computers and Accessories Manufacturer

Qisda introduced Life Cycle Thinking (LCT) into product development and design process by creating its own IEC 62430 (International Electrotechnical Commission) green management system. For instance, courses related to green products are offered to enrich the employees with knowledge such as life-cycle inventory. Beyond that, product design, guidelines and checklists are provided to ensure the compliance of both company and customers requirements. During the design stage, evaluation checklist can record product's eco-status and future improbabilities. Design for Environment report would be provided at the end of design stage.

Qisda injected green thinking into the early stages of product design and development, supporting every stage of the production life cycle with LCT to create more environmentally friendly green products. Such implementation brought Qisda ahead of the competition with earning an IEC 62430 certificate in green design. This environmentally conscious design philosophy was infused in Qisda's production. Its IEC 62430-certified major product lines include displays (e.g., LCD monitors), projectors (e.g., data/video projectors), mobile communication device (e.g., smart phones), auto information devices (e.g., multi-media players), lifestyle product (e.g., indoor use lighting), and consumer electronics (e.g., tablet), among others.

With the implementation of green design, Qisda exceeded its original goal of Green Design 555 (i.e., 5% of energy saving, 5% waste reduction, 5% recycle rate based on base year 2002) in 2012 by 3 to 4 times better, or 17% of energy saving, 17% waste reduction, 20% recycle rate. In addition, CO_2 reduction amounted to 12%. For the goal in 2015, Qisda is expected to achieve Green Design 555 compared to 2012 baseline.



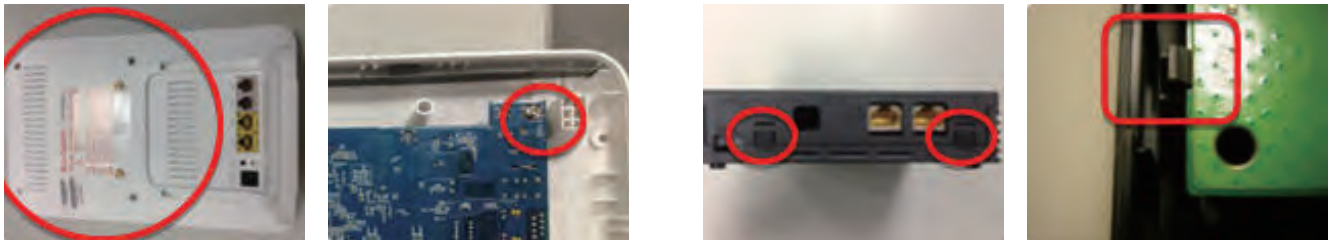
Qisda Eco-Design Concept

(Source: Qisda Corporate Social Responsibility Report, 2010)

(2) Case of Material-Saving Designs

Project: Energy Saving in Screwless Design
Company: MitraStar Technology (MitraStar)/Communications Equipment Manufacturer

MistraStar is an assembly plant for a variety of broadband products that uses air-driven screw drivers on a regular basis, which is one of major source of energy consumption. In order to save energy usage, MistraStar replaces the screws with latches, setting its assemblies free from screws and thereby lowering power use.



Original Design　　Modified Design

Screwless Design

(Source: Green Factory Label, 2013)

(3) Case of Designs for Disassembly Parts

Project: Green Design of Project
Company: Qisda Cooperation (Qisda)/Computers and Accessories Manufacturer

Qisda engages in green design of projectors by using simple integrated circuit and circuit design and by evaluating the impact of halogen-free plastic on product quality. They also consider parts for product recycling. The plastic material which they used is eliminated from printing and painting electric coating on the surface. They replace heat-melt with fasteners and screws and use soy-ink monochrome printing to reduce painting areas.

Before　　After

Qista Heat-Melt Copper Nails Replaced with Fasteners and Screws

(Source: Green Factory Label, 2013)

(4) Case of Recyclable Designs

Project: Recyclable Containers used to Reduce Waste and Save Material Costs
Company: Eternal Chemical (Eternal)/Chemical Material Manufacturer

Eternal uses green packing material to reduce resources consumption:

- Green materials include Tanker, ISO TANK, Intermediate Bulk Container (IBC) and Good Pack
- To reuse the used containers will reduce waste packing materials as well as enhance resources use efficiency.
- Materials and products packaging integration project. Using 1 ton IBC pack as product package to replace small packs. Moreover, it can be reused after cleaning.
- Replace the wood pallets with highly strong plastic pallets to reduce the use of wood pallet while reducing the resources consumption and saving cost.

With green packaging implementation project, Eternal is achieving annual cost saving by USD100,000 as well as reducing waste total in 97.7 tons.


Tank Car


ISO TANK

IBC


Good Pack

Eternal Green Packing Materials

(Source: Green Factory Label, 2013)

5.9 Green Management

It is to become a focal point of green management to follow international standards on restricted/prohibited substances and reduce the emission of greenhouse gases. Therefore, corporations alike shall adopt systemic management, pass international management certification, and adhere to supply chain regulations on conducting greenhouse gas control. In addition, manufactures shall also manage their relations with suppliers to ensure compliance of material and product use with applicable policies and norms. Stakeholders shall be constantly consulted through a variety of channels, which is a fundamental spirit of green management.

(1) Hazardous Substance Management

Project: Hazardous Substance Control in Supply Chain
Company: Unimicron Technology (Unimicron)/Printing Circuit Board Manufacturer

To ensure suppliers' components are hazardous substances free (HSF), Unimicron, based on the QC080000 (HSPM - Hazardous Substances Process Management) system, has set up HSF quality policies and goals. As a result, products from suppliers to Unimicron should meet RoHS regulations which will further benefit the Unimicron green image as well as enhance its market competitiveness.

Unimicron Green Supply Chain Platform

(Source: Unimicron Corporate Social Responsibility Report, 2011)

(2) Establishment and Exposure of Information about Sustainable Development

Project: Introduction of Social Responsibility- and Environmental-oriented Accounting System
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

The purpose of TSMC's environmental accounting system is to identify and calculate environmental costs for internal management. Consequently, TSMC is able to evaluate the cost reduction and/or economic benefit of environmental protection programs (e.g., through waste recycling and waste reduction).

Expecting environmental cost to increase in the future. TSMC implemented environmental accounting system to manage more effectively. In practice, TSMC's environmental accounting system is based on various environmental items. Annual cost saving including saving in energy, water, waste/material reduction as well as actual income from waste recycling is more than USD 45 M.

2012 Environmental Cost for TSMC Fabs in R.O.C.

Unit: k US dollars

Classification	Description	Investment	Expense
1. Direct cost for reducing environmental impact			
(1) Pollution Control	Cost for air pollution control, and others.	126,643	85,980
(2) Resource Conservation	Cost for resource (e.g. water, energy) conservation.	47,334	2,850
(3) Waste Disposal and Recycling	Cost for waste treatment (including recycling, incineration and landfill)	0	13,724
2. Indirect cost for reducing environmental impact (managerial cost)	(1) Cost of training cost (2) Environmental management system and certification expenditures (3) Environmental measurement and monitoring fees (4) Environmental protection product cost (5) Environmental protection organization fees	7,243	5,696
3. Other environment-related cost	(1) Cost for decontamination and remediation (2) Environmental damage insurance and environmental taxes (3) Cost related to environmental settlement, compensations, penalties and lawsuits	0	0
Total		181,220	108,252

2012 Cost Saving of Environmental Efficiency of TSMC Fabs in R.O.C.

Unit: k US dollars

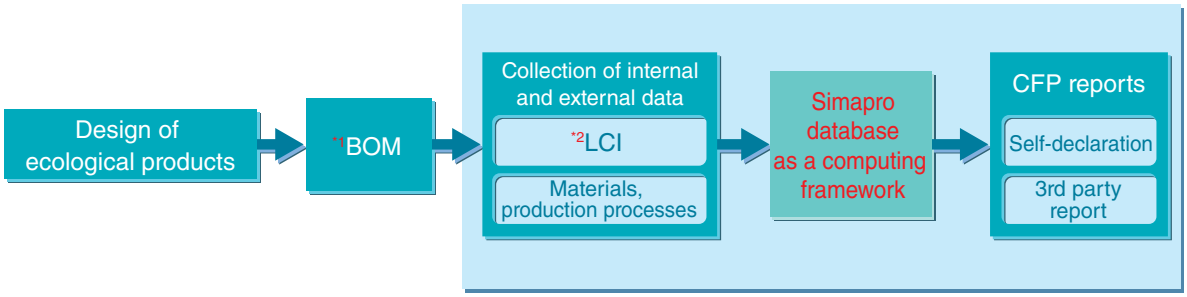
Category	Description	Cost Saving
1. Cost saving of environmental protection projects	Energy saving: completed 37 projects	20,243
	Water saving: completed 6 projects	2,347
	Waste reduction: completed 8 projects	897
	Material reduction: completed 50 projects	15,590
2. Real income of industrial waste recycling	Recycling of used chemicals, wafers, targets, batteries, lamps, packaging materials, paper cardboard, metals, plastics, and other wastes	6,524
Total		45,600

(Source: TSMC Corporate Social Responsibility Report, 2012)

Project: Establishing Carbon Footprint of Product
Company: Qisda Cooperation (Qisda)/Computers and Accessories Manufacturer

Qisda calculates its product carbon footprint from cradle to gate (also known as Business-to-Business) using the carbon management platform to generate self-declared Carbon Footprint of Product (CFP) Report. The methodology is taking reference from PAS 2050 and ISO 14067. During 2010 to 2012, the average product carbon emission was reduced by about 11.7%.

Qisda incorporates its carbon footprint requirements and those of the customers into their control system. With this effort, Qisda has done CFP reports for over 80% of its main products. Among them, Qisda's projector has been verifiedthe CFP and Environmental Product Declaration by British Standards Institution in 2012, which is the first certification of projector in the world.



*1 BOM: Bill of Materials

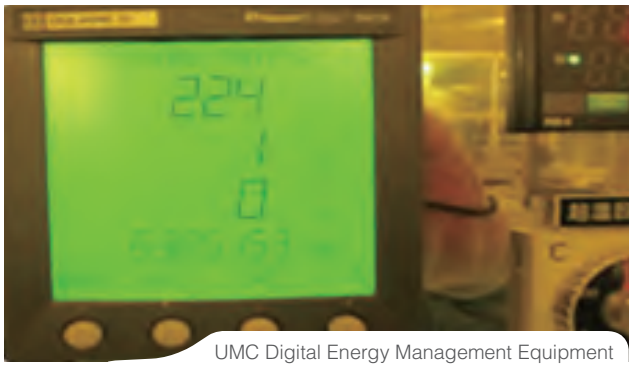
*2 LCI: Life Cycle Inventory

Qista Carbon Management Process

(Source: Qisda Corporate Social Responsibility Report, 2012)

Project: Energy Management
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

Over 70% of its facilities are equipped with digital power and water meters linked to e-management platforms to access instant energy consumption information and amount of water consumption and operational status.



UMC Digital Energy Management Equipment

(Source: Green Factory Label, 2013)

Project: Establishing Water Footprint of Product
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

In 2010, UMC completed 8" and 12" IC wafers inventory and verification of its product water footprint. The inventory scope includes water-related data for processes, raw materials suppliers, and manufacturing. The main inventory targets were from silica sand, wafer fabrication, to semiconductor manufacturing. For the entire process, UMC verified data related to water usage, water recycling, and wastewater generated during manufacturing. UMC was also first to complete the world's first integrated circuit (IC) carbon footprint and water footprint verifications.

UMC's water footprint results will act as a future basis for optimization of water resource utilization and for developing water conservation strategies. Through gathering data on the impact of water usage for suppliers throughout the supply chain, UMC plans to increase the efficient use of water resources. Thus, new factories will take water-saving design into account in order to reduce the overall impact of water resources.

UMC continues to implement water use reduction and management through verification of water footprint.

VERIFICATION STATEMENT OF
PRODUCT SUPPLY-CHAIN WATER FOOTPRINT ASSERTIONS
Statement No. 00001-2010-WFP-TWN-2
Page 1 of 2

United Microelectronics Corp., Fab 12A

initiate reporting of

Product Supply-chain Water Footprint Report of A 12" IC Wafer (2009)

Scope of Verification

Det Norske Veritas Certification (hereafter "DNV") has been commissioned by United Microelectronics Corp., Fab 12A (hereafter "the Company") to perform a verification of the product supply-chain water footprint assertion of the Company's Product Supply-chain Water Footprint Inventory Report (hereafter "the Inventory Report") with respect to the following product: A 12" IC Wafer, and the data from United Microelectronics Corp., Fab 12A : No. 18, Nan-Ke Rd. II, Tainan Science Park, Sinshin Township, Tainan County, Taiwan, R.O.C., and the time period is from Jan. 1, 2009 through Dec. 31, 2009.

Boundary of Verification

☐ *Business to Consumer* ☒ Business to Business

Verification Criteria and GHG Programme

The verification was performed on the basis of the water footprint accounting principle developed by Gerbens-Leenes and Hoekstra's: Water Footprint Network (2008), as well as the PCR for IC (Integrated Circuit) : PCR 2009 : 1, given to provide for consistent product supply-chain water footprint identification, calculation, monitoring and reporting.

Verification Statement

It is DNV's opinion that with limited assurance the product supply-chain water footprint assertion of the Inventory Report of A 12" IC Wafer (2009), which was published on July 2010, is free from material discrepancies in accordance with the water footprint accounting principle developed by Gerbens-Leenes and Hoekstra's: Water Footprint Network (2008).

Chun-Nan Lin
GHG Verifier
Aug. 2, 2010

David Hsieh
District Manager
DNV Certification Taiwan

This Verification Opinion is based on the information made available to us and the engagement conditions detailed above. Hence, DNV can not guarantee the accuracy or correctness of the information. DNV can not be held liable by any party relying or acting upon this Verification Opinion.

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VERIFICATION STATEMENT OF
PRODUCT SUPPLY-CHAIN WATER FOOTPRINT ASSERTIONS
Statement No. 00001-2010-WFP-TWN-1 Rev.1
Page 1 of 2

United Microelectronics Corp., Li-Shin Site

initiate reporting of

Product Supply-chain Water Footprint Report of An 8" IC Wafer (2009 Inventory with 2008 Suppliers' Data)

Scope of Verification

Det Norske Veritas Certification (hereafter "DNV") has been commissioned by United Microelectronics Corp., Li-Shin Site (hereafter "the Company") to perform a verification of the product supply-chain water footprint assertion of the Company's Product Supply-chain Water Footprint Inventory Report (hereafter "the Inventory Report") with respect to the following product: An 8" IC Wafer, and the data from United Microelectronics Corp., Li-Shin Site : No. 3, Li-Shin Rd. II, Hsinchu Science Park, Hsin-Chu, Taiwan, R.O.C., and the time period is from Jan. 1, 2009 through Dec. 31, 2009.

Boundary of Verification

☐ *Business to Consumer* ☒ Business to Business

Verification Criteria and GHG Programme

The verification was performed on the basis of the water footprint accounting principle developed by P.W. Gerbens-Leenes and A.Y. Hoekstra: Water Footprint Network (2008), as well as the PCR for IC (Integrated Circuit) : PCR 2009 : 1 given to provide for consistent product supply-chain water footprint identification, calculation, monitoring and reporting.

Verification Statement

It is DNV's opinion that with limited assurance the product supply-chain water footprint assertion of the Inventory Report of An 8" IC Wafer (2009 Inventory with 2008 Suppliers' Data), which was published on July 2010 , is free from material discrepancies in accordance with the water footprint accounting principle developed by P.W. Gerbens-Leenes and A.Y. Hoekstra: Water Footprint Network (2008).

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UMC Water Footprint Certification

(Source: UMC Corporate Social Responsibility Report, 2011)

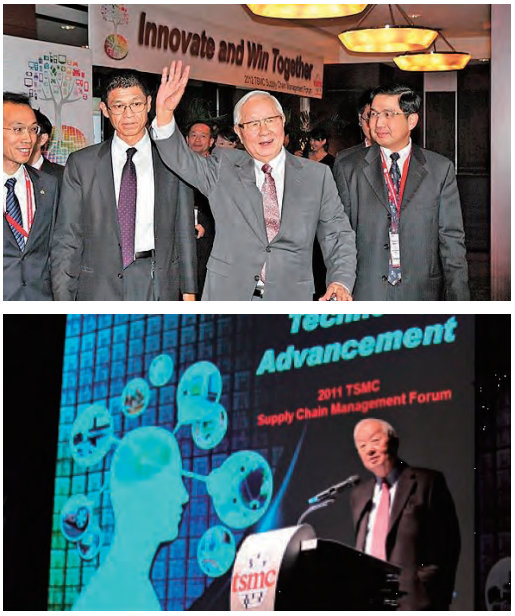
(3) Supply Chain Management

Project: Establishing Green Supply Chain Management to Evaluate Suppliers' Environment Performance
Company: Taiwan Semiconductor Manufacturing Company Limited (TSMC)/Semiconductor Manufacturer

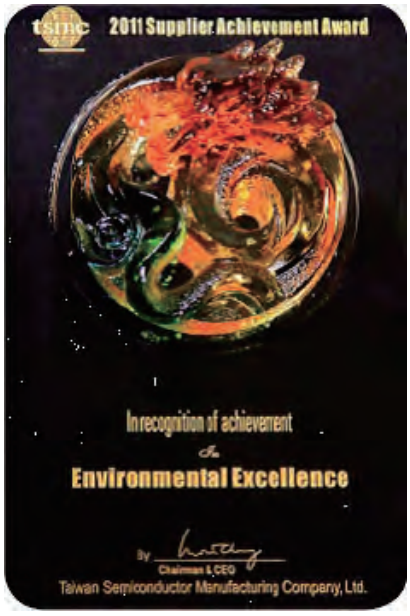
According to TSMC's green procurement policy, its assessment of suppliers' green performance includes:

1. Energy saving and carbon reduction management: suppliers are required to collect carbon inventory data in their manufacturing plants, develop a product-based carbon footprint, and provide carbon reduction performance data.
2. Water resources and water management: suppliers are required to collect water inventory data in their manufacturing plants to establish a water footprint, and to provide a specific water resource management plan.
3. Green products and hazardous substances control specification: in response to global hazardous substance controls and eco-friendly product specifications, TSMC asked suppliers to comply with Perfluorooctane Sulphonate (PFOS)/ Perfluorooctanoic Acid (PFOA)/Restriction of Hazardous Substances (RoHS)/Registration Evaluation and Authorization of Chemicals (REACH) and other global chemical control standards.
4. Waste management: suppliers need to continuously improve waste reduction performance and increase recycling and reuse ratios in their manufacturing facilities.
5. Tier-2 suppliers' green supply chain management: suppliers must work with their upstream suppliers on environmental protection, reduction of carbon emissions, and water conservation-related measures.
6. Environmental management system and the establishment of environmental objectives: suppliers must have ISO 14001, RC 14001, or other relevant environmental management system certification.
7. Other environmental protection standards: this includes the use of green procurement, adoption of green building designs, promotion of environmental education and others.

In addition, TSMC prepares special award "Achievement in Local Presence for Supply Chain Resilience" in honor of suppliers that have decided to invest in R.O.C., demonstrating suppliers determination of facilitating local businesses and commission to sustainable development.



TSMC Supply Chain Management Seminar



TSMC "The Best Green Supply Company Award"

Energy Saving and Carbon Reduction

Suppliers are required to conduct carbon inventory, provide carbon reduction data and develop product-carbon footprint.

EMS and Environmental Objectives

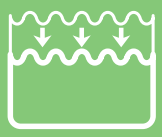
Suppliers must have ISO 14001 RC 14001 or other relevant certification

Other Environmental Protection Standards

This includes green procurement, green building designs, promotion of environmental education.

Water Resources Conservation

Suppliers are required to conduct water inventory, and to provide a specific water resource management plan.



Green Products and Hazardous Substances control Specification

In response to global hazardous substance controls and eco-friendly product specifications, TSMC collaborates with suppliers to comply with PFOS/PFOA/ Conflict Mineral Management/ RoHS/ REACH and other global chemical control standards.

Waste Management

Suppliers need to continuously improve waste reduction performance and raise recycling and reuse ratios.

Tier-2 Suppliers' Green Supply Chain

Suppliers must work with their upstream suppliers on environmental protection, reduction of carbon emissions, and water conservation-related measures.

(Source: TSMC Corporate Social Responsibility Report, 2012)

5.10 Corporate Social Responsibility

Corporations should interact with other businesses, government agencies, and the general public and forge a platform for exchange of green experience between experts and ordinary public. This is the concrete realization of sustainable development, which enhances company's competitive advantage, facilitates growth of company as well as our society.

(1) Related Partner

Project: Quarterly Publication to Reinforce Communication Among Stakeholders
Company: Advanced International Multitech (Advanced Group)/Fabricated Metal Products Manufacturer

Since the establishment of Advanced Group Quarterly Newsletter in 1997, the publication encompasses a message from the Chairman, recommends books, emphasizes new techniques and green information, features department, lists social activities, and provides legal knowledge. Advanced Group is aimed at establishing common prospects for the company, acquainting organizational divisions, sharing novel techniques and knowledge, spreading green issues, and promoting ongoing events. In addition, Advanced Group paves way for smooth communication among suppliers, customers, external consultants, bridging people inside and outside the company.

Advanced Group Quarterly Newspaper

(Source: Green Factory Label, 2013)

Project: A Healthy Work Environment: Care for Employees
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

The "UMC's Six Elements of a Healthy Work Environment" (safe, healthy, warm, cohesive, vigorous ad cultured) development project was started in 2010 and is focused on creating the perfect workplace as well as providing UMC employees with market-competitive salaries, various employee benefits and a safe, healthy work environment. With this project, UMC helps its employees in all aspects of their lives, allowing them to work happily without having to worry about other things. UMC will continue to improve on its human resources management and its holistic educational and training system to build a perfect workplace that embodies the essence of "Happy Employees", "Healthy Workforce" and "Vigorous Organization".

UMC hopes that by promoting and carrying out the ideal of a healthy work environment, it will gain the satisfaction of its employees and the support of outsiders, strengthening UMC's ability to recruit and retain talented people and thus improving the management performance on a personal and company level.

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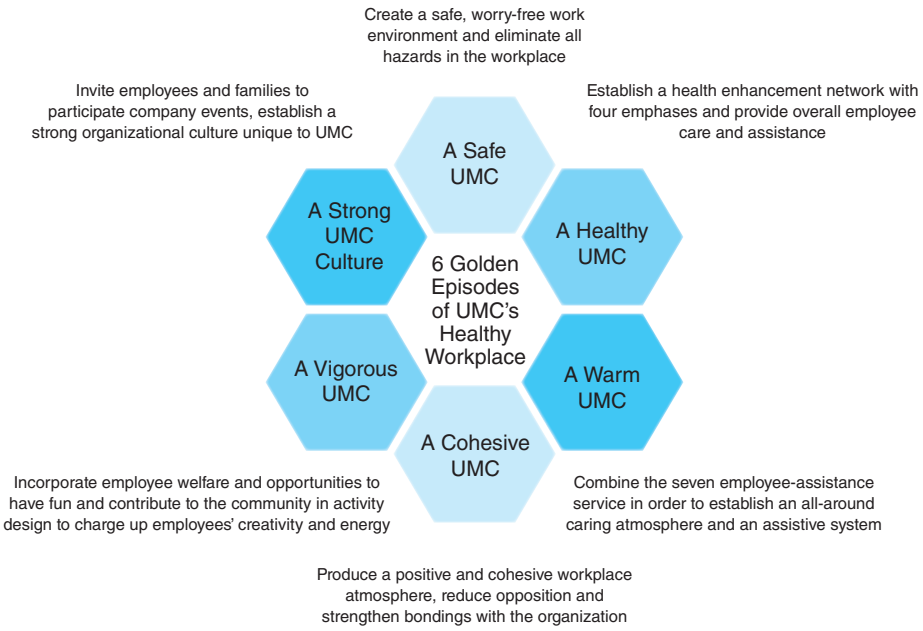
Three Essences of Perfect Workplace



UMC Healthy Workplace Program
(Source: VMS Corporate Social Responsibility Report, 2011)

Project: Detention Pond Created to Mobilize Participation in Conservation Activities
Company: The Dow Chemical Company (DOW)/Chemical Manufacturer

The midland in R.O.C. is marked geographically with little rainfall, especially during dry season. The water in detention ponds thus is an alternate source that can be used to curb drought and fire. With expanded greenery on the property, the detention pond can be used to water the plants. This is why Dow is driven to adopt a detention pond of 2.3 hectares nearby and plant about 50 trees annually to beautify the local community. They also took part in an international event of "Clean Beach" which is mobilizing company's staff members to assist this task. Prior to participation, there were panels and films that promote the beauty of the sea and the importance of ocean ecology, encouraging its employees to engage in community services and take part in local wetland environment events.

Dow Clean Beach Event

(Source: Green Factory Label, 2013)

(2) Feedback to Community

Project: UMC Community Volunteer Group
Company: United Microelectronics Corporation (UMC)/Semiconductor Manufacturer

With social responsibility, humanity, and care for education in mind, UMC has established a "UMC Science and Culture Foundation" while encouraging its employees to take part in volunteer work. The organization dispatched 600 employees to help out with the recovery in Pintung County in the aftermath of August flooding caused by Typhoon Morakot in 2009.

Love and care did not stop even years after the disaster, with many from the Company still holding camps for children in remote disaster-ridden areas, reading stories to school kids, throwing charity auctions in collaboration with local groups, decorating libraries, providing pre-career training and internship to high school and college students, orchestrating over 41 musicals in Pintung, Hsinchu, Tainan that attracted audience of over 10,000 people. UMC expects to enrich the lives of children through many activities and motivate more social care by its staff members.

UMC Volunteer Activities

(Source: UMC Corporate Social Responsibility Report, 2011)

Project: Concern for Disadvantaged Groups
Company: Delta Group (Delta)/Electricity Facilities Manufacturer

1. Donation of LED bulbs to disadvantaged groups

The Delta Electronics Foundation launched an LED light bulb purchasing activity that attracted 180 donors to help disadvantaged families replace 2,000 bulbs from traditional ones to LED model. Estimated annual electricity saving is around USD 100,000 as well as reducing 240 tones carbon emissions from this donation program. R.O.C. government was also subsidizing over 20,000 mid to low income families to purchase LED bulbs.

Delta LED Bulbs

2. Green Christmas gifts for elementary schools in remote areas

The Delta Electronics Foundation and volunteers called on Delta employees to give eco-friendly Christmas gifts to the students of Namasia Min-Chuang Elementary School. They presented eco-friendly gifts that did not use batteries, baseball gloves made of pigskin instead of cowhide, and utilized smart packaging for less waste and so on. On Christmas Eve of 2012, Delta staff went to Namasia Min-Chuang Elementary School in Kaohsiung to deliver the green gifts to children in these remote areas.

Namasia Min Qhuan Elementary School - Net-Zero Library

3. Cares for disaster refugees

After the Morakot typhoon disaster in 2009, the Delta Electronics Foundation and the Delta Group donated a total of USD 16 million to assist the government in the reconstruction of Namasia Min-Chuang Elementary School and turn the school into a comfortable and healthy green building. With this support, the new campus was awarded an EEWH Diamond Green Building certificate – this is the highest ranking level in R.O.C. By using Delta's solar and wind power systems, its library can achieve "Net-Zero" in terms of energy consumption, setting an example for the next-generation "Green Campus".

Namasia Ming Chuan Elementary School Fulfills Disaster Prevention and Shelter Functions

(Source: Delta Corporate Social Responsibility Report, 2012)

Project: Champion Green Concept Pavilionin Pavilion Vision
Company: Champion/Porcelain Bathroom Manufacturer

Champion spent more than USD 3 million and applied the highest standards to build the "Champion Green Vision" pavilion, which received the first group of guests, World Ceramic Forum members, right after the building was completed in 2009. The tourist factory stands first with an unprecedented, green-oriented vision in the tile industry.

Champion believes in sustainability, is dedicated to the harmony between living and nature, helps bring about a healthy environment and green aesthetics to give back to the community, and supplies with historical wisdom and green culture.

Champion Green Concept Pavilionin

(Source: Green Factory Lable, 2013)

(3) Experience Sharing

Project: Green Experience Sharing
Company: Formosa Plastics Group (FPG)/Chemical Material Manufacturer

FPG shares its energy saving improvement programs with other factories in various open house events. In addition, FPG has participated in several external associations and groups from various industries to help develop business operating systems in R.O.C. In many of these events, FPG serves as President of the Council, on the Board of Directors, or as Representatives. Through the years, FPG has participated in a total of 16 Petrochemical Associations, such as the Taiwan Synthetic Resins Manufacturers Association and the Petrochemical Industry Association of Taiwan. In addition, PFG also participated in numerous association events including those in the textile and electronics industry as well as other 36 associations.

Champion Green Concept Pavilionin

(Source: Formosa Plastics Group Corporate Social Responsibility Report, 2012)

5.11 Innovative Thinking

Innovative thinking is the best way to promote corporation to adhere to the specific industrial culture and characteristics. It helps develop the company's own Cleaner Production techniques with product differentiation to elevate green competitiveness.

(1) Dematerialization

Project: Development of Lightweight Products
Company: Everest Textile (Everest)/Textile Manufacturer

Everest practices the spirit of dematerialization by "Re-thinking" and "Re-design". Everest uses the concept of eco-friendliness and green design to combine with water-based polyurethane foam coating and lamination technology to create "Ever Eco-Innovative Soft Shell". This novel design could minimize energy consumption and reduce waste in production process. More importantly, it comes from the special micro-porous membrane, which provides higher air and moisture permeability, soft feeling and comfortable. Such shell is the suitable for outdoor jacket and pants for outdoor, skiing, leisure and casual wear.

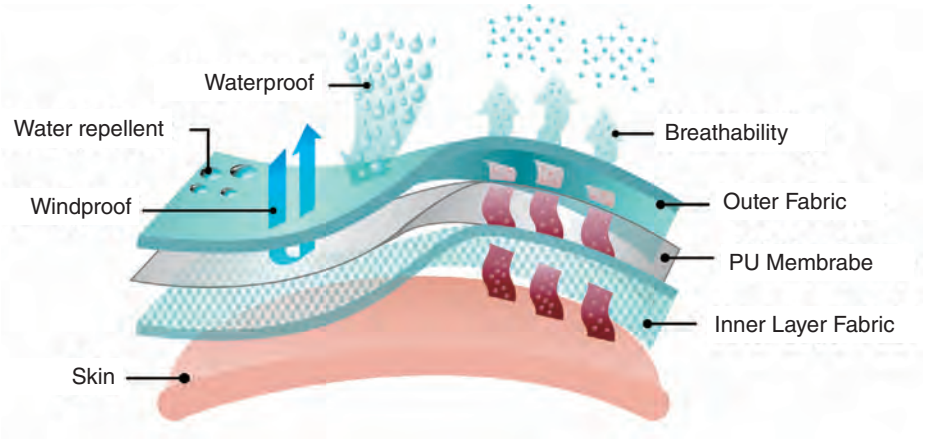


Illustration of 3-layer fabrics, Soft Shell

Everest Eco-Innovative Soft Shell

(Source: Everest Textile Sustainability Report, 2013)

(2) Innovative Initiatives for Detoxification

Project: High-Transparent Polypropylene
Company: LCY Chemical (LCY)/Chemical Material Manufacturer

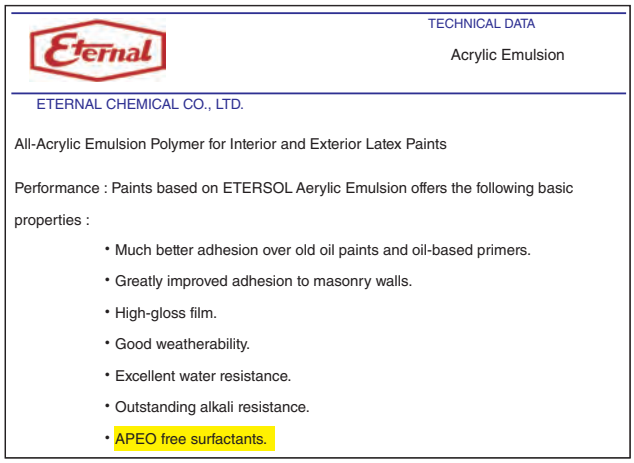
For the infants' health, EU has banned the use of Polycarbonate in baby bottles application because of containing Bisphenol A. LCY developedthe new high-transparency polypropylene (PP), which features toxic-free and good appearance.This new PP has been used in baby bottle market massively and gained customers' recognition.

LCY High-Transparent Polypropylene

(Source: Green Factory Label, 2013)

Project: Alkylphenol-Free Product
Company: Eternal Chemical (Eternal)/Chemical Material Manufacturer

Most water-based emulsions contain alkylphenols, which is a type of environmental hormone. If improperly disposed into the emulsion, it will be detrimental to the environment and living species. Eternal has been engaged in R&D, attempting to produce alkylphenol-free water-based emulsions by replacing the harmful alkylphenols with non-phenol surfactant to reduce harm to the environment



TECHNICAL DATA

Acrylic Emulsion

ETERNAL CHEMICAL CO., LTD.

All-Acrylic Emulsion Polymer for Interior and Exterior Latex Paints

Performance : Paints based on ETERSOL Aerylic Emulsion offers the following basic properties :

- Much better adhesion over old oil paints and oil-based primers.
- Greatly improved adhesion to masonry walls.
- High-gloss film.
- Good weatherability.
- Excellent water resistance.
- Outstanding alkali resistance.
- APEO free surfactants.

Properties for Acrylic Emulsion with Alkyl Phenol Ethoxylate (APEO) Free
(Source: Green Factory Label, 2013)

(3) Innovative Initiatives for Decarburization

Project: Wind Power Generator from Waste Gas
Company: Unimicron Technology (Unimicron)/Printing Circuit Board Manufacturer

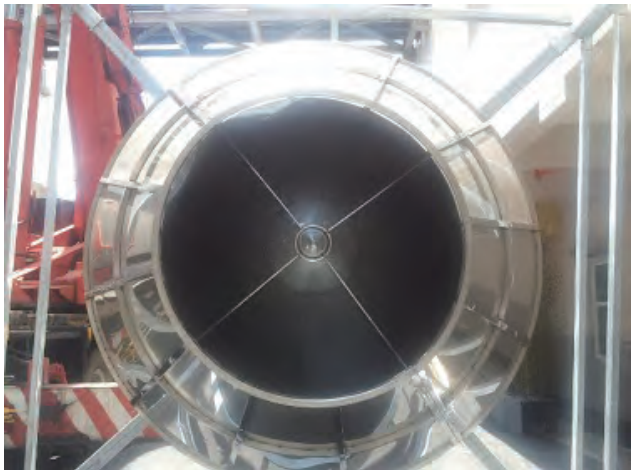
Unimicron has set up a wind power generator system in the R&D Building, which utilizes the gas emitted from the exhaust tower and recycles it for power generation. This invention, patented in 2012, helps reduce energy consumption.

Wind power generator functions by spinning the blades with gas flows to convert wind power into electricity power. Since the blades are spun by gas flows, the aeronautics of the blades has significant impacts on the wind power output performance. The applications of aeronautic technology have helped improve the wind power generator's output efficiency. In 2012, Unimicron built two sets of wind power generators with larger power (2 kW) in the new building. With the application of the new ducting hose design, the wind speed of the exhaust has been optimized, which not only provides the activating energy the wind power shades require, but also accelerates the spinning speed to optimize the power generation efficiency.

中華民國專利證書

Patent Certification

Sketchschemagraph



Wind Shields
(Source: Unimicorn Corporate Social Responsibility Report, 2012)

Project: Introduction of Module Design
Company: Delta Group (Delta)/Electricity Facilities Manufacturer

Delta produced new NH Plus Uninterrupted Power System (UPS) products, which uses patented precision circuit structure and superior ventilation design, yielding a maximum power/density ratio of modules. Each power module delivers 20 kVA power density which is noted for its delicate compactness in the industry, with a power level of only 3U (U as the minimum central processing unit power unit).

The NH Plus series UPS is able to assist customers in reducing waste and conserving energy, as well as reducing the cost of running their business.

Delta UPS systems feature the following:

- Leading AC-AC Efficiency
- Fully redundant and configuration design
- High input and output power factors
- Low total harmonic distortion of the current
- Easily expandable without requiring additional hardware

Delta UPS Product

(Source: Delta Corporate Social Responsibility Report, 2012)

Project: Establishment of Network Carpool
Company: AU Optronics (AUO)/Computers and Accessories Manufacturer

AUO not only reserves exclusive parking spaces on its facility for shared vehicles but also promotes the idea of carpool for inter-facility commute.

Since 2010, AUO has been mobilizing carpooling campaigns. The platform provides carpool riders information and match-up service for would-be riders. Company staff can easily log on to this platform to request carpool ridership or announce carpool information.

To encourage more colleagues to participating in this activity, AUO organized the "Energy Saving Star" and "Carbon Reduction Star" contests in 2011. If carpool passengers can attain a top 5 ranking in monthly carbon reduction index, they will receive a gift and will be honored as "Energy Saving Star" of the month.

For car drivers, if they can reach any of the top 5 rankings in monthly carbon reduction index, they will be granted a carpool pass, and will be honored as "Carbon Reduction Star" of the month. As such, they can park their cars in exclusive parking spaces reserved for carbon reduction stars.

Such establishment yields better utilization of share rides, with the increase of use rate from 69 to 92%, saving 14,000 tons of gasoline annually.

"Carpooling" Platform

(Source: AUO Corporate Social Responsibility Report, 2011)

5.12 Prospect

As environment and sustainable development topics gain increasing prevalence, environment has become the fundamental principle for global businesses to operate and demonstrate their values defined in terms of sustainable development. Given the inevitable pressure for keeping up with the global fashion, R.O.C. introduces “Green Factory Labeling” system, urging businesses alike to position themselves toward operations with high efficiency, high value added, and low carbon.

The introduction of Green Factory Label not only encapsulates a variety of critical issues pertaining to sustainable development but summarizes international environment standards and regulations. R.O.C. strongly recommends that businesses promote Green Factory and Cleaner Production pursuant to the Green Factory Labeling to advance green competitiveness. The former is an effort that centers upon the harmony between factory efficiency, users, and nature for the creation of safe, healthy and sustainable workplace. The latter can be measured through quantification, which facilitates better crystallization throughout manufacture end-to-end management.

Enterprises that stress the demand for cleaner production techniques and sustainable development may not benefit in the short run; however, such engagement helps them build the potential for long term stable growth and risk control, enabling them to overcome enormous challenges against major global changes. R.O.C. expects that Green Factory can facilitate industrial sustainable development and initiate an international green market, in which green trade can be carried out to the fullest extent.

Green Factory Label Awards Ceremony

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Champion Group (Champion)	+886-3-7583809	+886-3-7583127	export@mail.champion.com.tw	www.champion-tile.com	No. 200-7, Zhugaocuo, Dapu Li 13 Lin, Zhunan Town, Miaoli Hsien, Taiwan (R.O.C.)
Delta Group (Delta)	+886-2-87972088	+886-2-87972338	mkt-serv@delta.com.tw	http://www.deltaww.com	No. 186, Ruiguang Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)
Eternal Chemical (Eternal)	+886-8-8669009	+886-8-8669808	Kelvin_chiu@email.eternal-group.com	http://www.eternal-group.com	No. 23, Pingnan Rd., Fangliao Township. Pingtung County 94041, Taiwan (R. O. C.)
Everest Textile (Everest)	+886-6-5786215	+886-6-5782864	luna.liu@everest.com.tw	http://www.everest.com	No. 256, Minghe Vil., Shanshang Dist.,Tainan City 74342, Taiwan (R.O.C.)
Formosa Plastics Group (FPG)	+886-2-27122211	+886-2-27129211	None	http://www.fpg.com	No. 201 Tung Hwa North Road Taipei, Taiwan (R.O.C.)
Minnesota Mining& Manufacturing Company (3M)	+886-2-27049011	+886-2-27049011	cchan@mmm.com	http://3m.com	6F., No. 95, Sec. 2, Dunhua S. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)
MitraStar Technology Corporation (MitraStar)	+886-3-5777998	None	info@mitrastar.com.tw	http://www.mitrastar.com	No. 6, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan (R.O.C.)

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Qisda Corporation (Qisda)	+886-3-3598800	+886-3-3599000	Ves.Lu@Qisda.com	http://www.Qisda.com	No. 157 Shan-ying Road, Gueishan, Taoyuan 333, Taiwan (R.O.C.)
Unimicron Technology (Unimicron)	+886-3-3500386	+886-3-3501396	tenfenshuang@unimicron.com	http://www.unimicron.com	No. 179, Shanying Rd., Gueishan Industrial Park, Taoyuan County 333, Taiwan (R.O.C.)
Taiwan Semiconductor Manufacturing Company Limited (TSMC)	+886-3-5054602	+886-3-5682085	elizabeth_sun@tsmc.com	http://www.tsmc.com	No. 8, Li-Hsin Rd. VI, Hsinchu Science Park,Hsinchu, Taiwan 300-78 (R.O.C.)
The Dow Chemical Company (DOW)	+886-3-7539100 #9158	+886-3-7584060	ElysiaHsieh@dow.com	http://www.dow.com	No. 6, Kesi 2nd Rd, Jhunan, Miaoli, Jhunan Site, Hsinchu Science-Based Industrial Pard, Taiwan 35053. (R.O.C.)
United Microelectronics Corporation (UMC)	+886-3-5782258	+886-3-5779392	ir@umc.com	http://www.umc.com	No. 3, Li-Hisin 2nd Road, Hsinchu Science Park, Hsinchu, Taiwan (R.O.C.)

How APO Member Countries Will Benefit

The APO COE GP will enhance, demonstrate and share with other countries its excellence in GP. It shall develop models in various sectors including manufacturing, service and agriculture to serve as showcase to inspire stakeholders in member countries. It shall initiate research to be undertaken in collaboration with APO on green issues. It shall provide technical assistance in specific sectors and provide experts to member countries when needed. A database on GP experts and other indicators will be established by the COE on GP to serve the needs of members. The data base will be made available online to community of experts and practitioners. Best practice manuals and handbooks shall be published to serve the needs of all stakeholders.

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