HOW DOES TSMC DEAL WITH SUSTAINABLE SEMICONDUCTOR MANUFACTURING IN TAIWAN?

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SEMICON West 2015
Moscone Center, San Francisco
July 14, 2015
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High-Tech Facility Research Center

Education:
• PhD, The University of Texas at Austin, USA  
  (美國德州大學營管工程及專案管理博士)

Experience:
• Professor, Department of Civil Engineering,  
  National Taiwan University  
  (國立台灣大學土木工程學系 教授)

• Professor Emeritus, Purdue University,  
  West Lafayette, USA  
  (美國普渡大學工學院 名譽教授)

• Facility Engineer, Industry Technology  
  Research Institute (ITRI, 1974-1977), Taiwan  
  (工研院積體電路示範工廠建廠工程師)
Presentation Outline

• Market Position
• Fabs Facilities
• EHS Issues
• Green Energy
• Water & Waste Recycling
• Green Building/Fab
• Concluding Remarks
Academic View on Sustainable Manufacturing from the Angle of Fab Facility
Presentation Outline

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### 2014F Top 20 Semiconductor Sales Leaders ($M)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Intel</td>
<td>U.S.</td>
<td>48,321</td>
<td>51,368</td>
<td>6%</td>
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<tr>
<td>2</td>
<td>2</td>
<td>Samsung</td>
<td>South Korea</td>
<td>34,378</td>
<td>37,259</td>
<td>8%</td>
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<tr>
<td>3</td>
<td>3</td>
<td><strong>TSMC</strong></td>
<td>Taiwan</td>
<td>19,935</td>
<td>25,088</td>
<td>26%</td>
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<tr>
<td>4</td>
<td>4</td>
<td>Qualcomm**</td>
<td>U.S.</td>
<td>17,211</td>
<td>19,100</td>
<td>11%</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Micron + Elpida</td>
<td>U.S.</td>
<td>14,294</td>
<td>16,614</td>
<td>16%</td>
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<tr>
<td>6</td>
<td>6</td>
<td>SK Hynix</td>
<td>South Korea</td>
<td>12,970</td>
<td>15,838</td>
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<tr>
<td>7</td>
<td>8</td>
<td>TI</td>
<td>U.S.</td>
<td>11,474</td>
<td>12,179</td>
<td>6%</td>
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<td>8</td>
<td>7</td>
<td>Toshiba</td>
<td>Japan</td>
<td>11,958</td>
<td>11,216</td>
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<td>9</td>
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<td>8,219</td>
<td>8,360</td>
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<td>10</td>
<td>10</td>
<td>ST</td>
<td>Europe</td>
<td>8,014</td>
<td>7,374</td>
<td>-8%</td>
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<td>11</td>
<td>11</td>
<td>Renesas</td>
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<td>7,372</td>
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<tr>
<td>12</td>
<td>12</td>
<td>MediaTek + MStar**</td>
<td>Taiwan</td>
<td>5,723</td>
<td>7,142</td>
<td>25%</td>
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<tr>
<td>13</td>
<td>14</td>
<td>Infineon</td>
<td>Europe</td>
<td>5,260</td>
<td>6,151</td>
<td>17%</td>
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<tr>
<td>14</td>
<td>16</td>
<td>NXP</td>
<td>Europe</td>
<td>4,815</td>
<td>5,625</td>
<td>17%</td>
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<tr>
<td>15</td>
<td>13</td>
<td>AMD**</td>
<td>U.S.</td>
<td>5,299</td>
<td>5,512</td>
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<td>16</td>
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<td>Sony</td>
<td>Japan</td>
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<td>17</td>
<td>15</td>
<td>Avago + LSI**</td>
<td>Singapore</td>
<td>4,979</td>
<td>5,087</td>
<td>2%</td>
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<td>19</td>
<td>Freescale</td>
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<td>3,977</td>
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<td>19</td>
<td>20</td>
<td>UMC*</td>
<td>Taiwan</td>
<td>3,940</td>
<td>4,300</td>
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<td>20</td>
<td>21</td>
<td>Nvidia**</td>
<td>U.S.</td>
<td>3,898</td>
<td>4,237</td>
<td>9%</td>
</tr>
</tbody>
</table>

**Top 20 Suppliers**

|  | 237,379 | 259,562 | 9% |

**Top 20 Suppliers Excluding Foundries**

|  | 213,504 | 230,174 | 8% |

*Foundry

**Fabless

Source: IC Insights’ Strategic Reviews Database
<table>
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<td>4</td>
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<td>4.9</td>
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<td>5</td>
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<td>-4.8</td>
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<td>Powerchip</td>
<td>917</td>
<td>2.0</td>
<td>862</td>
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<td>7</td>
<td>10</td>
<td>TowerJazz</td>
<td>828</td>
<td>1.8</td>
<td>505</td>
<td>64.0</td>
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<tr>
<td>8</td>
<td>7</td>
<td>Vanguard International</td>
<td>790</td>
<td>1.7</td>
<td>712</td>
<td>11.0</td>
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<td>Shanghai Huahong Grace</td>
<td>665</td>
<td>1.4</td>
<td>555</td>
<td>19.7</td>
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<td>Semiconductor Manufacturing2</td>
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<td>13</td>
<td>Fujitsu Semiconductor</td>
<td>653</td>
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<td>459</td>
<td>42.2</td>
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<td>Others</td>
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<td>4,052</td>
<td>9.1</td>
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<td>Total Market</td>
<td>46,852</td>
<td>100</td>
<td>40,349</td>
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</table>
Taiwan Market Continues to Lead the Semiconductor Industry in Equipment and Materials Spending
$21 billion 2014 and $22 billion in 2015
Source: Dan Tracy and Clark Tseng, SEMI July 2014
Presentation Outline

• Market Position
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• Concluding Remarks
# TSMC Fabrication Facilities

## 6” & 8” FAB
- **8” FAB Overseas**
  - Fab10 (Shanghai)
  - Fab11 (USA)
  - SSMC (Singapore)*
- **8” FAB Taiwan**
  - Fab 2
  - Fab 3
  - Fab 5
  - Fab 6
  - Fab 8

## 12” FAB
- **Fab12**
  - P1/P2
  - P3
  - P4/5
  - P6
- **Fab14**
  - P1/P2
  - P3/4
  - P5/6
  - P7
- **Fab15**
  - P1/P2
  - P3/P4
  - P5/P6
  - P7

## Solar/LED
- **Solar P1**
- **LED P1**

## Backend
- **BP2**

*JV with NXP*
Sustainable Strategy—Continuous Improvement

- 2014 Q2: Fab15 P1~P4 for 28 nm,
- 2015 Q3: Fab14P7~8 for 16 nm
- 2016 Q3: Fab15P5~6 for 10nm
- 2017~2018: Fab 15 P7~P9 for 7~5nm
- Below 5nm Process and 450mm(18”) Fab are under R&D
- Fab Construction from ground breaking to tools move-in takes 8~12 months to finish
- In total, it take 18~24 months from Business Decision to Massive Volume Production
- Continue to build Fab in advance
- Get ready for Client’s immediately advancement to the next generation of product manufacturing
Sustainable Strategy--Satisfy Client’s Needs

- Cutting-edge process technologies
- Good Product Quality
- High Yield
- Reasonable Price
- Timely Delivery
- Good Faith Practice
- Increase Competitiveness
- Profit
Presentation Outline

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# A Power House of Semiconductor Manufacturing

## 6” & 8” FAB
- **8” FAB Overseas**
  - Fab10 (Shanghai)
  - Fab11 (USA)
- **8” FAB Taiwan**
  - Fab 3
  - Fab 5
  - SSMC (Singapore)*
- **6” FAB**
  - Fab 2
  - Fab 8

*JV with NXP*

## 12” FAB
- Fab12
  - P1/P2
  - P3
  - P4/5
  - P6
- Fab14
  - P1/P2
  - P3/4
  - P5/6
  - P7
- Fab15
  - P1/P2
  - P3/P4
  - P5/6
  - P7

## Solar/LED
- Solar P1
- LED P1

## Backend
- BP2

## Fab12P7 Tool Move-in, Fab15P5/P6 Construction
Fab12P8, Fab15P7,P8,P9 Planning
Taiwan Island

- Total area: 36,000 km² (394 km long, 144 km wide)
- Highest elevation: 3,952 m (Jade Mountain Peak)
- Population: 23 millions (640 people/km²)
- Average annual rainfall depth: 2,500 mm
Collision of Eurasia & Philippines Plates
Seismicity in Taiwan (1900-2011)

Tectonics of Taiwan

Collision of Eurasia & Philippines Plates
Seismic-Dampening System

• New approach to mitigate the damage of clean room in an earthquake
  – designed for earthquake of PGA ≤ 75 gals
    (= 95% earthquake risk portfolio)
  – reducing average acceleration at clean room level by 21%
  – reducing average displacement at clean room level by 43.5%

This simulation was based on four stations during 921 earthquake. (下營, 新化, 善化, 渡拔國小)
Earthquake Early Warning System (EEWS)
Integrated EEWS for Science Parks

NCREE On-site EEWS at Hsinchu
NCREE On-site EEWS at Taichung
NCREE On-site EEWS at Tainan
NCREE Regional EEWS
Global Seismograph Network
CWB Regional EEWS

Warning time / Epicenter distance:
~15s / ~60km
~20s / ~100km
ACE AAA Program Benchmark--higher than industrial average

- Documentation for Fire Safety Rules
- Exhaust Systems
- Housekeeping Standards
- Maintenance Standards
- Electrical Installation Inspections
- Cutting and Welding Controls
- Smoking Controls
- Self-Inspection Procedures
- Fire Protection Training
- Watchman Services/Security
- Contingency Planning
- Fire Prot. Equip. Impairment Procedure
- Water Supplies for Fire Fighting Purpose
- Fire Brigade Facilities
- Automatic Sprinkler Systems
- Fire Hydrant Systems
- Automatic Detection Systems
- Fire Hose Reels
- Fire Cut-Offs
- Portable Fire Extinguishers
- Exposures
- Fire Cut-Offs
- Dispensing of Hazardous Gases
- Storage of Hazardous Gases
- Dispensing of Flammable Liquids
- Storage of Flammable Liquids
- Cleanroom Smoke Control System
- Protection of Hazardous Process Tools
- Housekeeping Standards
- Maintenance Standards
- ACE Semiconductors Industry Average (Fabs in Taiwan, China, Singapore, Malaysia, and Korea)
- TSMC Status (Fab-5, 6, 8, 12, 14)
Risk Management on EHS

- Compliant to AAA criteria

- Inherent safe fab design
- MFL wall separating phases of fab
- Detached HPM Building
- More than two independent fire water supplies
- Open landscape for Bulk Silane
- Dampening system to minimum production impact
- Fully sprinklered premise installed to NFPA
- Physical separation
- Safety corridor to reduce loss
- HPM safeguards per FM and NFPA
MFL Fire and Physical Separation

• **Concept:** Each phase is a separate risk

• **Design:**
  - Over 30 meters isolation distance for P2 and P3 building
  - 4-hr rated MFL Wall Configuration, double fire walls (2-hr. rated for each) with 3-m wide corridor in between
Redundancies, Dual system/source and Emergency Power

– Built-in redundancies in facilities support equipment (such as DI water, chillers/cooling tower, transformers, process water pumps, central scrubbers, etc.)

– At least dual source (and in separate areas) of process water supply and power supply with provision for interconnection, if need arises.

– Dual and separate source of bulk gas and chemicals, specialty gas and chemicals. Pipes are run in separate areas.

– Dual and separate water sources and pumps for fab fire protection system

– Adequate emergency power for critical process tools and for maintaining clean room environment
“Dual Bus-bar” Power Supply

• New Design (F14P3, F12P4...)
  – Dual supplies, no bottleneck
  – Significantly increase power supply reliability

• Typical Design (tsmc’s existing fabs)
  – Dual supplies but subject to single failure of GIS common bay
  – Spare Parts Pool for each type of GIS common bay have been Established
Giga Bridge Risk Management

- Signal connection with P2&P3 Fire, Gas leakage and earthquake system for safety interlock, which supplied by UPS power.

<table>
<thead>
<tr>
<th>Event Scenario</th>
<th>Fire Doors (Normal Open)</th>
<th>AMHS Fire Shutters (Normal Open)</th>
<th>Warning Strobe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fire Event</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>Doors Close</td>
<td>Shutters Close</td>
<td>P2 Entrance</td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td></td>
<td>P3 Entrance</td>
</tr>
<tr>
<td>Bridge</td>
<td></td>
<td></td>
<td>P2 and P3 Entrance</td>
</tr>
<tr>
<td><strong>Gas Leak Event</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>P2</td>
<td>P2 Entrance Door Close</td>
<td>No Action</td>
<td>P2 Entrance</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Entrance Door Close</td>
<td></td>
<td>P3 Entrance</td>
</tr>
</tbody>
</table>

Warning Strobe

Fire door close
## Emergency Response Center, ERC

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Fire Alarm System</td>
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<tr>
<td>Very Early Smoke Detection System</td>
<td></td>
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<tr>
<td>W/B Fire Alarm System</td>
<td></td>
</tr>
<tr>
<td>Sprinkler System</td>
<td></td>
</tr>
<tr>
<td>Emergency Cabinet</td>
<td></td>
</tr>
<tr>
<td>Emergency Response Procedure</td>
<td></td>
</tr>
<tr>
<td>Gas Monitoring System</td>
<td></td>
</tr>
<tr>
<td>Seismic Monitoring System</td>
<td></td>
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<tr>
<td>De-smoke System</td>
<td></td>
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<tr>
<td>CCTV/ PA (Public Address) System</td>
<td></td>
</tr>
<tr>
<td>Wireless Communication System</td>
<td></td>
</tr>
<tr>
<td>Electrical Monitoring System</td>
<td></td>
</tr>
<tr>
<td>Emergency Response Tools</td>
<td></td>
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</table>
Presentation Outline

• Market Position
• Fabs Facilities
• EHS Issues
• Green Energy
• Water & Waste Recycling
• Green Building/Fab
• Concluding Remarks
Inside: Consume Huge Natural Resource
Outside: May cause Environmental Issues

Source: Tim Cheng
Real-time Energy Efficiency Management System

- **Energy Balance for All User Points**

- **Total Energy Management:**
  - **Real-Time Monitoring:** Data Collection and analysis in every 15 minutes
  - **Total Monitoring:** Total balance check from inside out.
  - **Efficiency Management:** Peak and off peak time management loading management

### Energy Balance for Analysis Result

<table>
<thead>
<tr>
<th>Energy note</th>
<th>Energy Usage (%)</th>
<th>AVG. consumption (Total consumption)</th>
<th>Unit</th>
<th>Time of Use</th>
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</thead>
<tbody>
<tr>
<td>[1] Fab 15 Power Total Consumption P12_Power_Total_15m [AN] (P1&amp;P2 Power Total)</td>
<td>100.0 %</td>
<td>87,383,854 (8,388,349,981)</td>
<td>kW</td>
<td>Half peak: 62.5 %, Off peak: 37.5 %</td>
</tr>
<tr>
<td>[1] Facility</td>
<td>40.7 %</td>
<td>35,616,008 (3,419,136,670)</td>
<td>kW</td>
<td>Half peak: 62.6 %, Off peak: 37.4 %</td>
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<tr>
<td>[2] Process Tool</td>
<td>56.4 %</td>
<td>49,305,281 (4,733,307,000)</td>
<td>kW</td>
<td>Half peak: 62.3 %, Off peak: 37.7 %</td>
</tr>
<tr>
<td>[3] Office</td>
<td>1.2 %</td>
<td>1,016,823 (97,615,000)</td>
<td>kW</td>
<td>Half peak: 70.9 %, Off peak: 29.1 %</td>
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<tr>
<td>Other</td>
<td>1.7 %</td>
<td>1,445,742 (138,791,311)</td>
<td>kW</td>
<td></td>
</tr>
</tbody>
</table>

**Peak and Off-Peak Consumption Ratio**
Real-time Energy Efficiency Management System

Power Tree Management: From Top to Bottom

- **Node 1**: Plant Overview
- **Node 2**: Process, Facility, Office
- **Node 3**: Process Areas, Facilities Systems

Ex: Node 3 Facilities Systems
# Real-time Energy Efficiency Management System

**Efficiency Analysis:** Real time analysis in every 15 minutes to monitor the unit cost per kWh, peak/off-peak monitoring, loading factor.

<table>
<thead>
<tr>
<th>Energy Node / Variable</th>
<th>Type</th>
<th>Energy Use Unit Cost</th>
<th>Timezone</th>
<th>Cost Percentage</th>
<th>Energy Use Percentage</th>
<th>Average Use</th>
<th>Maximum Use</th>
<th>Load Factor</th>
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<tr>
<td>[1].Fab 15 Power Total Consumption P12_Power_Total_15m [AN] (P1&amp;P2 Power Total)</td>
<td>Node</td>
<td>$2.68</td>
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<tr>
<td>[1].Facility</td>
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<td>[3].Office</td>
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<td>$2.68</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Cost Efficiency ($/kWH) by Node**
- **Peak / Off-Peak Ratio**
- **Loading Factor to maximize the equipment efficiency**
**Real-time Energy Efficiency Management System**

- **Energy Regression**: From historical data to prediction model to be capable of daily management and target budget setting.

  **Energy Performance Trend**

  *Actual Consumption vs. Regression Model*

  **Baseline Period**
  - **EnPI Start**: 2014-01-01 00:00
  - **EnPI End**: 2014-02-14 00:00
  - **Expressions**: $\frac{CL}{(BD \times 0.653061224)}$
  - **EnPI Model**: $-0.00002212070174 \times BD + 0.043554903281787 \times BI + 32.6116311046594$

  **Factor of Energy Consumption in Regression Model**

  **Auto Alert for Deviation of Consumption**
Improve Energy Use Effectiveness in Cleanroom

- Traditional class-1 bay and chase cleanroom
- Mini-environment within class-100 ballroom
- FOUP (micro) environment within class-10,000 ballroom
Eco-Mode UPS

- Replace UPS operation mode from on-line mode (efficiency 94%) to Eco-mode (efficiency 99%), switch to battery supply within 4ms when voltage dip or outage.
- Energy saving 5% for each set.
Cancelled heat boiler system.

Waste heat recovered from 12°C chiller then provided to 35°C warm water system

Heat recovery main unit, hot water supply procedure

Cancelled the electrical heating, gas boiler setup
Air Reclaim Practice

- Recover the general exhaust air recovery from the manufacturing area and use in secondary areas (recovers 30% of general exhaust air).
- Reduce the energy consumption of external air cooling and drying, which saves 3 million kilowatts of operation electricity each year.
Application of Smart Parking Management

- The Smart Parking Management System utilizes RFID eTag technology.
- Due to the large amount of parking and vehicle search time saved, the fuel consumption and exhaust gas emission produced by the vehicles were reduced as well.
- Using FAB15 as an example, the CO$_2$ emission saved each year is 422 tons which is equivalent to planting 36,310 trees.
Presentation Outline

• Market Position
• Fabs Facilities
• EHS Issues
• Green Energy
• Water & Waste Recycling
• Green Building/Fab
• Concluding Remarks
TSMC Water Use Status

In 2013, annual **city water consumption**: 29.8 million tons, the annual **wastewater**: 19 million tons.

- **Cooling towers evaporation**: -10,049,170 tons
- **Irrigation**: -151,445 tons
- **Rain Reuse**: +52,333 tons (in 2014)
- **Condensed water recycling**: +1,814,685 tons

資料來源：台積公司 2013年企業社會責任年報
TSMC Water Consumption and Effectiveness

- 2009-2013:
  - Main mass production technology enhanced from 45nm to 28nm
  - Production increased by 1.7 times, water consumption 1.8 times
  - Unit water consumption effectiveness increased by 30%

資料來源：台積公司 2013年企業社會責任年報
TSMC Wastewater Discharge

- 2009-2013:
  - Main mass production technology enhanced from 45nm to 28nm
  - Increased by 1.7 times, water consumption reduced by 1.8 times
  - Unit wastewater discharge reduced by 27%

資料來源：台積公司 2013年企業社會責任年報

TSMC Property
TSMC Water Conservation Efficiency (2009-2013)

- Average process water recycling rate increased from 83.4% to 86.9%. Recycle water achieved to 52.77 million tons in 2013, 1.77 times of city water consumption.

- Meanwhile according to WSC, the unit water consumption of Taiwan Semiconductor Industry was only 38% comparing to the US, 54% to Japan, 70% to South Korea.

![Water Consumption Comparison](chart.png)

資料來源：世界半導體協會 WSC Y2013
Every drop of water is reused 3.5 times in TSMC

(Recycled Water Y + City Water Z) / (City Z) = Water Reuse Times

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<td>每滴水使用次數</td>
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The need for cooling tower is low in winter. Condensed water was drained as waste water.

The quality of MAU condensed water is good. It can be treated thru RO and recycled back to pure water system and air washer use.

If the quality is not good, it could be switched to be used by cooling tower.
Recycled Waste Water and Silicone Powder after Backside Grinding, BG

1. Purity > 99.99% (4N)
2. Particle Size > 1um
Recycled Rain Water

After pH and conductivity check, the recycled rain could be distributed to landscaping use, secondary quality use or rain sewer.
Waste Water Recycling

Based on the type of chemicals and their concentration, 25 chemicals are separately treated.

- IPA
- $\text{H}_3\text{PO}_4$
- M1
- M2
- Thinner
- NMP
- $\text{H}_2\text{SO}_4$
- $\text{CuSO}_4$
- TMAH
- ACT/ST250
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TSMC Green Action & Green Power
Application of Green Building Certificates

LEED
- Site Selection
- Development Density Control
- Brownfield Redevelopment
- Fundamental Energy Commissioning
- Measurement and Verify
- Refrigerant Management (CFC)
- Green Power
- Alternative Transportation
- Environmental Tobacco Smoke Control
- Construction IAQ Management Plan
- LEED® Accredited Professional

EEWH
- Eco Environment Preservation
- Stormwater Design
- Heat Island Effect
- Water Use Reduction
- Optimize Energy Performance
- On-Site Renewable Energy
- Increased Ventilation
- Construction Waste Management
- Materials Reuse
- Certified Material
- IEQ Enhancement
- Waste Water Reduction
- Biological Diversity Assessment
- Greening Index
- Building CO₂ Reduction
- Construction Soil Balance
- Indoor Sonic Environment
- Onsite Inspection
- Garbage Storage Renovation
# Green Building Certificates

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: Under Review  : Application Preparing
TSMC Green Manufacturing Statistics

- **12 Energy Conservation Outstanding Performance Awards**
- **13 LEED Green Buildings**
- **9 Low Carbon Enterprise**
- **9 Taiwan Enterprises Environmental Protection Awards**
- **8 EEWH Green Buildings**
- **7 Water Conservation Outstanding Performance Awards**

TSMC Green Manufacturing
Green Landslope

加勁擋土牆

生態河道

現場實際照片
Animal and Insect Pass Duct
Repopulate Wild Lilly and Diversify Ecosystem
Solar Panel on Exterior Wall and Roof
TSMC’s Green Path for Sustainability

2006
Formed a task force, and invited consultants to learn green buildings
Established Green Building Project

2008
Learning for Green Building
Get an award-winning Design spec.
Growing

2010
Harvest
Green Campus
Hsinchu site F12
Tainan site F14
Taichung site F15
Sharing

2012
Co-worked with MOEA to build ”Green Factory” standards
F12P4/5 received the US LEED certification with 6,100 man hours invested
Held the “TSMC Green Building Forum”, called and established the “Taiwan Corporate Sustainability Forum”
F14P3 received Taiwan’s 1st LEED certification with 13,900 man hours invested

2014
2014-2017: expect to receive green building certifications for 12 future fabs and office buildings

“TSMC Green Act” and “TSMC Green Power” books published in 2013
Held “Industrial Energy Saving Training Courses “ in 2012
Held “Industrial Water Saving Training Courses ” in 2011

Uniting
Promote and share the concept of Green Buildings, Green Science Park, and Green Taiwan

Growing
Learning
Get an award-winning Design spec.

Learning

Co-acting
Presentation Outline

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Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987)
The United Nations Conference on Sustainable Development-Rio 20
http://www.thesustainableleader.org/sustainable-development

- Met at Rio de Janeiro, Brazil, June 20-22, 2012
- To ensure the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations
- Eradicating poverty and freeing humanity from poverty and hunger as a matter of urgency
Save our Mother Earth

http://www.slideshare.net/arpitgupta31149/save-our-mother-earth
Thanks and Acknowledge

Tim Cheng
Arthur Chuang
Marie Lee
Sophie Lin
Patty Pan
Frank Sun