Policy Practice and Technology Applications – Experiences on Low Carbon Emission Operations in Chinese Taipei

Purpose: Information
Submitted by: Chinese Taipei
Policy Practice and Technology Applications – Experiences on Low Carbon Emission Operations in Chinese Taipei

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Industrial Technology Research Institute
Chinese Taipei

2014.8.20
Outline

- Project Overview
- Policy Research
- Field Verification
- Workshop & Training Course
- Conclusion
# Project Overview

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Field Verification</td>
<td>Shop Floor Analysis &amp; Energy Saving Suggestions</td>
<td>Data Analysis &amp; Performance Evaluation</td>
<td></td>
</tr>
<tr>
<td>Workshop &amp; Training Course</td>
<td>Event Design Speakers and Participants Innovation Tour Preparation</td>
<td>8/25-28 Take Place</td>
<td>Analyze the Questionnaire</td>
</tr>
</tbody>
</table>

**Objectives:**

- Deliver **policy suggestions and applicable models**
- Promote **collaboration within APEC economies**
Outline

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Energy Outlook in APEC

- 60% of world’s energy consumption
- Continue to grow by 53% in 2035 → CO₂ by 46%

Energy Efficiency Target: Improve 45% by 2035
## Chinese Taipei Energy Saving Project

### Target:

- **Aggressive & Voluntary**

  ✓ **Aggressive:** Energy Efficiency $\uparrow 2\% / \text{year}$, $\geq 50\%$ by 2025
  
  ✓ **Voluntary:** Achieve 2000 Emission Level by 2025

### Low-carbon Energy System

1. New Generation Energy Plan
2. Reduce CO$_2$ Emission of Electricity Generation
3. Smart Grid

### Low-carbon Community and Society

1. Low-carbon Community
2. Low-carbon City
3. Low-carbon Island
4. Green Consumption Trend and Life Style

### All-sector Action Plan

#### Low-carbon Industry

1. Energy Conservation and Carbon Reduction
2. Green Energy Industry

#### Low-carbon Transportation

1. Smart and Low-carbon Transportation
2. Human-oriented Transportation Environment
3. Raise New Cars’ Efficiency
4. Electric Vehicles

#### Low-carbon Buildings

1. Green Buildings
2. Green Infrastructure

### Public Awareness

1. Energy Conservation and Carbon Reduction Education
2. Public Communication and Government Propaganda

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Well-defined Scope
Internationally recognized methodology to plan, measure and continually improve energy performance

- Manage Commitment in:
  1. Clear Target
  2. Full Implementation

- Understand, Evaluate and Control Energy Use
- Involve People from Different Position to Work Together

- Shape the energy-efficient culture in the industry
- Fosters technology exchange and cooperation opportunities
Beyond ISO 50001

Conventional Energy Management
- Inefficient
- Energy Usage Pattern Repeats
  Cost high → energy audit

ISO 50001
- Optimized Energy Saving Techniques
- Long-term Effect

Policy Facilitation
- Incentives
- Industry Guidelines

Energy Consumption under Different Management Scenarios

Conventional Energy Management
- Inefficient
- Energy Usage Pattern Repeats
  Cost high → energy audit

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- Incentives
- Industry Guidelines

Energy Consumption under Different Management Scenarios
Team and Technology Insight

Model: Policy Facilitation+ Promotion Team + Advanced Technology

► Energy Conservation Culture

### Integrated Promotion Mechanisms

1. Early Promotion:
   - ESCOs (2005)
   - Taiwan Industrial Greenhouse and Energy Reduction Corps (2010)

2. Early Participation:
   - AUO ISO 50001 in 2010 (Draft Stage)

3. 2,243 Plants → 640 Thousands kL Oil Equivalent↓; 2 Million Tons CO₂↓ (2012)

### Advanced Technology

Provided SMEs 9,478 Energy Saving Solutions (2012)

#### Key Industrial Technology Solutions

<table>
<thead>
<tr>
<th>Industry</th>
<th>Technology</th>
<th>Emission ↓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile</td>
<td>Waste Heat Recovery System</td>
<td>36.6%</td>
</tr>
<tr>
<td>Glass Product</td>
<td>1. Redesign Electric Kiln Furnace</td>
<td>8%</td>
</tr>
<tr>
<td>Tape Product</td>
<td>2. Homogenize the Temperature of Melting Process</td>
<td></td>
</tr>
<tr>
<td>Tape Product</td>
<td>1. Integrate the Solvent Recycling Unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Optimize the Manufacture Process</td>
<td></td>
</tr>
<tr>
<td>Automobile</td>
<td>Process Efficiency Evaluation</td>
<td>5-20%</td>
</tr>
<tr>
<td>General Manufacture</td>
<td>Examine Equipment and Provide Improvement Solutions</td>
<td>10-30%</td>
</tr>
</tbody>
</table>

### Global Certified Company List

<table>
<thead>
<tr>
<th>Rank</th>
<th>Economy</th>
<th>No. of Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Germany</td>
<td>3,441</td>
</tr>
<tr>
<td>2</td>
<td>France</td>
<td>973</td>
</tr>
<tr>
<td>3</td>
<td>Netherland</td>
<td>408</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Taiwan (Asia’s Top 2)</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Thailand</td>
<td>41</td>
</tr>
</tbody>
</table>

Source: German Federal Environmental Agency (May, 2014)
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Energy Saving Field Verification

- One Garment and One Textile Thailand Factories

**Building Model Setup**

- Distribution of Energy Consumption
- Energy Retrofit Strategies

**Retrofits Analysis**

- Energy Control Strategies
- Consulting

**Next Step**

- iBEMS Control
- Security Control
- ISO-50001
Strategies and Results

✔ Les Enphant :

1. Steam Boiler System: Improve Energy Performance, Maintenance and Insulation

2. Lighting System: High Performance Lighting

Outcome

<table>
<thead>
<tr>
<th></th>
<th>Energy Conservation (kWh)</th>
<th>Emission Reduction (kgCO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>11,404.8 (30%↓)</td>
<td>7,071.0</td>
</tr>
<tr>
<td>Steam boiler</td>
<td>7,477.0 (5%↓)</td>
<td>4,635.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18,881.8 (10%↓)</strong></td>
<td><strong>11,706.7</strong></td>
</tr>
</tbody>
</table>

Assumption: Emission Factor of Electricity = 0.62kg CO₂/kWh

✔ Suratanapat Textile LTD

1. Steam Boiler System: Heat Pump (Biomass → Electricity)

2. Lighting System: High Performance Lighting

Emission Reduction: 757.6 Tons CO₂ (78.6% ↓)
Technology Promotion Roadmap

Stage 1 (Present Project) : Textile and Garment Industry:
- Occupies Thailand GDP 17%, 3% Industry
- Industry Occupies 32% Emission

Thailand Industrial Emission Distribution

<table>
<thead>
<tr>
<th>Industry</th>
<th>Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food &amp; tobacco</td>
<td>34%</td>
</tr>
<tr>
<td>Refining</td>
<td>6%</td>
</tr>
<tr>
<td>Chemical</td>
<td>8%</td>
</tr>
<tr>
<td>Iron &amp; Steel</td>
<td>5%</td>
</tr>
<tr>
<td>Equipment &amp; machinery</td>
<td>1%</td>
</tr>
<tr>
<td>Paper pulp &amp; print</td>
<td>1%</td>
</tr>
<tr>
<td>Non-metallic minerals</td>
<td>1%</td>
</tr>
<tr>
<td>Non-ferrous metals</td>
<td>0%</td>
</tr>
<tr>
<td>Non-specified</td>
<td>22%</td>
</tr>
<tr>
<td>Textile and Leather</td>
<td>21%</td>
</tr>
</tbody>
</table>

1.1 Small-scale Textile Plant Implementation

<table>
<thead>
<tr>
<th>Measures</th>
<th>Outcome</th>
<th>Macro Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption Evaluation</td>
<td>Energy Consumption ↓10%</td>
<td>228k Tons CO₂↓ (0.1%)</td>
</tr>
<tr>
<td>Lighting and Significant Energy Consumption Unit Replacement or Upgrade</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2 Energy Management + Control System

<table>
<thead>
<tr>
<th>Measures</th>
<th>Outcome</th>
<th>Macro Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Flow, Pressure and Wind Speed Model</td>
<td>Energy Consumption ↓33-40%</td>
<td>912k Tons CO₂↓ (0.4%)</td>
</tr>
<tr>
<td>Real-time Automatic Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case: IBM + TAIYUAN Textile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## What’s Next?

### Stage 2 (Future Project): Expand to other Industries

<table>
<thead>
<tr>
<th>Chinese Taipei’s Technology Innovation</th>
<th>Industries with High Energy Saving Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermoelectric material and module technology</strong></td>
<td>![Pie chart showing energy savings across industries]</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Recycle the Low-temperature ($\leq 300^\circ$C) Waste Heat → Electricity Generation</td>
</tr>
<tr>
<td><strong>Case</strong></td>
<td>500W Small-scale Demo-site (Thermoelectric System, China Steel)</td>
</tr>
</tbody>
</table>
| **Outcome (Annual)** | • ↓ Electricity 39.5 Million kWh  
• ↓ Waste Heat 34G Kcal  
• ↓ CO$_2$ 50 Thousand Tons |

| **CO$_2$ Capture Technology with Calcium Looping Process** | |
| **Application** | Capture CO$_2$ (Calcium Looping) → Store CO$_2$ (Micro Algae) → Biomass or Energy |
| **Case study** | 1.9MWth Pilot Plant (Cement Industry) |
| **Outcome** | • Captures 90% CO$_2$ (Conversion Rate: 15%)  
• ↓ Cost of Capture: 28→26 USD/ton |
| **Applicable Industry** | Iron & Steel, Petrochemical, Cement and Ceramics Industry |

### Industries with High Energy Saving Potential

- **Non-metallic Minerals**: 34%
- **Iron & steel**: 5%
- **Chemical**: 22%
- **Other**: 5%
- **Other**: 3%
- **Other**: 0%

#### Industrial Implementation (47%)

- **Macro impact**: ↓5,041 Thousand Tons CO$_2$/year (2.21%↓)

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### Key Features

**APEC Workshop on Energy Efficiency for a Sustainable Asia-Pacific Community & Training Course on Energy Efficiency**

- **Date:** Aug. 25-28
- **Location:** Grand Hyatt Hotel, Chinese Taipei

**Objective**
An abundant pool for ideas, opinions and opportunities for future collaboration:

<table>
<thead>
<tr>
<th>Participants</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Speakers from Germany, Thailand, Australia, Netherland and Chinese Taipei</td>
<td>➢ Sectors: Government, Industry and RTO</td>
</tr>
<tr>
<td>➢ Participants from Malaysia, Mexico, Thailand, Peru, Chile, Russia, Vietnam,</td>
<td>➢ Variety of Themes: Policy, Best Practices from Manufacturing, Commercial and Residential Sectors</td>
</tr>
<tr>
<td>Indonesia and Philippine</td>
<td>➢ Field Verification in Thailand</td>
</tr>
<tr>
<td>➢ Gathered People and their Opinions on Energy Issues from <strong>11 Economies</strong></td>
<td></td>
</tr>
</tbody>
</table>
The achievement

- 90 Attendants from Industry, Government and RTO
- Exchanged Policies and Best Practices within 11 APEC Economies
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Conclusion

Expand Chinese Taipei’s Energy Conservation and Carbon Emission Reduction Experiences to other Economies

Policy Research

Technology Innovation
- ISO 50001
- Energy Management Solutions
- Advanced Technology
  - TEMM Recycling Waste Heat to Generate Electricity
  - CCSU (Calcium Looping)

Policy
- National Energy Conservation and Carbon Reduction Master Program
- Carbon Reduction and Energy Conservation Action Plan

Expert Promotion Teams
- Taiwan Industrial Greenhouse and Energy Reduction Corps
- Technology Transfer through Industrial Partnership

Workshop & Training Course
- Ideas and Experiences
- Collaboration Opportunities

Expansion

Expand to other Economies
- Field Verification in Thailand Textile and Garment Industry
- Energy Efficient Culture to Foster Collaboration Opportunities

Field Verification