Challenges and Accomplishments towards a sustainable ‘Eco-Industrial Park’ in Ulsan

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Korea Industrial Complex Corp.
1. Eco-Industrial Park Initiative
2. Outcomes of the EIP Project in Ulsan
3. Expanding Achievements
Industrialization and Environmental Issues

### Population
- 1962: 85,000
- 2012: 1.2 million

### Amount of industrial production
- 1962: USD 2.2 million
- 2012: USD 208.2 billion

### Air pollution
- SO₂: 0.057ppm (1981)

### Water pollution
- BOD₅: 11.7ppm (1991)

### Bad Odors
- 51 cases of bad odor complaints (2000)
Overcoming Environmental Problems

- 2004: Declaration of ‘Ecopolis Ulsan’
- 2005: Establishment of a master plan to revive Taehwa River
- 2005: Starting of ‘Eco-Industrial Park Project’ for sustainability and greening of industry
- 2010: Establishment of a green growth action plan
Korea EIP Master Plan (‘05~’19)

1st Phase
- 2005. 11 ~ 2010.05
- Pilot EIP with 5 industrial complexes

2nd Phase
- 2010. 06 ~ 2014.12
- Diffusion on 46 industrial complexes with a Standard EIP model

3rd Phase
- 2015. 01 ~ 2019.12
- EIN. EIP Model including all industrial complexes

1st phase Pilot period
- Pilot on 5 industrial complexes

2nd phase Diffusion period
- Diffusion on 46 industrial complexes

3rd phase Completion period
- Construction of national IS network
Activities of EIP Project Div.

**Step 1: Exploring new networks**
- Data collection to explore new synergy networks
- Review of reported datum by companies
- Encouraging participation of companies through seminars & business meetings
- Collection of on-site information from companies through diverse forums
- Project identification through top-down or bottom-up approach by coordinators

**Step 2: IS Feasibility Study**
- Support feasibility study for network establishment
- Supporting feasibility investigation team
- Co-authoring of research project proposal with stakeholders
- Monitoring the progress of the feasibility study
- Final report as a business model that includes the stakeholders requirements

**Step 3: Commercialization**
- Engagement in stakeholder participation and overcoming barriers
- Coordinating benefit sharing among participants
- Support project financing sources (ESCO, WASCO, Green Growth Fund, etc.)
- Reviewing the potential of linking the project with GHG emission reduction projects
- Highlight the success story
**Type of Industrial Symbiosis (IS)**

**Energy Optimization (including waste to energy)**

- **District Heat Supply**
  - Exhaust Heat

- **Power Plant (Organic Rankin Cycle)**
  - Low Pressure Heat

- **Waste Heat Supply**
  - High Pressure Steam

- **Industrial Complex**
  - Low Pressure Steam
  - Middle Pressure Steam

- **Municipal Incinerator Plant**
  - Combustible Municipal Waste

- **Incineration heat Supply**

- **Renewable Energy Supply**
  - Combustible Industrial Waste & By-product Gas

- **SRF Boiler**

- **Electricity Supply**

- **ASR (Automobile Shredder Residue), SRF (Solid Refuse Fuel)**
Resource Optimization (including waste to resource)

Type of Industrial Symbiosis (IS)
<table>
<thead>
<tr>
<th><strong>Supporting IS Projects in Ulsan</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period</strong></td>
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<tr>
<td><strong>Data</strong></td>
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<td></td>
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<tr>
<td><strong>R&amp;D</strong></td>
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<tr>
<td><strong>Participant</strong></td>
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<td><strong>Fund</strong></td>
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</table>
Supporting IS Projects in Ulsan

- **Company**
  - By-product (48)
  - Industrial Incineration Heat (3)
  - Excess Heat (12)
  - Municipal Incineration Heat (2)

- **Public Facility**
  - Wastewater Inorganic Waste (2)
  - Municipal Waste

- **Urban & Agricultural Area**
  - Municipal Waste

- **Distillation & Purification**
  - High Value-added New Product (2)

- **Separation & Production**
  - Organic Bio Waste (2)
  - Combustible Waste (2)

- **SRF & Gasification**
  - SRF & Gasification
  - High Value-added New Product (2)

- **SRF Boiler**
  - Process Heat (16)

- **Heat Pinch**
  - Excess Heat (12)
  - District Heat (3)

- **Technology**
  - Alternative Raw Material (24)
  - High Value-added New Product (13)
  - Renewal Energy (13)

- **Supply**
  - Electricity Generation (1)

- **Demand**
  - Power Plant
  - Hot Water (2)
  - Hot Water (1)
  - District Heat (3)
## Supporting IS Projects in Ulsan

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Recycling Technology</th>
<th>R&amp;D</th>
<th>Commercialization (%)</th>
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<tr>
<td><strong>Company</strong></td>
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<tr>
<td>By-product</td>
<td>Company</td>
<td>Resource</td>
<td>24</td>
<td>9 (37.5)</td>
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<td>Using as alternative raw material after distillation &amp; purification</td>
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<td>Manufacturing high value-added new product after separation &amp; synthesis</td>
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<td>6 (54.5)</td>
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<td></td>
<td>Energy</td>
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<td>Manufacturing an Industrial Energy Source using waste</td>
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<tr>
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<td>Electricity generation using waste heat</td>
<td>1</td>
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<tr>
<td>Incineration heat</td>
<td>Company</td>
<td>Energy</td>
<td>3</td>
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<td>Incineration heat utilization for industrial energy supply</td>
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<td>By-product</td>
<td>Public facility</td>
<td>Resource</td>
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<td></td>
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<td></td>
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<tr>
<td>Energy</td>
<td>Urban area</td>
<td>Energy</td>
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<td>Waste heat utilization for district heat supply</td>
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<td>Agricultural</td>
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<td>Using as alternative raw material after distillation &amp; purification</td>
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<td>Public facility</td>
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<td>Resource</td>
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<td></td>
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<td>74</td>
<td>33 (44.6)</td>
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<tr>
<td><strong>Total</strong></td>
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# Achievements of IS Projects in Ulsan

## Project Performance (of 33 projects that have commercialization)

<table>
<thead>
<tr>
<th>Item</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Net</th>
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</thead>
<tbody>
<tr>
<td>Investments (million USD)</td>
<td>25</td>
<td>113.6</td>
<td>4.8</td>
<td>143.4</td>
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<tr>
<td>Economic Benefit (million USD/yr)</td>
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<td></td>
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<tr>
<td>Costs Reduction</td>
<td>24.8</td>
<td>39</td>
<td>6.2</td>
<td>70</td>
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<tr>
<td>New Sales</td>
<td>5.8</td>
<td>32.7</td>
<td>9.8</td>
<td>48.3</td>
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<tr>
<td>Net Profit</td>
<td>30.6</td>
<td>71.7</td>
<td>16</td>
<td>118.3</td>
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<tr>
<td>Environmental Benefit (ton, m³, tCO₂/yr)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Waste Recycling</td>
<td>31,728</td>
<td>6,816</td>
<td>1,500</td>
<td>40,044</td>
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<tr>
<td>Wastewater Recycling</td>
<td>37,032</td>
<td>41,975</td>
<td>350</td>
<td>79,357</td>
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<td>CO₂ Reduction</td>
<td>118,377</td>
<td>369,249</td>
<td>124,587</td>
<td>612,213</td>
</tr>
</tbody>
</table>


Success Story of EIP Project

Energy Optimization in Y

[Step 1]
- Municipal Waste Incinerator 1 (SA)
  - Incineration Heat (16kgf)
- Municipal Waste Incinerator 2 (SA)
  - Incineration Heat (45kgf)

[Step 2]
- #2 FCC (SKE.)
- Utility (SKE.)
- Biomass Boiler (45kgf)
- Reformer (45kgf)

[Step 3]
- PP/PU (HS1)
- Optical Film (HS3)
- PTA (HS2)
- Reaction Heat

[Step 4]
- H2 (DY)
- Reformer (45kgf)
- PTA (LTChem)
- Reaction Heat (5kgf)
- DOP (HHChe)
- Reaction Heat (45kgf)

[Step 5]
- Acetate Tow (EF)
- Utility (SKChem.)
- 1,4-BDO (KP)
- Industrial Waste Incinerator (TT)
  - Incineration Heat (18kgf)

 Savings energy consumption of 13% In Yong-yun Region

<table>
<thead>
<tr>
<th>Performance</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Investments</td>
<td>83.0 million USD</td>
</tr>
<tr>
<td>Profit</td>
<td>42.9 million USD/yr</td>
</tr>
<tr>
<td>CO₂ Reduction</td>
<td>272,137 tCO₂/yr</td>
</tr>
</tbody>
</table>
Success Story of EIP Project

Coating Material Production Company
Zn Dust Production Process

By-Product (Coarse Zn Particle)

Zn Dust Recycling Company
Attrition Milling Process

High Value-add Product (Zn Flake & Dust)

Coating Production Company
Anticorrosive Coating Production Process

Organic Compound Production Process

Petrochemical Company

Waste Oil (By-product Mixture)

Waste Oil Recycling Company
Distillation & Purification Process

High Value-add Product (Heat Transfer Oil)

Heat Transfer Oil Demand Company
Process for Liquid & Gas type

Heat Transfer Oil Demand Company
Process for High Temperature
Classification of IS Project

**Project Performance in Korea**

- **Exploring IS Project**
  - Creating 595 Projects Plans

- **Supporting Feasibility Study**
  - Completing 303 Studies

- **Commercialization**
  - Starting 197 Businesses

- **Classification of Business**
  - 12 Emissions Groups
  - 37 Recycling Technologies

- **Standardization of BM**
  - 5 BM Standard (Pilot)
Classification of Business

**Emission group**

1. Waste metal

2. Waste acid, alkali and oil

6. Slag, ash and waste foundry sand

11. Excess and exhausted heat

12. Industrial and municipal wastewater

**Recycling technology (BM)**

1. Recycling of non-ferrous scrap as an industrial resource
2. Recovery of precious metals from scrap
3. Recycling of iron scrap

4. Recycling of waste acid as an industrial resource
5. Recovery of precious organics from industrial wastewater

21. Manufacturing of reducing agent for steel using cokes
22. Manufacturing of construction materials using slag etc.
23. Manufacturing of inorganic compounds using fly ash etc.

36. Energy optimization using excess process heat and incinerator heat

37. Industrial water optimization using effluent of wastewater treatment facility
Achievements expansion strategy

Expansion Strategy

1, 2 Phase EIP Project
- Exploring and Know-How of many IS Projects

3 Phase EIP Project
- Development of many BMs based on best practices

Expansion towards EIN Systems in Korea
- Incubation and Support of ‘RESCO’

Support for Green Industry in Developing Countries
- Distribution by ‘RESCO’ after Switching to Appropriate Technology

RESCO: REsource Service Company (Private)
Thank you!

If you have any questions or comments, please send an e-mail to ecojhkim@kicx.or.kr