
Eco-Industrial Development
2015. 02. 12
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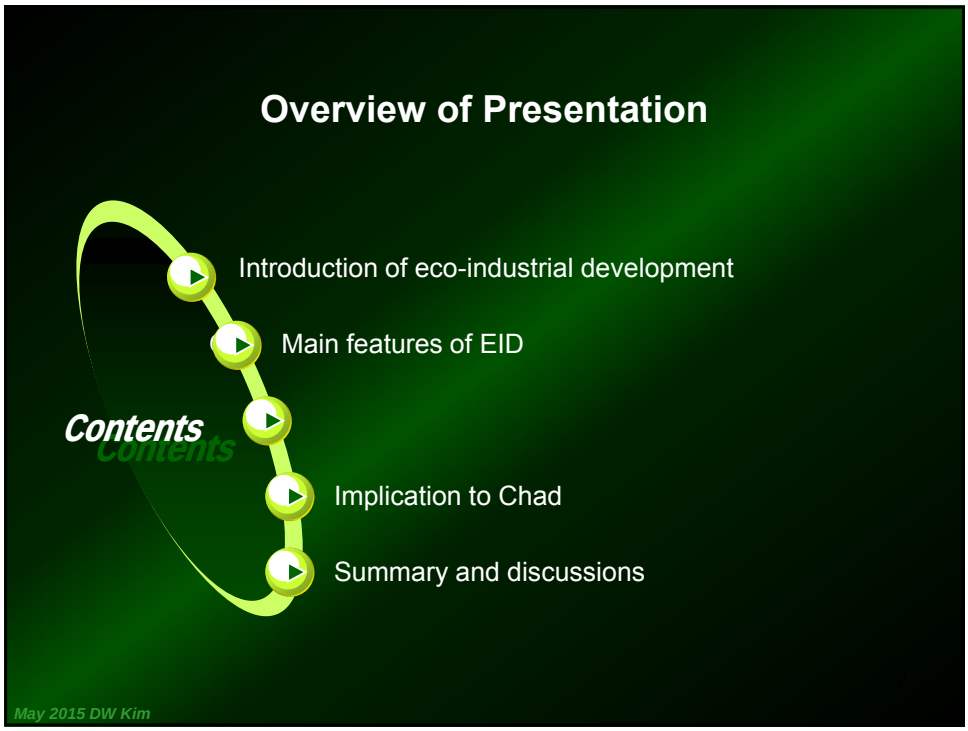
"Waste is a resource left in a wrong place"


Overview of Presentation
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Introduction of eco-industrial development
Main features of EID
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Summary and discussions
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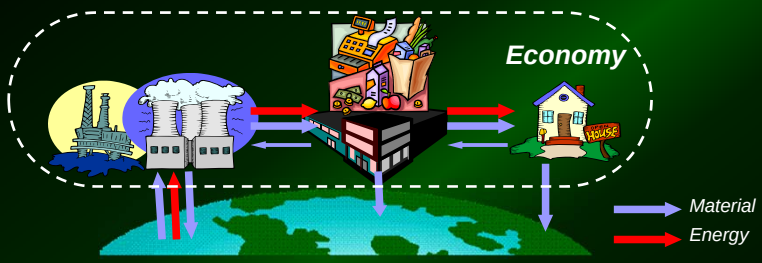
## Conventional Industrial System




- Materials and energy are extracted, processed, used and dumped
- Low resource efficiency: While a wide range of resources are funnelled into the production processes, only a small proportion is effectively incorporated into the final product and the rest are wasted.
- New substances are produced during manufacturing processes
- Unbalanced production and accumulation of waste cause imbalance in a particular material cycle

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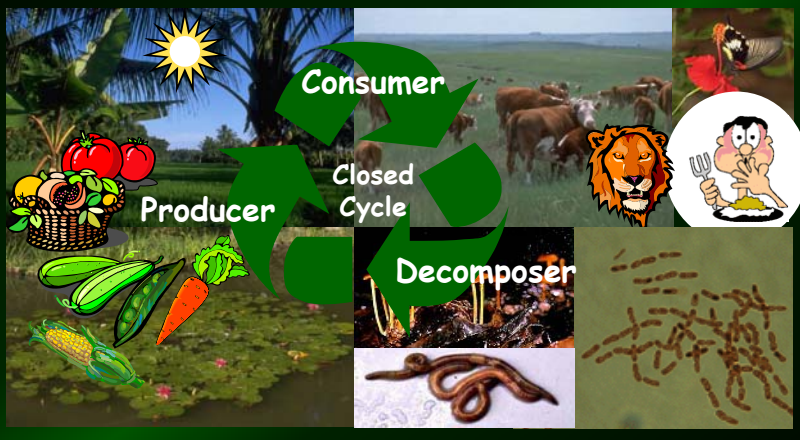
## Food Web in Natural Ecological System




All excretions or any by-products from one creature is used as feeds of others and no waste is left in nature eventually. (Closed loop cycle)
Ex) Cholesterol

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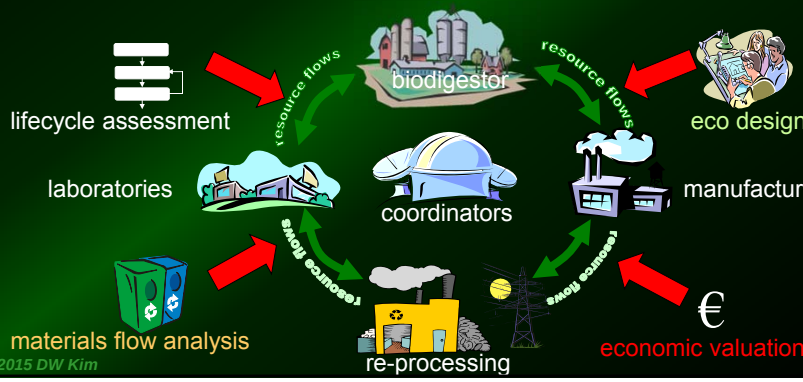
# Industrial Ecology

- New emerging discipline to articulate industry with ecology
  - Transforming industrial system toward the way of natural eco-system
- Optimise resource use by integrated recycling & closed loop through inter-firm collaboration in an industrial network
- Reconcile economic development with the environment
  - Economic growth with minimum environmental footprint on nature including global warming

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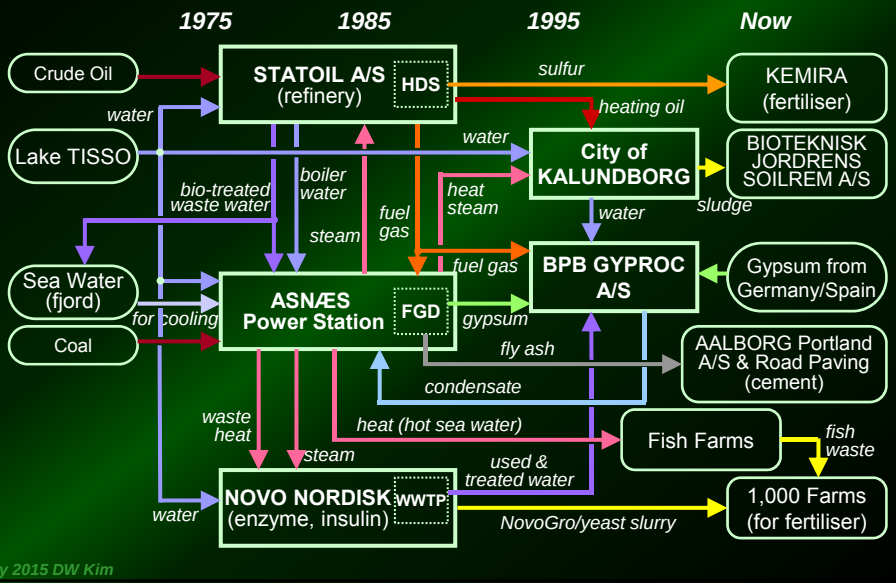
# *Industrial Symbiosis Network in Kalundborg, Denmark*

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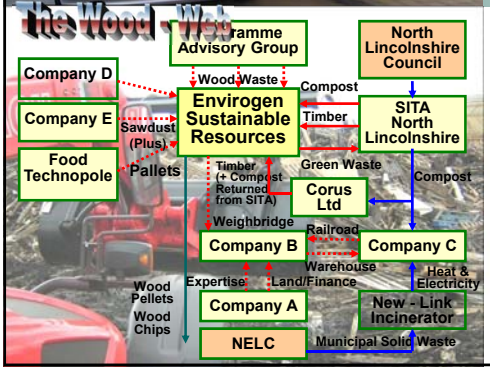
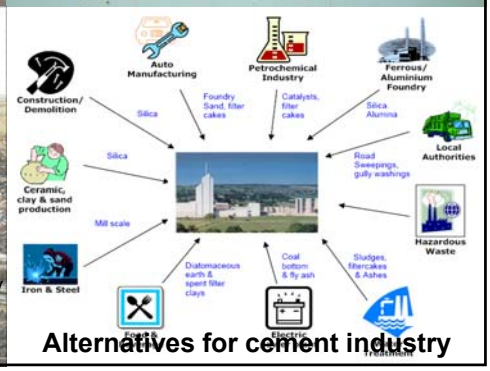
# NISP Achievements



Bio-diesel from tallow


Bone to Bricks



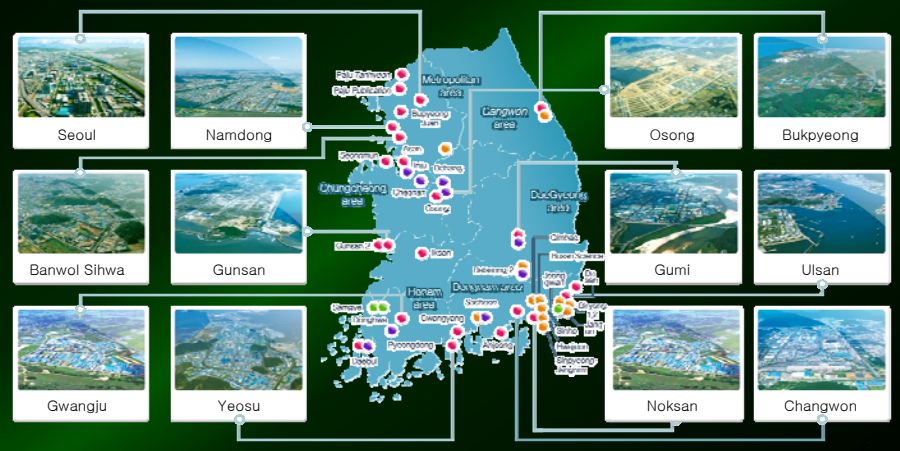



Alternatives for cement industry

# 51 EIPs in Korea Supported by KICOX

## With 47,000 Companies

34% in Domestic Product, 39% in Export, 23% (0.8 mil.) in Labors (2010)




National Industrial Complex  General Industrial Complex  Foreign Investment Zone  Rural Industrial Complex

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## Eco-industrial Development in the World

***Industrial symbiosis (IS)***
- Kalundborg IS, Denmark
- NISP, UK
- Mexico, Brazil, Hungary, Slovenia, Turkey

***Eco-industrial Park (EIP)***
- USA, Canada
- Korea, China

***Eco Town***
- Japan

***Recycling network***
- Styrian RN, Austria
- Germany (Oldenburger Münsterland RN, Ruhr region)

***Eco-industrial Network***
- *AGUM Env. Mgt. Network, Rhine-Neckar Region, Germany*
- *Ora Ecopark, Fredrikstad, Norway*
- *Regional Energy Supply System of Jyväskylä, Finland*



※ Diverse meanings of "**Eco**"
- Environmentally friendly (Eco-centre, Eco-park, Eco-town, Eco-village…)
- Resource circulation (EID, EIP, EIN…)

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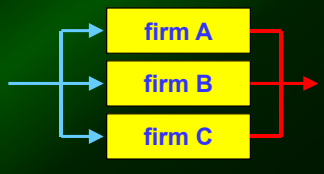
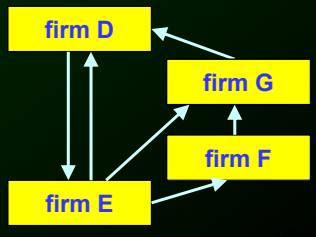
## Types of inter-firm collaboration

### Sharing
- **Information share (matching demander and supplier, regulations)**
- **Utility share such as water, heat and gas (N2, Comp air, H2..)**
- **Facility share (purified/waste water, specific material..)**




### Exchange
- **Direct exchange between firms**
- **Collecting small amount to meet critical economic volume**
- **Intermediation of recycling firms for pretreatment to link by-products**

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## Main Benefits of EID

Economic benefits & competitiveness of business

- Reducing production cost (raw material & waste)
- Increasing resource efficiency & business competitiveness
- Creating additional business opportunities

Environmental benefits

- Reducing the use of natural resources
- Reducing contamination in industrial region
- Mitigating global warming
- Extending the lifetime of landfills
- Upgrading environmental technologies & the level of sustainability

Social benefits

- Developing regional economy through creating new jobs
- Better circumstances for industry with less environmental conflicts
- Upgrading the overall standard of industry
- Developing “win-win-win” culture in the society

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## Main Risks of EID

Instability in business

- Leak of Biz information
- Instability of process/quality
- Reshuffle of waste market
- Uncertainty of practically flexible inter-firm networking against disconnection

Conflict in interests between

- Individuals on economic benefit
- Economic and environmental benefits
- Individual private benefits and net societal gain

Incorrect EID management

- Green wash
- Marketing tool

** Strongly manufacture based

* BPX: By-product Exchange

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# EID and Appropriate Technology

Sustainable development

- Net societal gain through 3 bottom line benefit
- Optimized resource use (resource efficiency)
- Collaboration rather than competition

Optimised by local/regional context

- No universal solution
- Synergy with neighbor industries
- Evolve over time to adapt its environment rather than fixed plan

Not necessarily front-edge technology

- Existing technologies are widely used
- Creative views on resource

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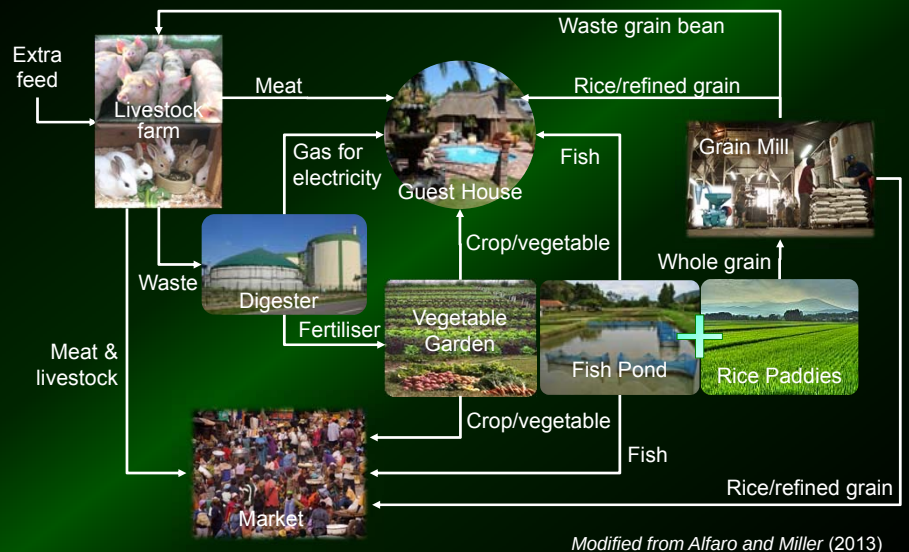
# **Agriculture based EID** (Design of Liberia Model)




*Modified from Alfaro and Miller* (2013)

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## Design Process of EID in Sahr

1. Identify main industries, resources and by-products in a region
2. Quantify main resources available based on natural capability
3. Identify links and synergies between
4. Identify missing industries (decomposers)

- Agricultural: rice, mango, citronnelle, moringa…
- Energy: refinery, sugar cane power plant,
- Food: sugar refining

- Industries: sugar and energy
- by-products: agricultural by-products to energy
- resources:

- bio-fuels
- chemical industry
- waste plastics recycling (PET, PE, PP)
- tourism
- water recycling
- wood industry
- livestocks

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## Potential agricultural products in Sahr



citronnelle



mango



moringa

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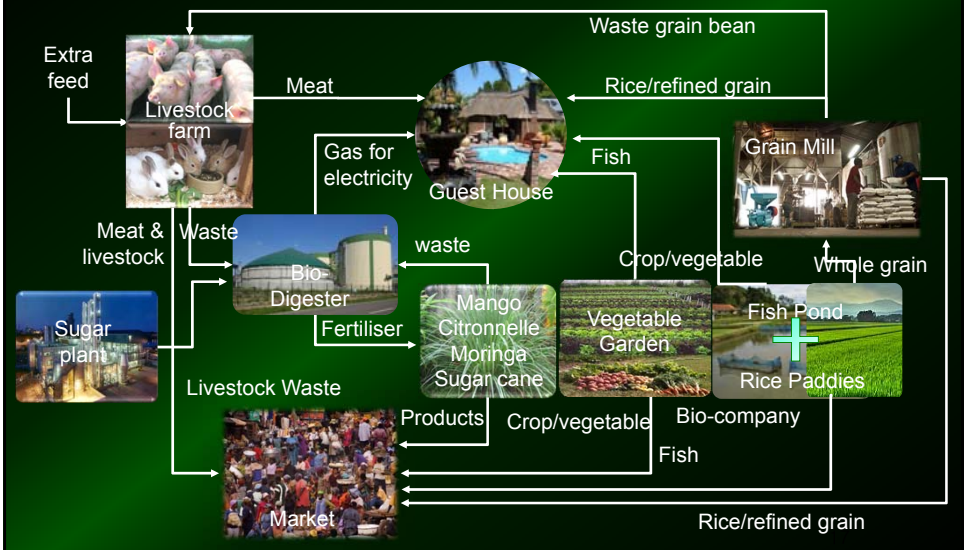
## Sahr Eco-industrial Development

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## Still more resources are left to be linked

Power plant

Water plant

Sugar Cane

Waste Plastics (PET, PE, PP…)

Refinery

Others

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## Future Plan for Chad Project

**Short-term Strategy (~6 months)**

Chad 현지 활동가 지원에 집중

- 현장 활동을 위하여 신뢰할만한 현장 활동가 육성
- Eco-village 형 교육센터/체험학습장 설계 지원
- 현장 지원체계의 구축 및 지원 기금 확보

**Mid-term Strategy (~2 years)**

Chad의 성공 모델 개발 (Sahr)

- 협동조합과 EID 기반의 eco-village 구축 지원
- 산업화 실현을 통한 성장기반 구축
- 다양한 기술재능의 기여분야 발굴 적용

**Long-term Strategy (~5 years)**

성과 확산 및 적용 확대

- Sahr 성공사례에 기반한 Chad 내 적용지역 확대
- 유사한 환경의 타 국가로 적용 확대
- 적용 기술분야의 확대 심화

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## Summary & Discussions

EID can be a type of appropriate technology

- Sustainable development (3 bottom line)
- Optimised by local/regional context
- Creative view on resource efficiency rather than front-edge technology

EID is required of newly developing countries such as Chad

- Sustainable development of a region avoiding errors of conventional development in industry
- Requires creative model based on its own industries including agriculture

Future plan of Chad Project

- Short-term
- Mid-term
- Long-term

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