Examples of environmental and economic benefits from RECP and IS opportunities implementation

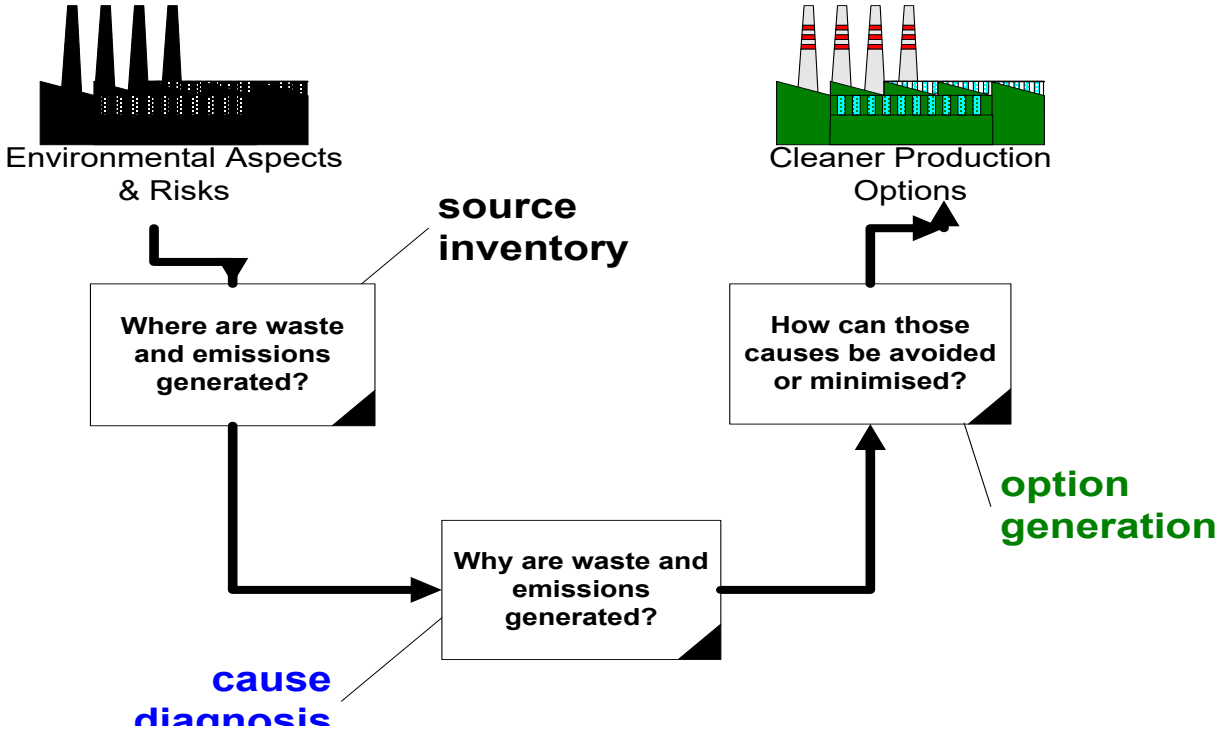
Agenda

- ✓ RECP opportunities and benefits
- ✓ IS opportunities and benefits
- ✓ International case studies and experiences
- ✓ Discussion and Q&A

RECP opportunity identification

RECP Logical Framework

Systematic root source and cause analysis guides the identification, evaluation and implementation of RECP opportunities



Source: Van Berkel (1995), Introduction to Cleaner Production Auditing, UNEP Industry and Environment Review

RECP Feasibility Analysis

Screening of options through feasibility analysis

Technical evaluation

- Materials, water and energy consumption
- Product / by-product quality
- Improvement on Right First Time (RFT)
- Human resource requirement
- Ease of implementation
- Cross-linkages with other options
- Time for implementation

Environmental evaluation

- Entire life cycle of the product
- On-site / off-site neighbourhood improvements
- Reduction in the amounts of wastes / emissions
- Reduction in consumption of natural resources
- Reduction in noise / odour / safety risks

Economic evaluation

- Payback period
- Net Present Value (NPV)
- Profitability Index (PI)
- Internal Rate of Return (IRR)
- Sensitivity analysis
- Access-to-finance options

Source: National Cleaner Production Centre South Africa (NCPC-SA)

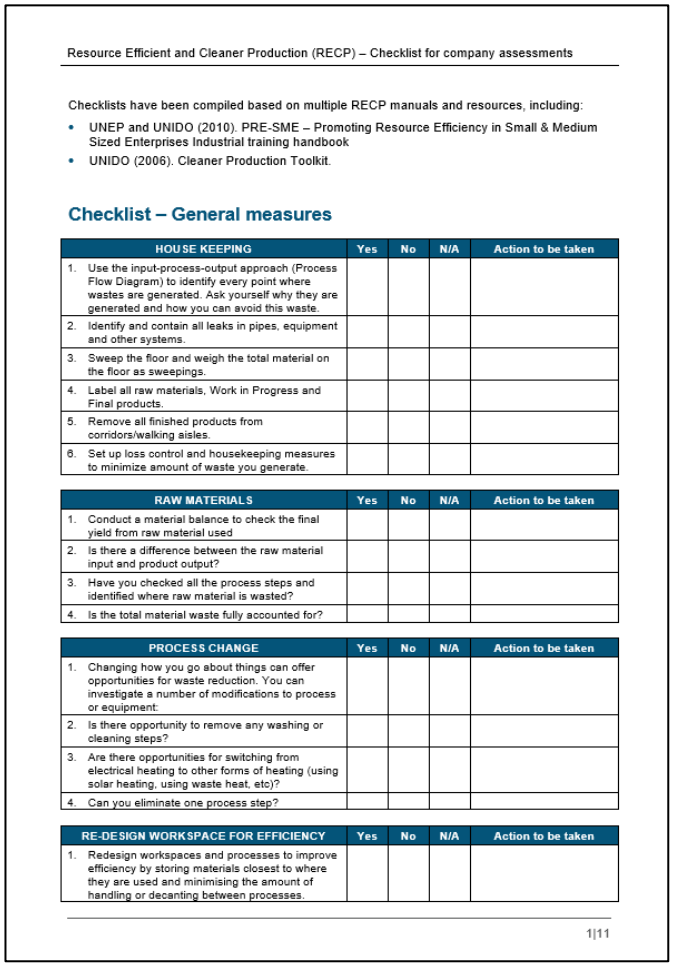
RECP checklist with practical examples

RECP checklist with practical examples to increase your company's resource efficiency

- General measures
- Water
- Energy
- Containers and packaging
- Water management
- Management practices

Sources:

- UNEP and UNIDO (2010). PRE-SME – Promoting Resource Efficiency in Small & Medium Sized Enterprises Industrial training handbook.
- UNIDO (2006). Cleaner Production Toolkit.



Resource Efficient and Cleaner Production (RECP) – Checklist for company assessments

Checklists have been compiled based on multiple RECP manuals and resources, including:

- UNEP and UNIDO (2010). PRE-SME – Promoting Resource Efficiency in Small & Medium Sized Enterprises Industrial training handbook
- UNIDO (2006). Cleaner Production Toolkit.

Checklist – General measures

HOUSE KEEPING	Yes	No	N/A	Action to be taken
1. Use the input-process-output approach (Process Flow Diagram) to identify every point where wastes are generated. Ask yourself why they are generated and how you can avoid this waste.				
2. Identify and contain all leaks in pipes, equipment and other systems.				
3. Sweep the floor and weigh the total material on the floor as sweepings.				
4. Label all raw materials, Work in Progress and Final products.				
5. Remove all finished products from corridors/walking aisles.				
6. Set up loss control and housekeeping measures to minimize amount of waste you generate.				

RAW MATERIALS	Yes	No	N/A	Action to be taken
1. Conduct a material balance to check the final yield from raw material used				
2. Is there a difference between the raw material input and product output?				
3. Have you checked all the process steps and identified where raw material is wasted?				
4. Is the total material waste fully accounted for?				

PROCESS CHANGE	Yes	No	N/A	Action to be taken
1. Changing how you go about things can offer opportunities for waste reduction. You can investigate a number of modifications to process or equipment:				
2. Is there opportunity to remove any washing or cleaning steps?				
3. Are there opportunities for switching from electrical heating to other forms of heating (using solar heating, using waste heat, etc)?				
4. Can you eliminate one process step?				

RE-DESIGN WORKSPACE FOR EFFICIENCY	Yes	No	N/A	Action to be taken
1. Redesign workspaces and processes to improve efficiency by storing materials closest to where they are used and minimising the amount of handling or decanting between processes.				

1|11

Economic and environmental benefits from RECP opportunities

RECP assessment in East London Industrial Development Zone (ELIDZ), South Africa

Territory: East London

Area:6.4 Acres

Inputs/Raw materials:

- Plastic waste could contain:
  - Polyethylene (PE)
  - Polypropylene (PP)
  - Polystyrene (PS)
- Boiler with a 196 kW capacity
- Polyvinylchloride (PVC), polyacrylate (PA) and polyethylene terephthalate (PET) should not be present, or extremely limited as these compounds compromise the quality of the final products.

Products:

- **Solvent** for premium paints, resins and coatings
- light paraffinic mineral **oil** / light mineral white oil fractions deeply hydro refined
- **Waxes** characterized by the low level of aromatics and impurities

Contact: info@elidz.co.za

Complete can be found here

Examples of energy saving opportunities in South Africa

Opportunities (not all-inclusive)	Estimated annual savings			Investment	
	Annual kWh savings	Annual savings - ZAR	tCO2/year	ZAR	Payback-yrs.
Power factor correction unit	n/a	ZAR 257 827	n/a	ZAR 250 000	1.0
Peak demand controller	n/a	ZAR 596 616	n/a	ZAR 70 000	0.1
Reduce baseload by 5%	219 000	ZAR 159 520	228.3	ZAR 0	Immediate
Savlon chiller water side economiser	16 593	ZAR12 086	17.3	ZAR 40 000	3.3
Replace diaphragm pumps with peristaltic pumps	86 448	ZAR 62 969	90.2	ZAR 202 120	3.2
Solve compressed air leaks	15313	ZAR 11 154	16.0	R 0	Immediate
Variable Speed Drives (VSD)	30 616	ZAR 22 301	31.9	ZAR 30 000	1.3
Boiler economiser	4 250	ZAR 76 500	1.18	ZAR 200 000	2.6
Steam pipes insulation	919	ZAR 16 550	0.26	ZAR 18 375	1.1
Repair steam leaks	1 952	ZAR 35 192	0.54	ZAR 0	Immediate
Total	**375 064**	**ZAR 1 250 714**	**385.6**	**R810 495**	**0.6**

Examples of water saving opportunities in South Africa

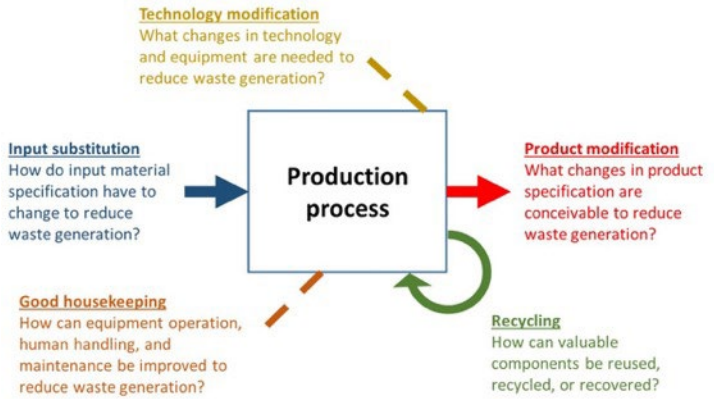
Opportunities (Not all-inclusive)	Annual savings		Investment Required	Payback period
	ZAR	Kl	ZAR	Years
Rainfall capture for onsite use	ZAR 63 622	2,544 kl	ZAR 98 509	1.5
Optimise floor cleaning	ZAR 13 786	551 kl	0	0
Treatment and reusing effluent water on-site	ZAR 77 500	1827 kl	ZAR 500 000	6.4
Rainfall capture for onsite use (o/h tank)	ZAR 13 800	600 kl	ZAR 50 000	3.6
Rainfall capture for onsite use (underground recharge)	ZAR 200 873	6931 kl	ZAR 300 000	1.5
Various good housekeeping and process control options	ZAR 1 750 000	76 063 kl	ZAR 783 216	0.5
Various good housekeeping and process control options (e.g. cleaning time and equipment, rinsing methods, pressure control)	ZAR 960 296	43 649 kl	ZAR 500 000	≤ 1 year

Examples of waste saving opportunities in South Africa

Improving waste handling and storage which do not require significant investment:

- Segregate different waste types for reuse and recycling
- Improved storage of process chemicals
- Awareness raising of employees to improve H&S standards

Waste reduction techniques



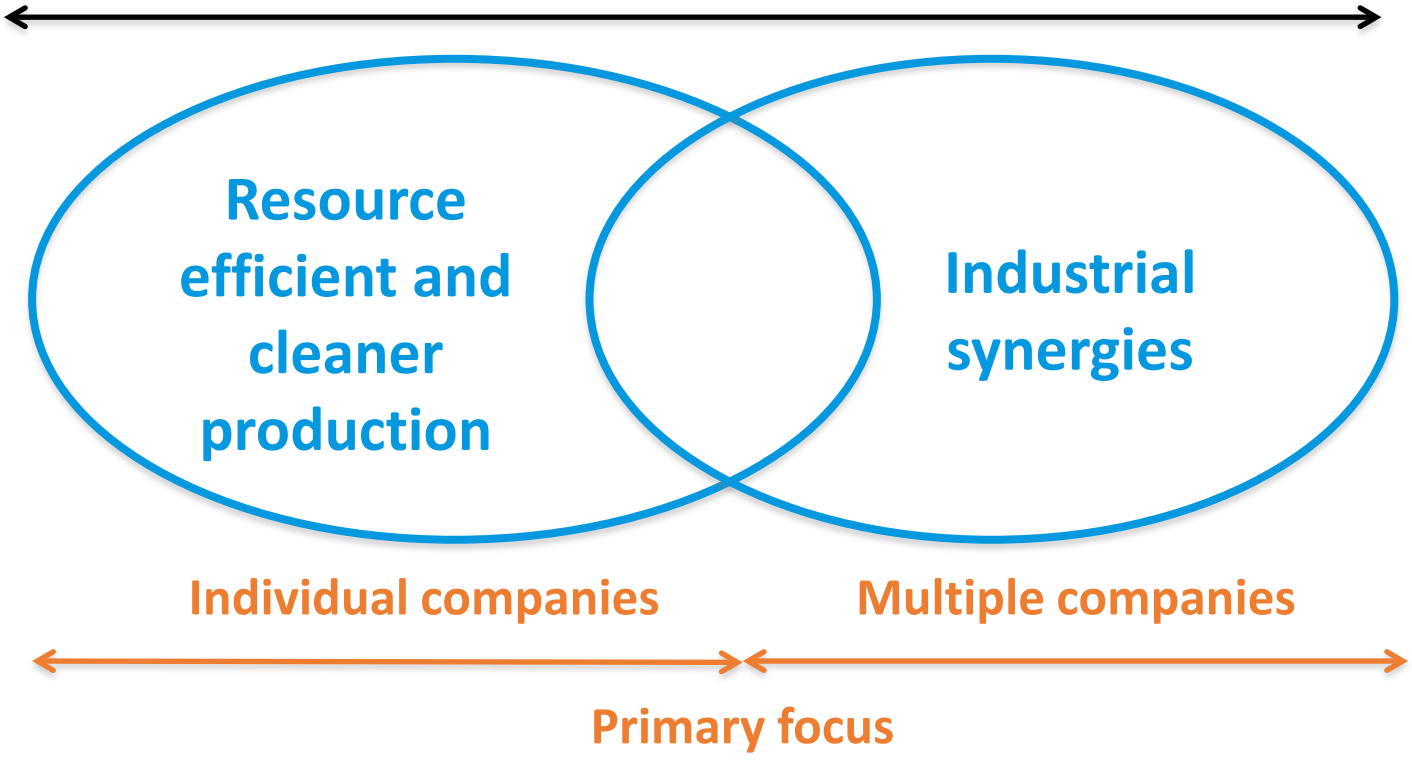
Opportunities (Not all-inclusive)	Annual savings		Investment Required	Payback period
	ZAR	Kg	ZAR	Years
On-site solid waste recovery and reuse	R 111 454	125 000 kg	0	Immediate
Process bath use and cleaning optimisation	R 146 860	2 500 kg	R 150 000	1.0
Use of alternative fuel at boiler	R 1 079 895	Up to 95 000 liters	R 787 500	0.7

Source: National Cleaner Production Centre South Africa (2018). Global RECP Programme. Pilot Project on eco-industrial parks in South Africa

IS opportunity identification

RECP & IS: Complementary approaches

Improve economic, environmental, and social performance and increase resource efficiencies



UNIDO EIP Toolbox

Industrial Symbiosis Identification Tool

UNIDO Industrial Symbiosis Identification Tool (V2)

IDENTIFY INDUSTRIAL SYMBIOSIS OPTIONS

SEARCH BY-PRODUCTS / WASTES

GO TO INSTRUCTIONS | SEARCH BY COMPANY | REFERENCES

Kindly make your selection under "By-product / waste": Other cells are populated automatically...

1. First, make your selection here!

2. This box lists similar by-products, or alternative names that are sometimes used.

3. Who could sell or buy this by-product? Here you can find companies potentially interested in your by-product

4. More information? Please consult "References" for weblinks and academic articles

By-product / Waste	Similar by-product(s)	Possible providers	Possible users	Practical examples	Comments
Wood residues	Lignin residues	Ethanol plant	Coal power plant	Kalundborg	
	Starch scrap	Starch industry	Biomass power plant	Tianjin	
	Pellets	Paper industry	Briquette factory	Guangxi Guitang	
	Waste paper sludge/pulp	Wood industry	Pressboard/plywood plant	Styria	
	Bark		Cement factory & construction	Kawasaki	
			Fertilizer		

UNIDO EIP Toolbox

Industrial Symbiosis Identification Tool

UNIDO Industrial Symbiosis Identification Tool (V2)

IDENTIFY INDUSTRIAL SYMBIOSIS OPTIONS: **SEARCH BY COMPANY TYPE**

GO TO INSTRUCTIONS | SEARCH BY-PRODUCTS / WASTES | REFERENCES

Possible inputs	Alternative or similar inputs	Possible providers	Practical example(s)	Comment(s)
Blast furnace gas	Syngas, Hydrogen	Iron and steel industry, Chemical industry (chlor-alkali)	Shandong, Liuzhou	chlor-alkali process = important producer, ammonia plant = important user
Carbonates (mineral)		Iron and steel industry	Shandong	CO2 + slag (mineralization)
Hydrochloric acid		Titanium oxide producer	Kwinana	Sulphur (elemental)
		Oil refinery	Kwinana	
Sulphuric acid (80%)		Chlor-alkali plant	Kwinana	H2SO4 98% is used as drying agent. After use, the resulting 80% solution is sold on the market
Zinc waste		Metal industry	Ulsan	Production of Zinc-rich paints
Steam (high temperature)		Waste incinerator	Ulsan	
Carbon dioxide		Ammonia plant, Ethanol plant, Biogas producer, Biogas producer		For instance, biosynthesis of succinic acid
C5 molasses residues	Pentose residues	Ethanol plant		For instance, production of furfural

1. Select a company

Chemical industry

2. Which inputs **could you buy** from a neighbouring company?
(or)
Which inputs **could you sell** to a neighbouring company?

3. What type of **company might sell** this input as a by-product?
(or)
What type of **company could be interested to buy** this by-product?

4. More information?
Please consult "References" for weblinks and academic articles

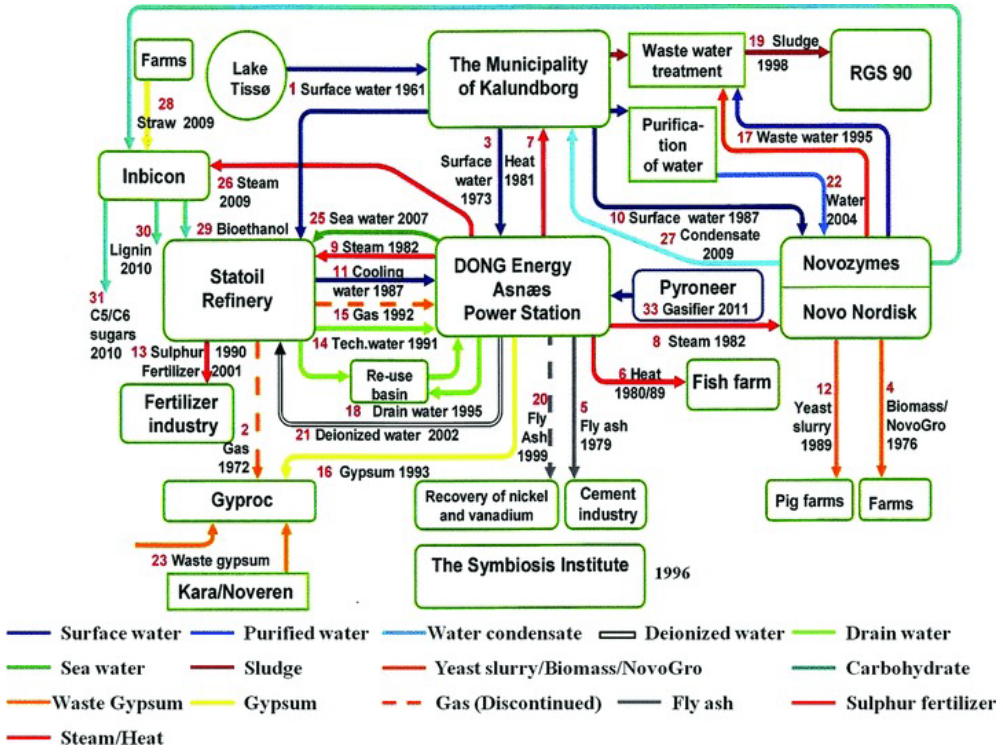
Possible outputs	Alternative or similar outputs	Possible users	Practical example(s)	Comment(s)
Alcoholic residues	Aldehyde	WWTP	Kalundborg, Ulsan	Carbon source for denitrification bacteria
Sulphuric acid (80%)		Chemical industry	Kwinana	H2SO4 98% is used as drying agent. After use, the resulting 80% solution is sold on the market
Hydrogen		Ammonia plant, Thermal power plant		Produced by chlor-alkali plant
Calcium sulfate	Gypsum	Plasterboards manufacturer, Soil remediation, Cement factory & construction	Kwinana	Typically produced by desulfurization processes. Can be for instance produced in a phosphoric acid production plant
Spent solvent	waste oil	Cement factory & construction	Eclepens, Styria, Ulsan	Must not contain halogenated solvent. Solvent can be impregnated on solid material, for instance saw dust.

Questions or comments?

International case studies and experiences

Case Study (IS): Kalundborg, Denmark

- **Territory:** Denmark
- **Area:**2500 Acres
- **Economic benefit:**
  - Bottom-line savings of 24 million EUR
  - 14 million EUR in socio-economic savings
- **Partners:**
- 1300MW power plant,
- Oil refinery (Statoil A/S),
- Plaster-board manufacturing plant
- (Gyproc Nordic East),
- Biotechnology production facility(Novo Group), and
- Soil remediation company(Soilrem A/S)
- local municipality
- **Contact:** symbiosecenter@kalundborg.dk
- Complete can be found here



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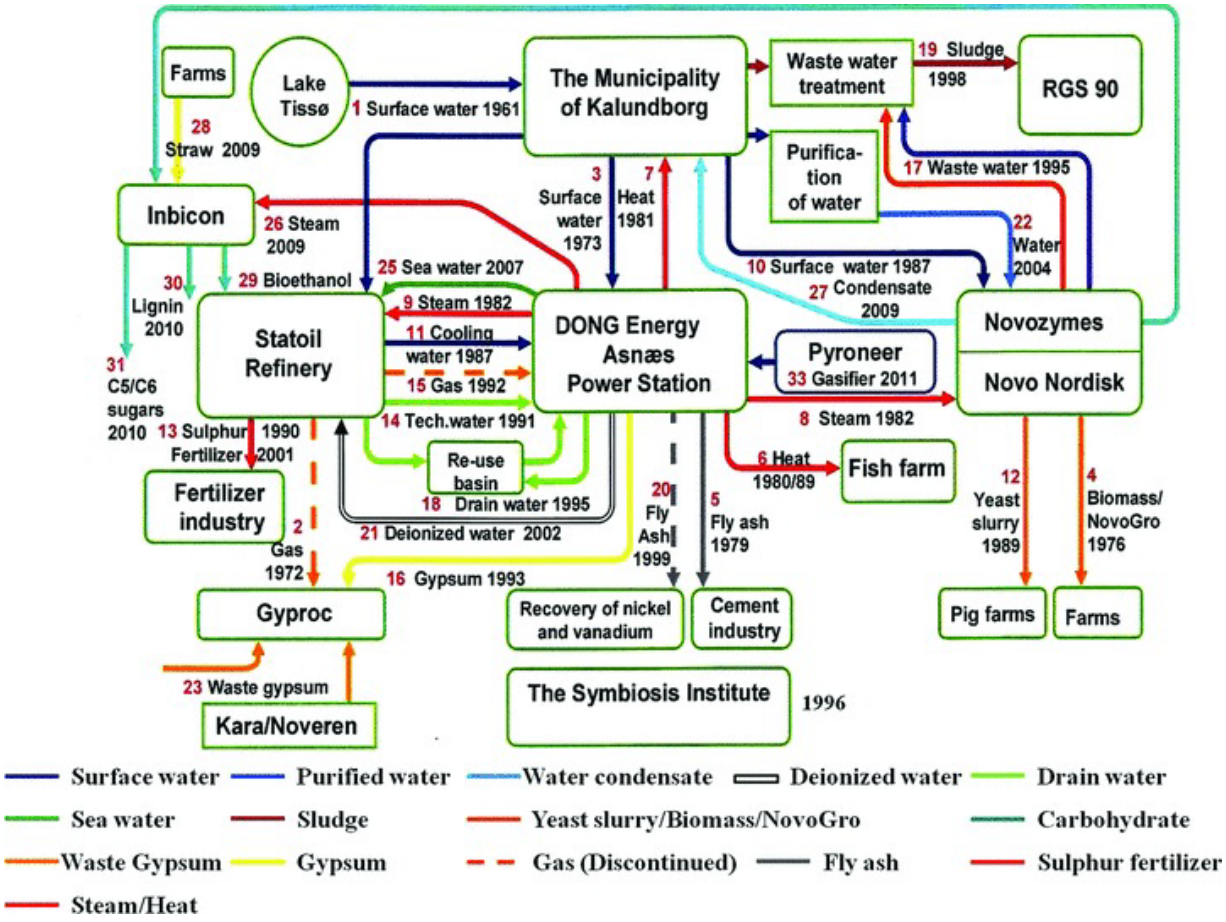
Farms
Lake Tissø
1 Surface water 1961
The Municipality of Kalundborg
Waste water treatment
19 Sludge 1998
RGS 90
28 Straw 2009
Purifica-tion of water
17 Waste water 1995
3 Surface water 1973
7 Heat 1981
Inbicon
26 Steam 2009
22 Water 2004
25 Sea water 2007
10 Surface water 1987
27 Condensate 2009
30 Lignin 2010
29 Bioethanol
9 Steam 1982
Statoil Refinery
11 Cooling water 1987
DONG Energy Asnæs Power Station
Pyroneer
33 Gasifier 2011
Novozymes
Novo Nordisk
31 C5/C6 sugars 2010
15 Gas 1992
14 Tech.water 1991
13 Sulphur 1990 Fertilizer 2001
8 Steam 1982
Re-use basin
6 Heat 1980/89
Fish farm
18 Drain water 1995
20 Fly Ash 1999
5 Fly ash 1979
12 Yeast slurry 1989
4 Biomass/ NovoGro 1976
Fertilizer industry
21 Deionized water 2002
2 Gas 1972
16 Gypsum 1993
Gyproc
Recovery of nickel and vanadium
Cement industry
Pig farms
Farms
23 Waste gypsum
Kara/Noveren
The Symbiosis Institute
1996
Surface water
Purified water
Water condensate
Deionized water
Drain water
Sea water
Sludge
Yeast slurry/Biomass/NovoGro
Carbohydrate
Waste Gypsum
Gypsum
Gas (Discontinued)
Fly ash
Sulphur fertilizer
Steam/Heat

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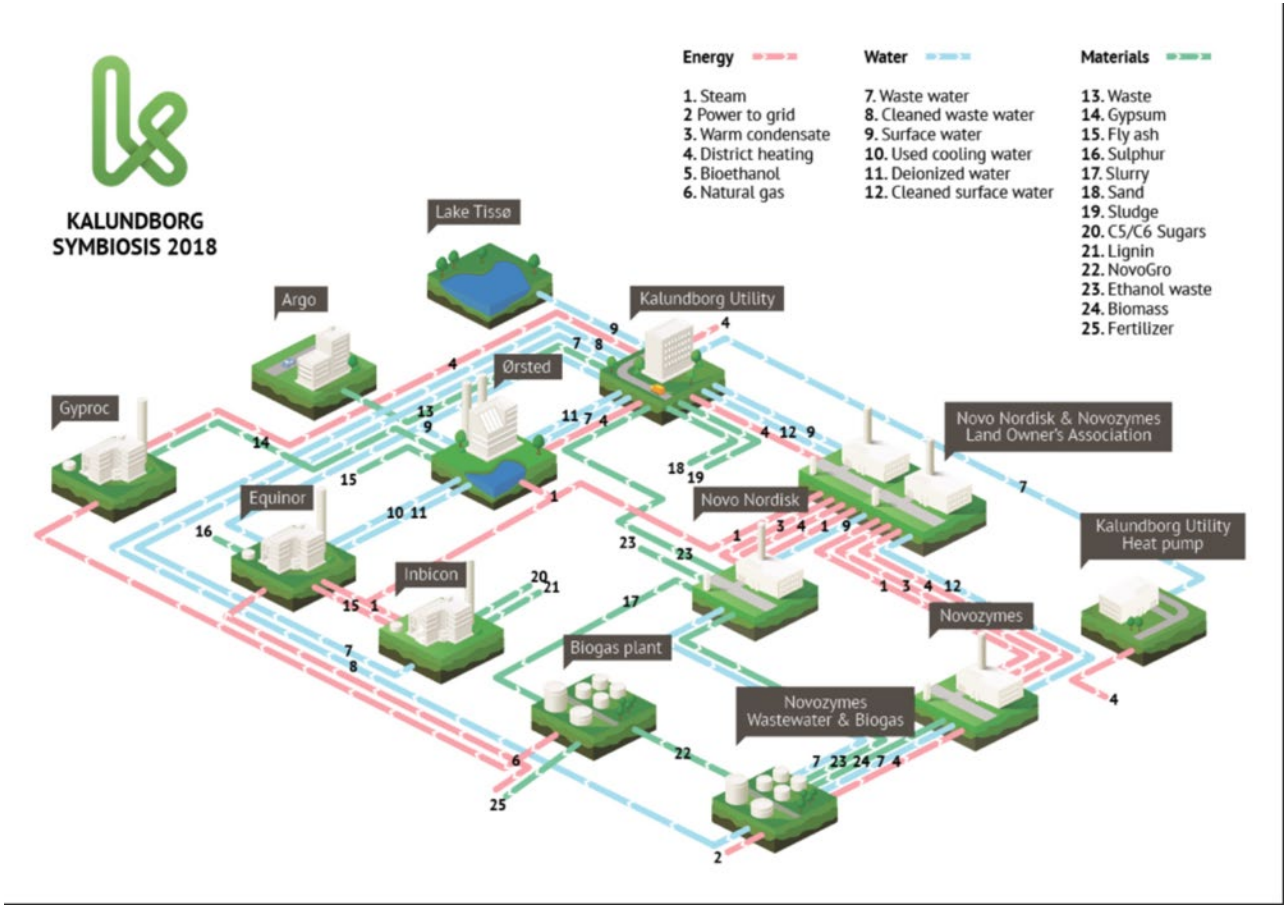

KALUNDBORG
SYMBIOSIS 2018
Energy
1. Steam
2 Power to grid
3. Warm condensate
4. District heating
5. Bioethanol
6. Natural gas
Water
7. Waste water
8. Cleaned waste water
9. Surface water
10. Used cooling water
11. Deionized water
12. Cleaned surface water
Materials
13. Waste
14. Gypsum
15. Fly ash
16. Sulphur
17. Slurry
18. Sand
19. Sludge
20. C5/C6 Sugars
21. Lignin
22. NovoGro
23. Ethanol waste
24. Biomass
25. Fertilizer
Lake Tissø
Argo
Kalundborg Utility
Ørsted
Gyproc
Novo Nordisk & Novozymes
Land Owner's Association
Equinor
Novo Nordisk
Kalundborg Utility
Heat pump
Inbicon
Novozymes
Biogas plant
Novozymes
Wastewater & Biogas

Contd...

Sources of reduction	Total reductions (tons/yr)
Resources	
Oil	19,000
Coal	30,000
Water	1,200,000
Emissions	
CO_2	130,000
SO_2	25,000
Waste	
Fly ash	135,000
Sulfur	2,800
Gypsum	80,000
Nitrogen from bio sludge	800
Phosphorous from bio sludge	400

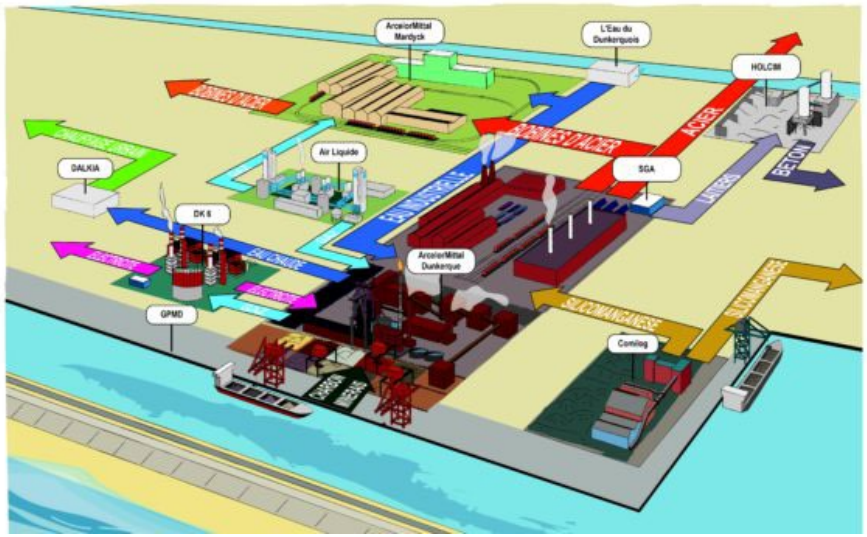
Case Study (IS & RECP): Dunkerque Promotion, France

The Park:

- the Dunkirk area demonstrates its expertise in the fields of circular economy, recycling of by-products and utilities.

Key IS and Urban Synergies:

- Dunkirk's local industrial ecology has become very attractive to employees as well as tenant companies, and is illustrated by the "toile industrielle" ("industrial fabric" model) developed by the Agence d'Urbanisme et de Développement (Town Planning and Development Agency).
- This tool demonstrates examples of RECP and IS between companies.



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- **Examples of IS**
  - Warm water from the cooling circuit of the Gravelines nuclear power plant is used by the Aquanord fish farm for their activity of breeding bass and bream, and by the LNG terminal to reheat the *LNG*, a necessary stage for regasification and the distribution of natural gas in the grid.
  - ArcelorMittal recycles its process gas in the DK6 combined cycle plant (790MW), and the heat from its blast furnaces is used in Dunkirk's urban heating network which has grown steadily since the 1980s. This network heats a host of public and private buildings in the city (hospital, Urban Community building, Town Hall, schools, swimming pool and more than 6,000 homes), with a cost saving of 15 to 20% for consumers.
  - Residual cold and heat, waste gas, slag, dredging sludge, etc, are all by-products from different local production plants that allow synergies between the area's industries and attract more and more new businesses.

Contd…

Territory: Western Australia

Area:30000Acres

Features:

- 32 by-product and 15 shared utility synergies ; Identified 127 possible synergies
- Employs more than 4,800 people directly, 64% of whom live locally
- Generates a further 26,000 indirect jobs

Savings:

- Water savings of 8,200 ML/year
- Energy savings of 3,750 TJ/year
- Waste reductions of 421,600 tonnes/year
- Gas emission reductions of more than 134,000 metric tonnes per year
- Carbon dioxide emission reductions the equivalent of removing 73,000 cars from the road.

Contact: kicadmin@kic.org.au

Complete can be found here

Case Study (IS & RECP): Kwinana Industrial Area, Australia

By-product synergies:

- Reuse of lime kiln dust for desulphurisation
- Reuse of by-product (phospho) gypsum for soil amendment

Service synergies:

- Air and water quality monitoring, facilitated by Kwinana Industries Council (KIC)
- Dialogue events with community and government agencies (every 2 months)

Supply chain synergies:

- Cement plant supplying cement products to construction companies
- Air Liquide and BOC Gases supplying gases to multiple industries

Utility synergies:

- 2 Cogeneration facilities
- Kwinana Water Reclamation Plant (KWRP)
- Joint wastewater treatment plant between chemical plant and oil refinery

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Four synergy dimensions:

•Product/by-product synergy

There are around 150 exchanges operating on commercial terms amongst the industrial companies located within the Western Trade Coast (WTC).

•Skilled workforce synergy:– workforce stability, aggregated skill capital, adequacy

- 30,000 highly skilled and experienced workers that are directly and indirectly employed in KIA.
- Two thirds of these workers live within 15kms of their place of work. This means the industrial area is surrounded by residential communities that understand industry.

•Support industries synergy:– proximity of the support industry sector to the primary industrial cluster.

Surrounding the Kwinana heavy industrial core where the chemical manufacturing and refining industries are located is a belt of companies that exist primarily to service the nearby major industries. They are connected to heavy industry.

•Governance synergy

Regulatory, political, policy, public common-user infrastructure, strategic planning, industry incentive framework.

Case Study (IS & RECP): Korea EIP Initiative, Korea

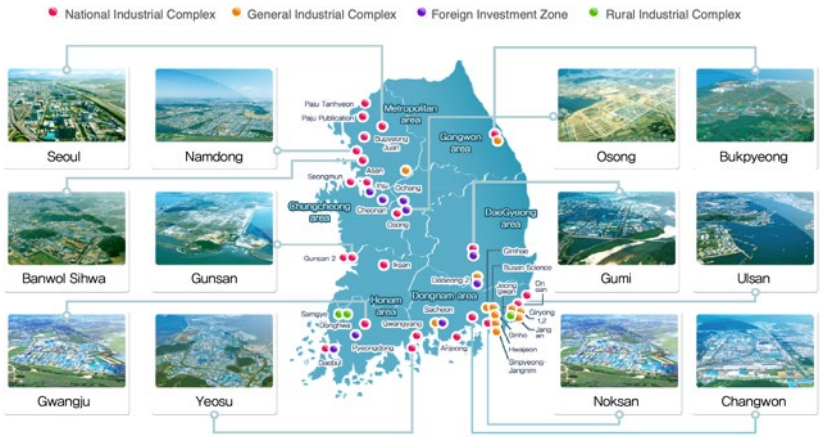
Territory: Korea

Features:

- 1831 companies in 105 industrial parks in 12 regions
- 235 commercial IS projects implemented by 2016

(66.2 success ratio)

- Generates a further 26,000 indirect jobs



Benefits:

By implementing the EIP program,

- Korea enabled reduction of:
  - 1.7 million tons of oil (TOE) energy consumed in the industry sectc
  - 8.54 million tons of carbon dioxide (CO) emissions
  - 6.85 million tons of waste generated from the industrial sector.
- Created 1000 new jobs
- Saved over KRW 857 billion and generated KRW 1.3 trillion in new revenues

Contact: mihoonj@kicox.or.kr

Complete can be found here

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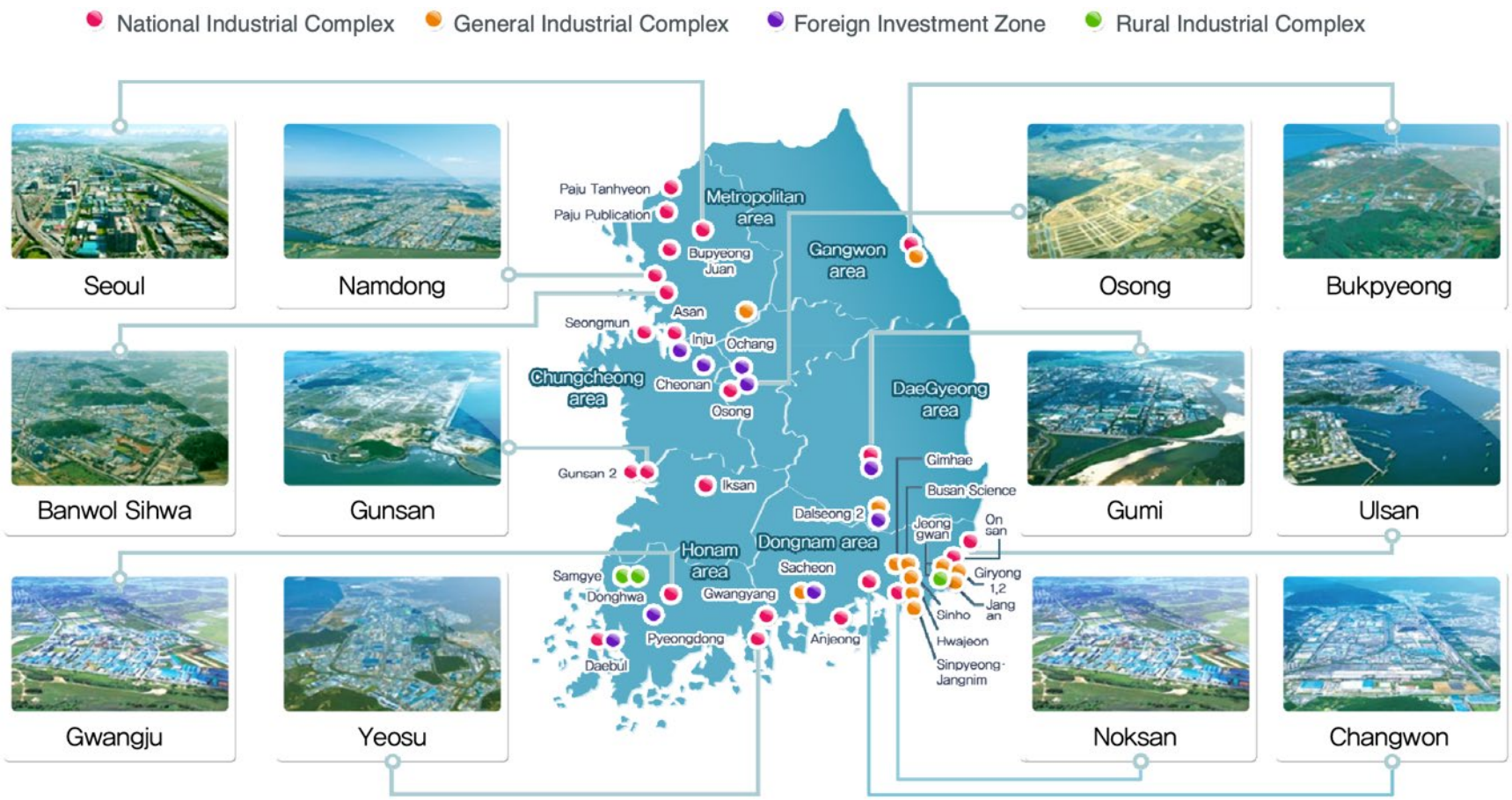
National Industrial Complex
General Industrial Complex
Foreign Investment Zone
Rural Industrial Complex
Seoul
Namdong
Osong
Bukpyeong
Banwol Sihwa
Gunsan
Gumi
Ulsan
Gwangju
Yeosu
Noksan
Changwon
Paju Tanhyeon
Paju Publication
Metropolitan area
Bupyeong Juan
Gangwon area
Asan
Seongmun
Inju
Ochang
Chungcheong area
Cheonan
Osong
DaeGyeong area
Gunsan 2
Iksan
Gimhae
Busan Science
Dalseong 2
Jeong gwan
On san
Dongnam area
Honam area
Sacheon
Samgye
Donghwa
Gwangyang
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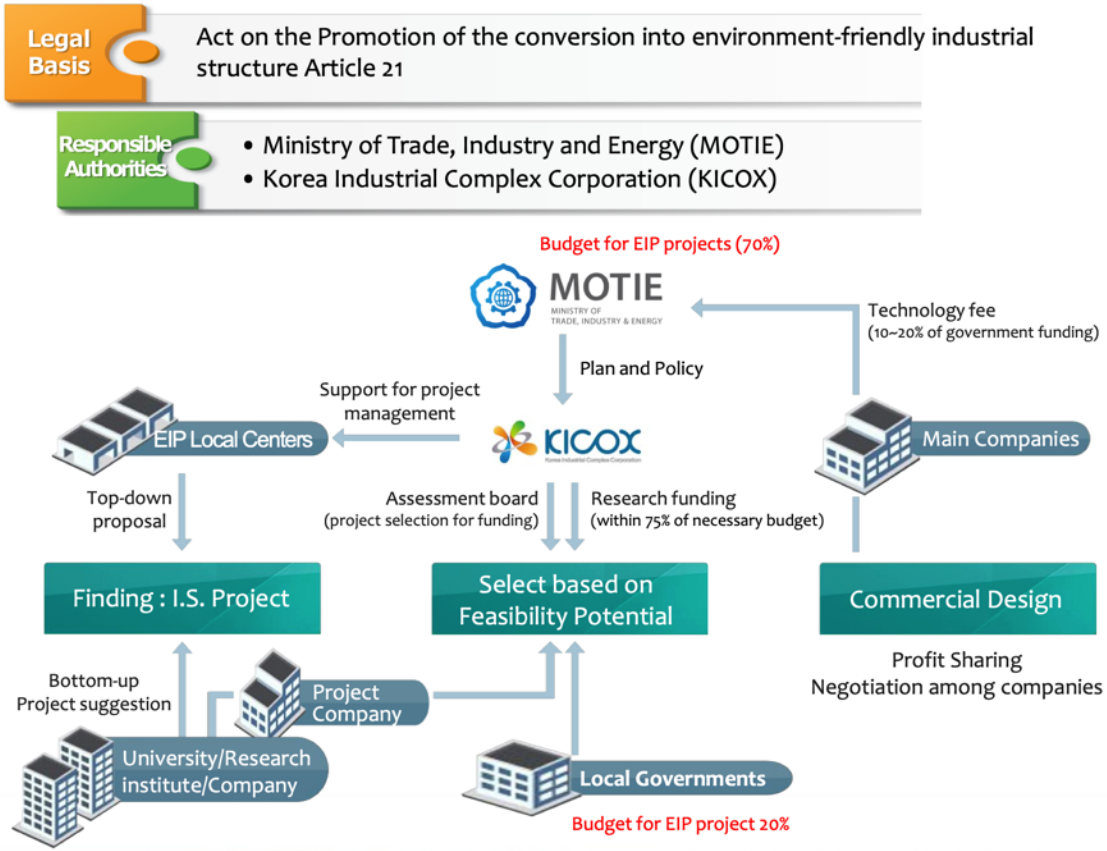

Fig: Implementation Mechanism

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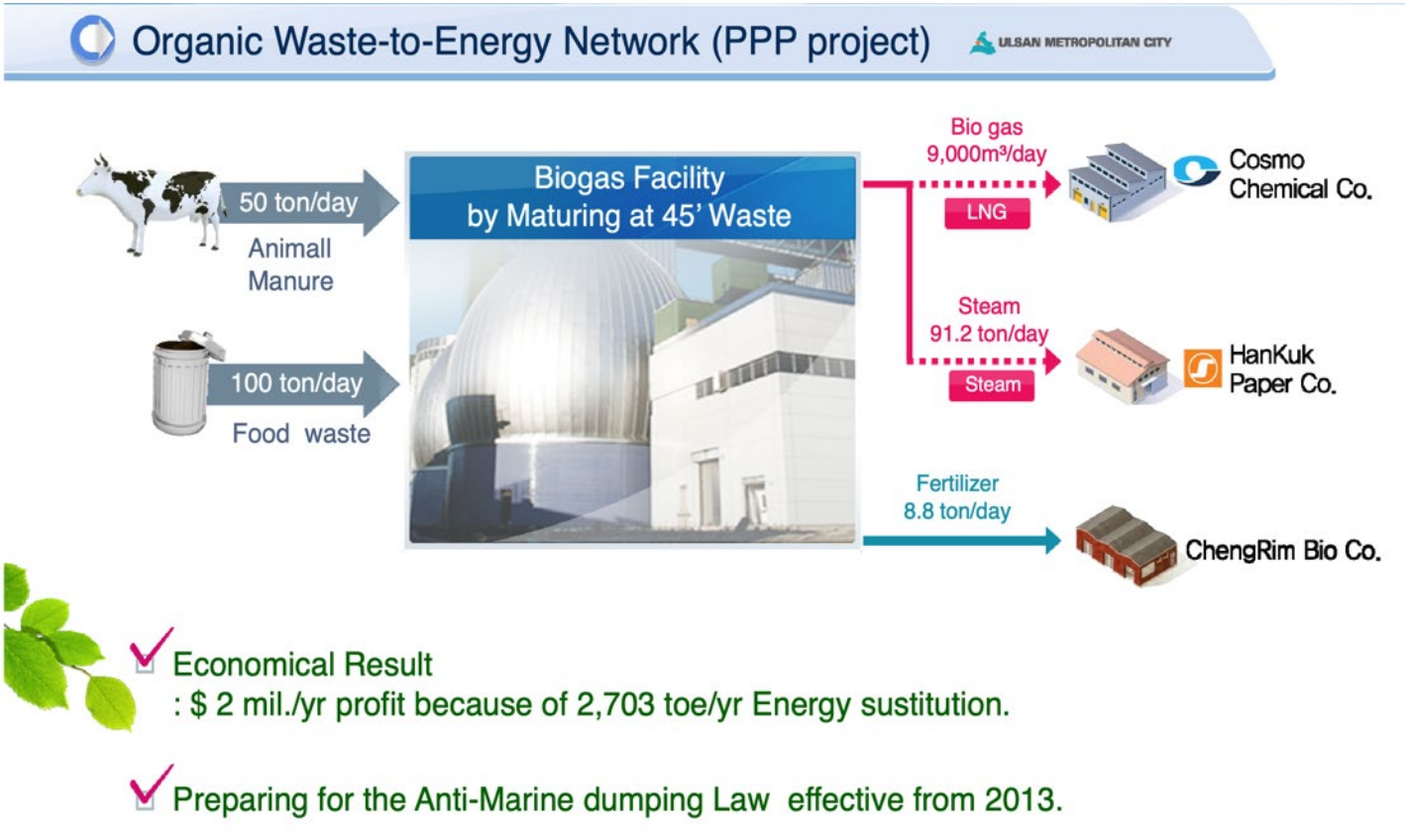

Fig: RECP/IS Case Study

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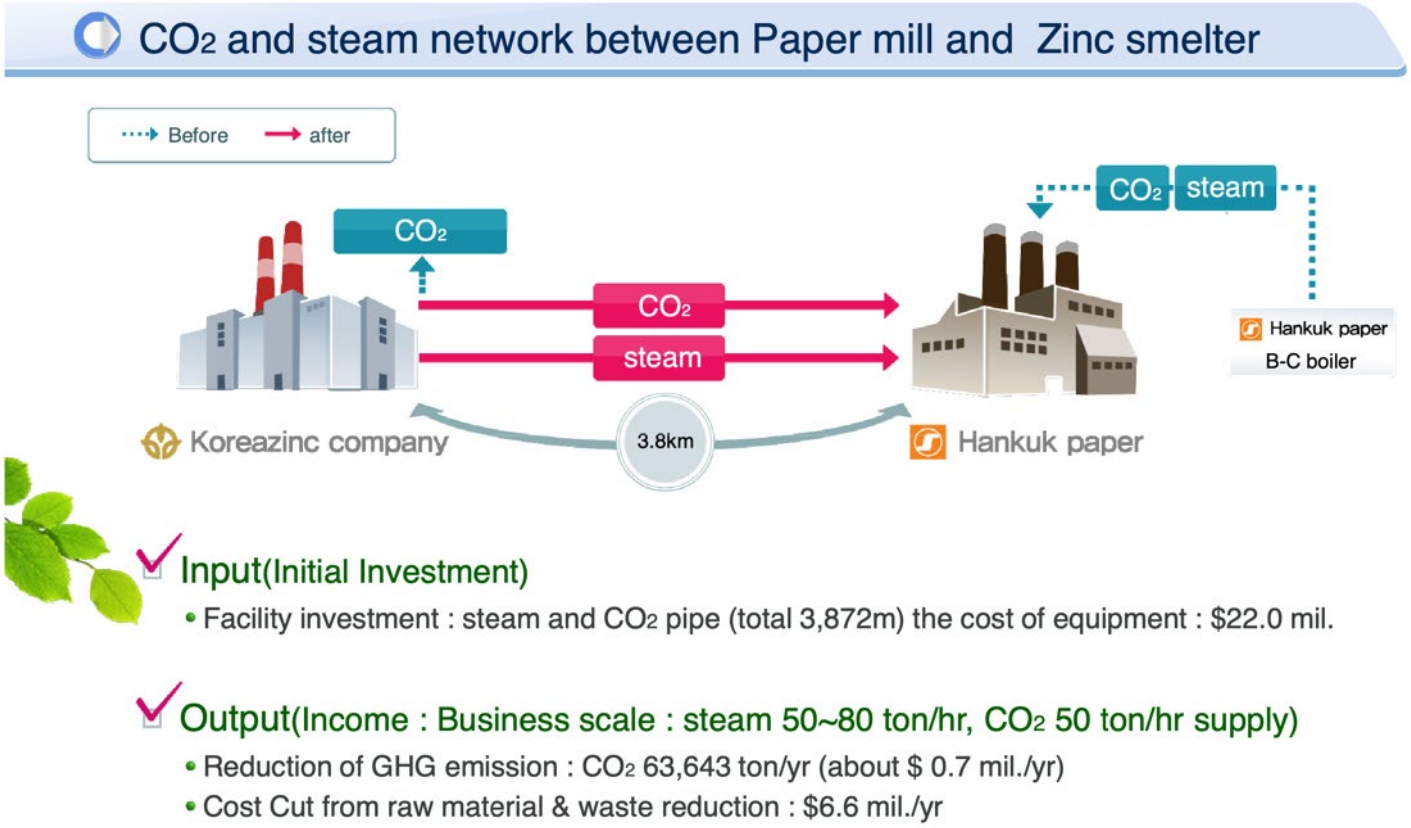

Fig: IS Case Study

Questions or comments?

Thank you!

Ankit Kapasi
ankit.kapasi@consultdss.com