Korean Green innovations through Ulsan EIP initiative

Hung-Suck Park, Ph.D., P.E.

Professor, Department of Civil and Environmental Engineering, University of Ulsan
Director, Ulsan Eco-Industrial Park center, Ulsan, South Korea

In this presentation…

- Innovation Vs. Eco-innovation
- Green growth and its relevance to Korea
- Strategies and core-policies promoting green growth in Korea
- Eco-innovation in industrial complexes
- Conclusion

1. Innovation Vs. Eco-innovation

Innovation

- The process that renews something that exists and not the introduction of something new

- can be seen as a change in the thought process for doing something, or the useful application of new inventions or discoveries

- may refer to incremental or radical and revolutionary changes in products, processes, or organizations

Source: Wikipedia

Eco-innovation

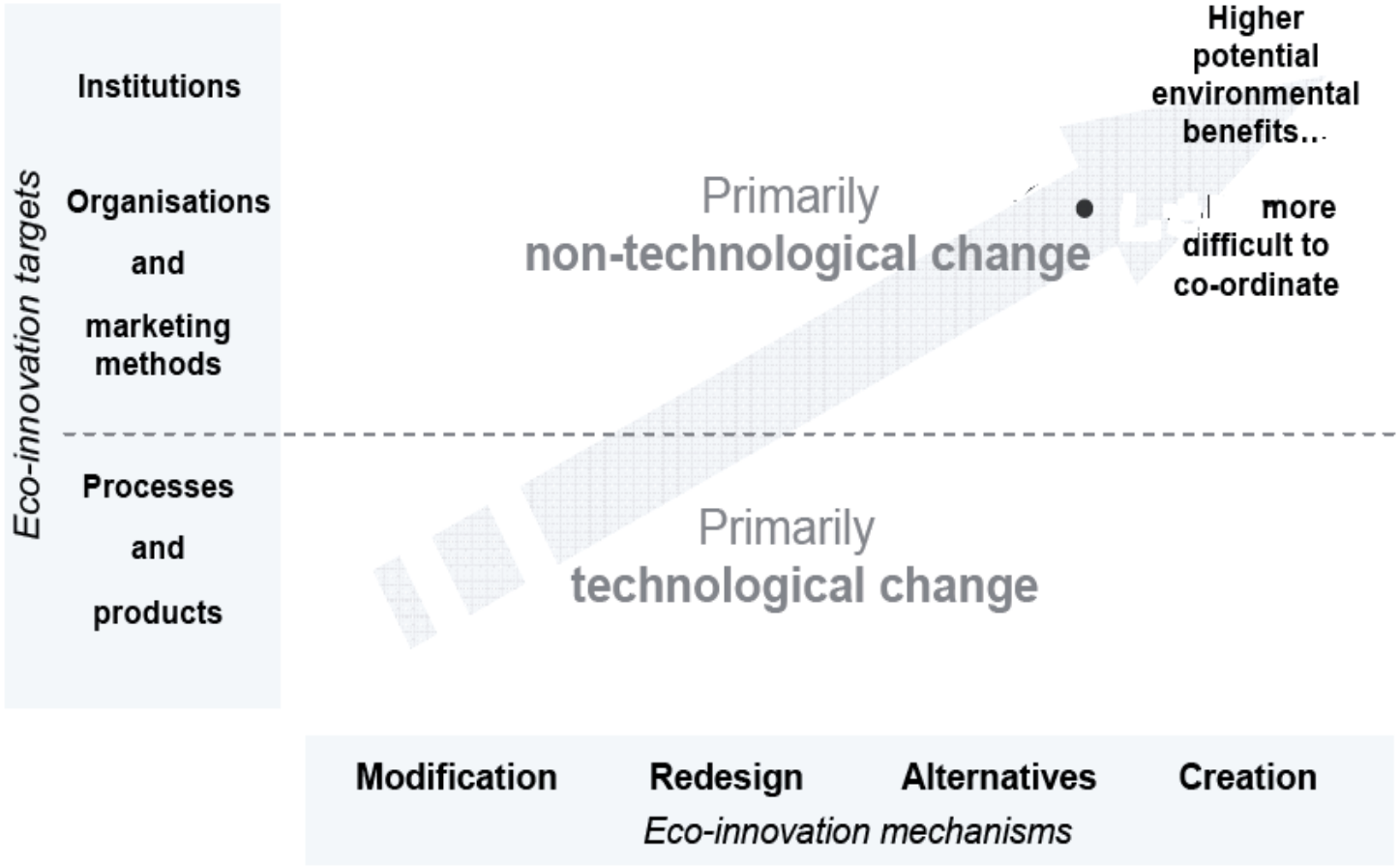
- *New products and processes which provide business value but at the same time significantly reduces the environmental impacts*

- (James, P (1997).“The Sustainability Circle: a new tool for product development and design”, *Journal of Sustainable Product Design*)

- New field of *techno-social innovation* that focuses less on products’ functions and more on environment and people.

- The promotion of eco-innovation is not only limited to products or processes but also is recently being applied in organizational level.

Typology of Eco-innovation



Source: Eco-innovation strategy, OECD

Eco-innovation vs. Innovation

- Eco-innovation represents innovation that explicitly emphasizes on the reduction of environmental impacts.

- Eco-innovation extends beyond the conventional organizational boundaries of the innovating company encompassing the changes in social norms, cultural values, and institutional structures to leverage more environmental benefits from the innovation .

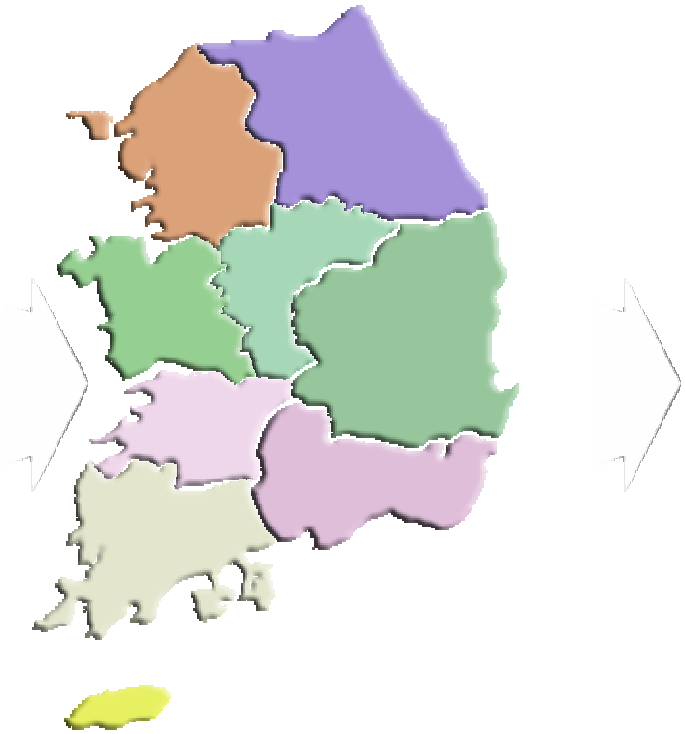
- often linked with eco-efficiency, eco-design, sustainable design or sustainable innovation.

2. Green growth and its relevance to Korea

Import and export status of South Korea

-Area : 9,953,850 ha
-Population : 48,749,700
-GNI : $ 17,175

Import (323,084)	
Foods	14,200
Fuels	91,669
Chemical	31,504
Intermediate product	68,542
Machinery	96,881
others	22,283



Export (363,533)	
Foods	4,078
Fuels	23,785
Chemical	37,414
Intermediate product	85,020
Machinery	206,334
others	6,898

(As on Dec' 2009)
(Unit : US$ million)

Green Growth – Korean context

- ***Grow fast and clean up later*** - no more acceptable to Korea with heavy dependence on natural resources that are limited in the country.
- **Low carbon Green growth**

– growth that does not conflict with but complements the environment.

– declared as the new national paradigm for the long-term development (August 15, 2008).

– policy emphasizing environmentally sustainable economic and social progress.

- **In essence, green growth need to address environmental degradation, climate change and diminishing natural resources in order to support the export-driven economic activities of the country.**

3. Strategies and core policies promoting green growth in Korea

Vision and Goals

Vision

- Low Carbon, Green Growth –

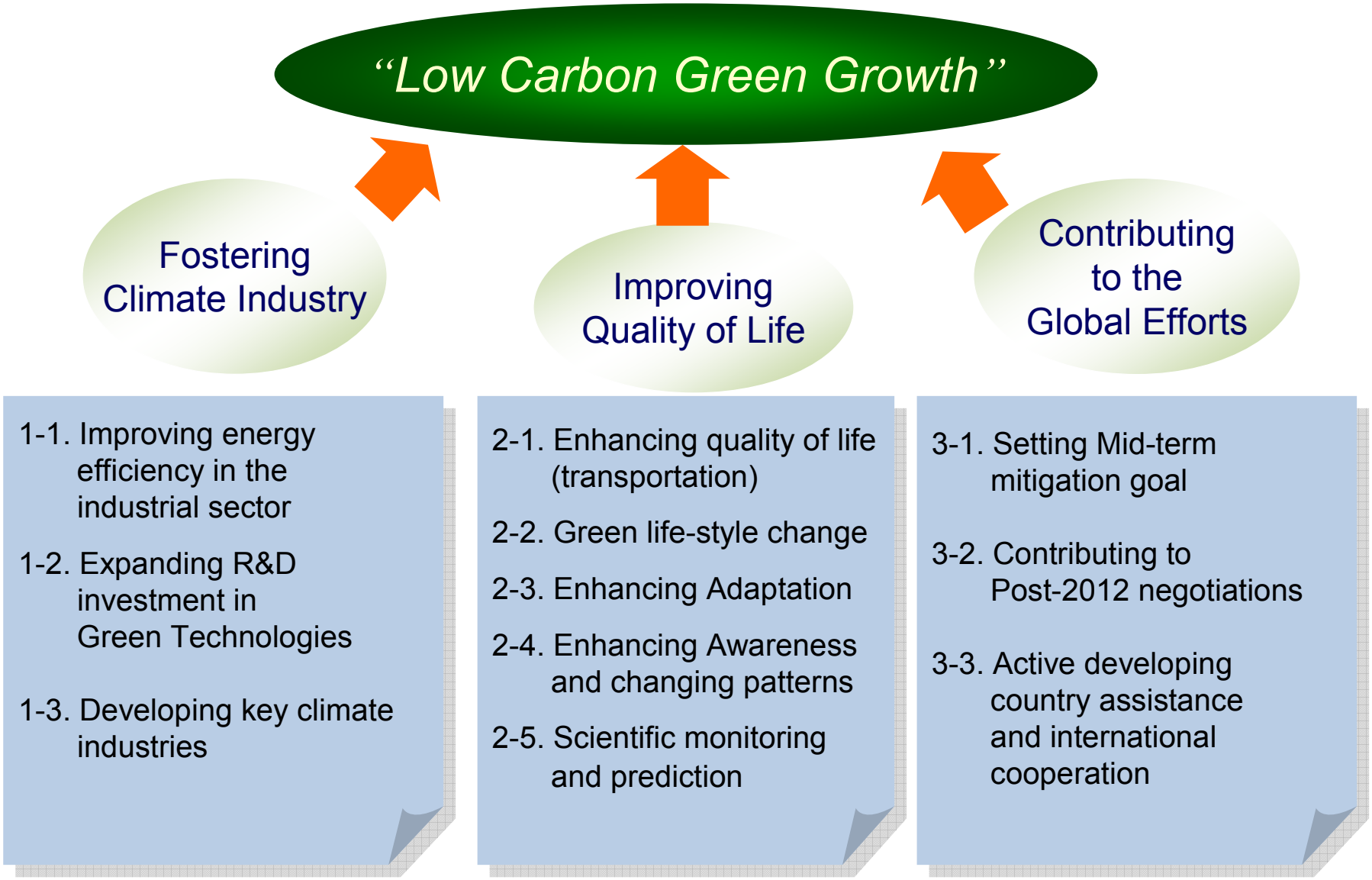
"contribute to the global efforts to combat climate change and achieve low carbon society thru green growth"

GOALS

1. Climate industry as a new economic driving force
2. Improving quality of life and the environment
3. Contributing to global efforts to combat climate change

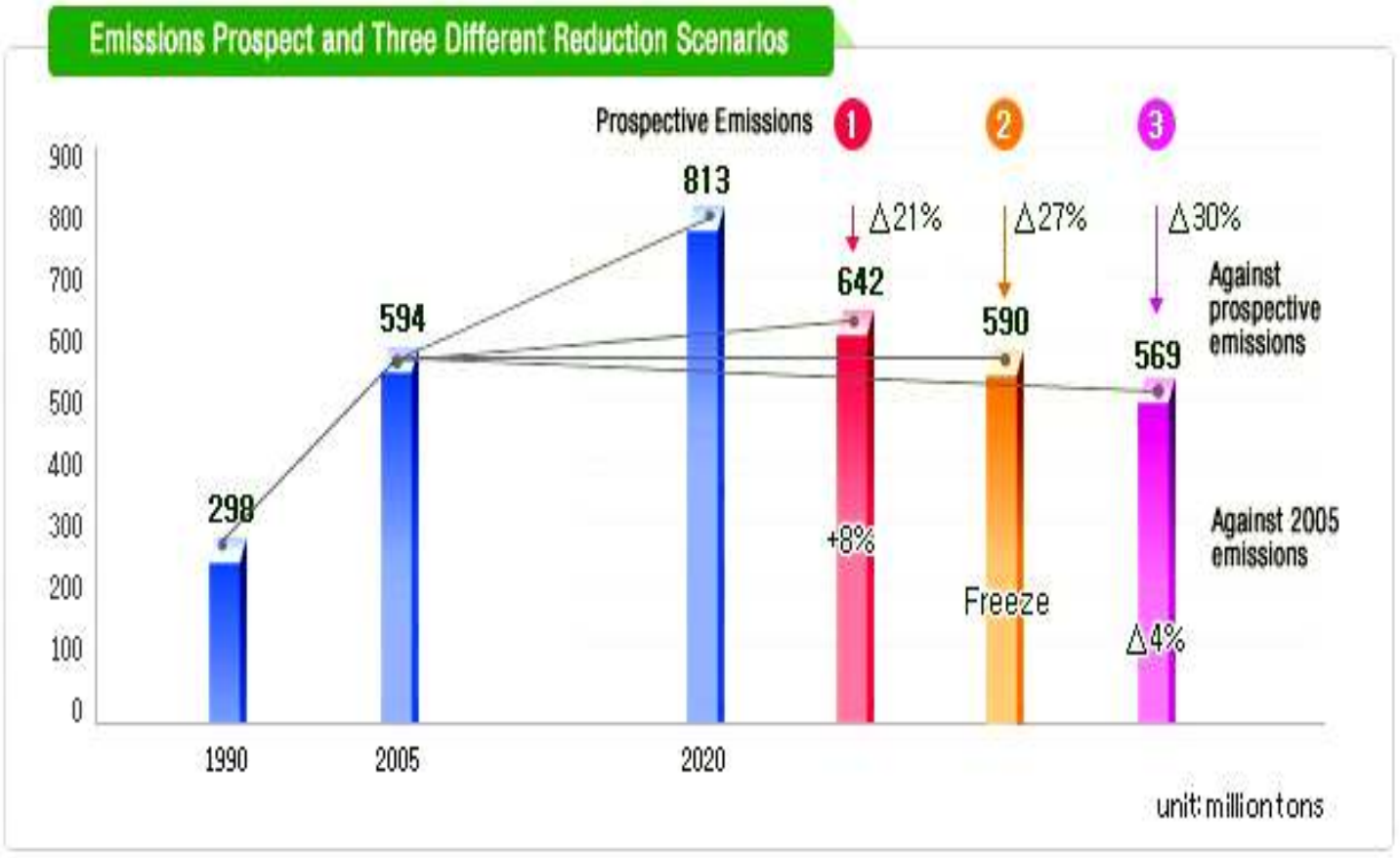
⇒ Action plan to materialize the Presidential Vision for "Low Carbon Green Growth"

Action plans



GHG reduction target for Green Growth

4% by 2020 from the 2005 levels (30% of the 2020 BAU levels), announcement on 17 November 2009.



4. Eco-innovation in industrial complexes

Industrial complexes in Korea

Type of industrial complexes	Number of complexes	Designated area (10^3 m^2)	Industrial area		
			Designated area (10^3 m^2)	Utilization area (10^3 m^2)	Utilization rate (%)
National	40	862,681	234,883	233,172	99.3
Regional	368	422,461	125,036	119,637	95.7
Urban hi-tech	6	720	67	67	100.0
Agricultural	401	63,925	43,820	42,676	97.4
Total	815	1,349,787	403,806	395,552	98.0

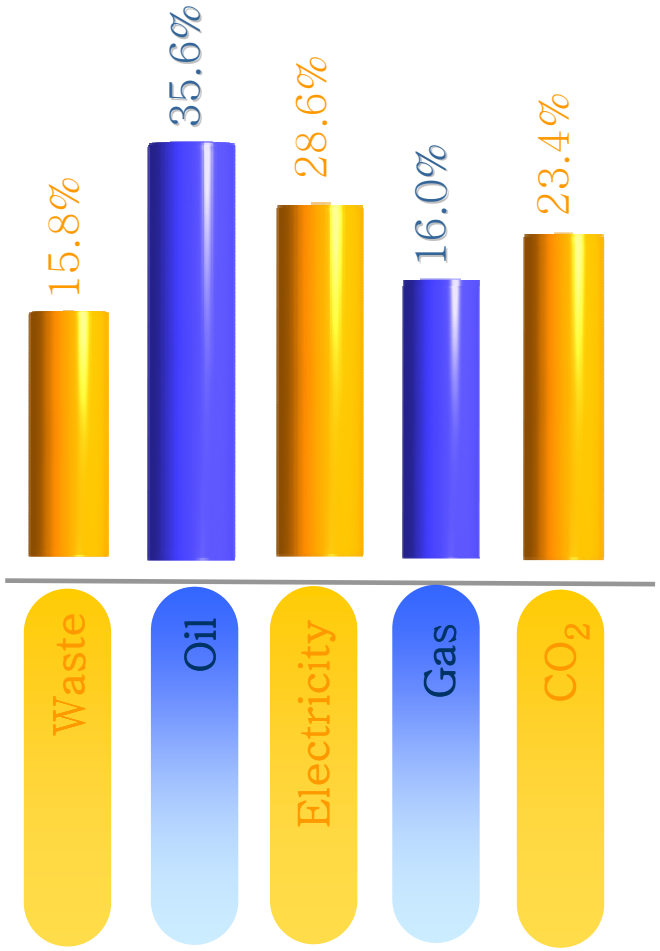
(As on Dec' 2009)

- Industrial complexes are the engines of Korean economy
- National, regional, and agricultural industrial complexes
- Manufacturing industries within industrial complexes - 60%, export rate - 75%, employment rate – 47%

- Densely located SME, High energy consumption, major sources of environmental pollution
- Emission of environmental pollutants, conflict with local communities

- Conversion of present industrial complexes to low carbon green growth complexes
- Reduce resource and energy, maximize efficiency, reduce environmental pollution through resource circulation such as recycling of wastes and by-products.

Waste generation, Energy consumption and CO_2 emission in industrial complexes



Environmental policies stimulating sustainable development of industrial parks in Korea

Rio Earth Summit (1992) – Adoption of cleaner production and industrial ecology concepts by Korean industries to improve their environmental, social and business performance.

APEFIS - Act to Promote Environmental Friendly Industrial Structure (MKE, 1995).

Korean National Cleaner Production Center establishment

- Streamlining the supporting system,
- Cleaner production transfer and dissemination (technology transfer, international collaborative projects, supply chain environmental management, environmental management system and EIPs),
- Promoting environmental industry

Industrial complexes as platforms for low carbon green growth

Eco-industrial park (EIP) project in Korea

Objective:

An industrial complex will be converted into a base to achieve low carbon green growth by maximizing the efficient use of raw materials and energy and reducing the generation of environmental pollutants through the establishment of resource recycling systems that allows re-utilizing wastes and by-products.

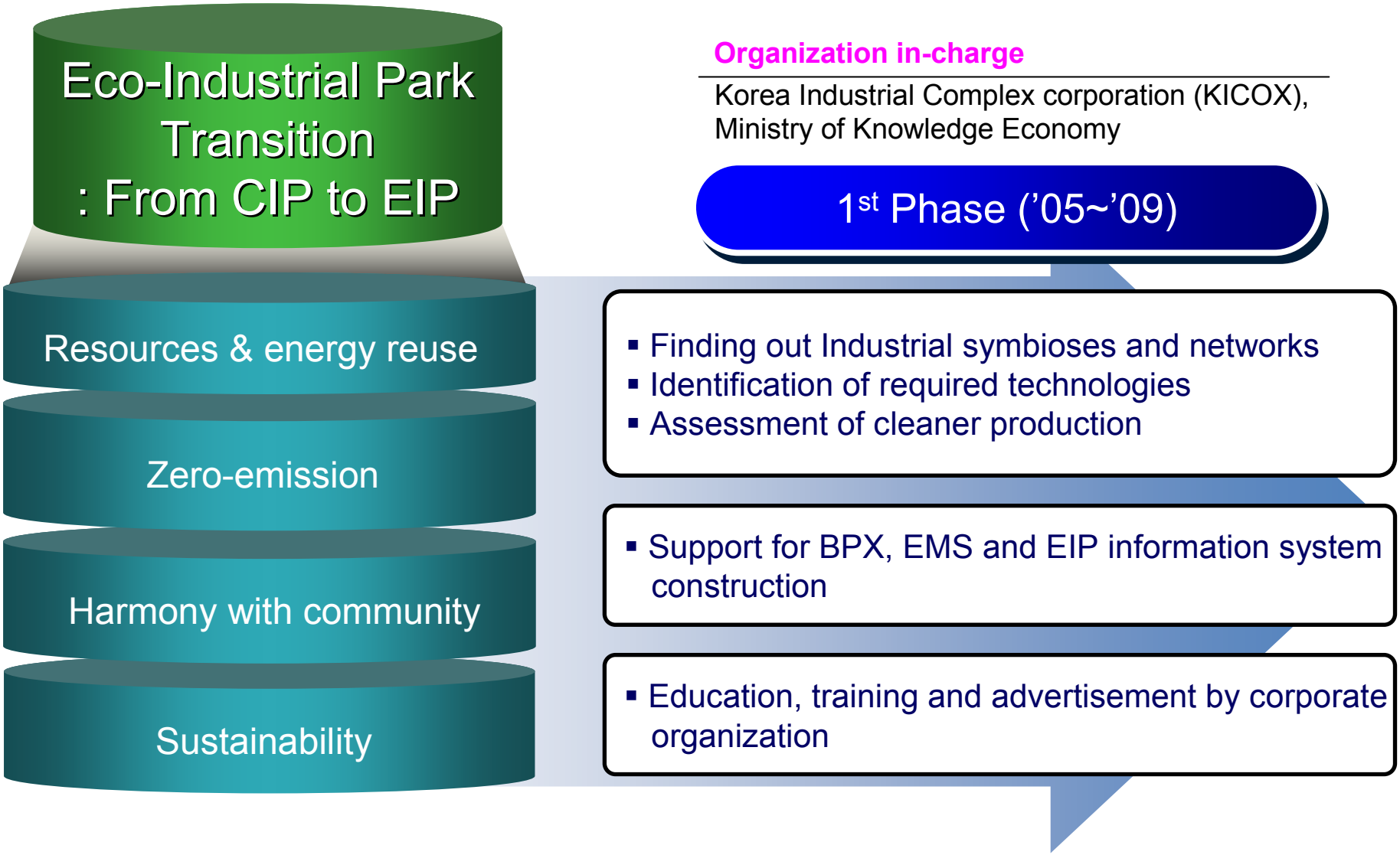
Gradual developments..

Establishment of Eco industrial parks (EIPs) through resource circulation network development for environmental pollution reduction and energy efficiency maximization in industrial complexes.

* Based on article 4.2 of Korean law : Act to Promote Environmentally Friendly Industrial Structure **(APEFIS)**

'03.10	Establishment of national EIP demonstration project plan (MKE)
'05.10	Selection of demonstration sites: Pohang, Yeosu, Ulsan mipo-onsan
'06.02	Additional selection of demonstration sites: Banwol-sihwa, Cheongju
'06.12	Change of EIP ownership (KNCPC → KICOX)
'10.06	Beginning of 2nd phase EIP project

Objective


Eco-Industrial Park Transition
: From CIP to EIP
Resources & energy reuse
Zero-emission
Harmony with community
Sustainability
Organization in-charge
Korea Industrial Complex corporation (KICOX), Ministry of Knowledge Economy
1st Phase ('05~'09)
▪ Finding out Industrial symbioses and networks
▪ Identification of required technologies
▪ Assessment of cleaner production
▪ Support for BPX, EMS and EIP information system construction
▪ Education, training and advertisement by corporate organization

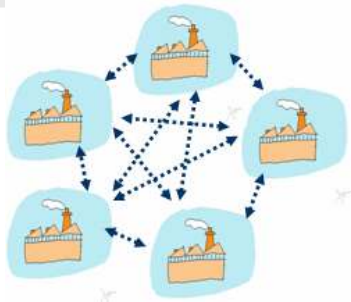
Korean EIP Master plan

Phase 1

5 EIP pilot project

($17million)

2005 ~ 2009

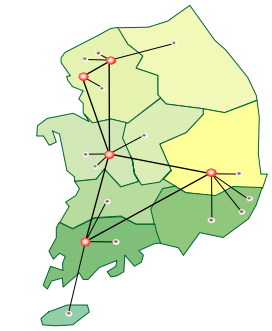


Eco-Networking between plants for 5 national industrial parks (Material, energy, by-product)

Phase 2

Diffuse EIP through over 8 IPs ($68million)

2010 ~ 2014



Transfer and disseminate experiences to other Industrial Parks (8 sites)

Phase 3

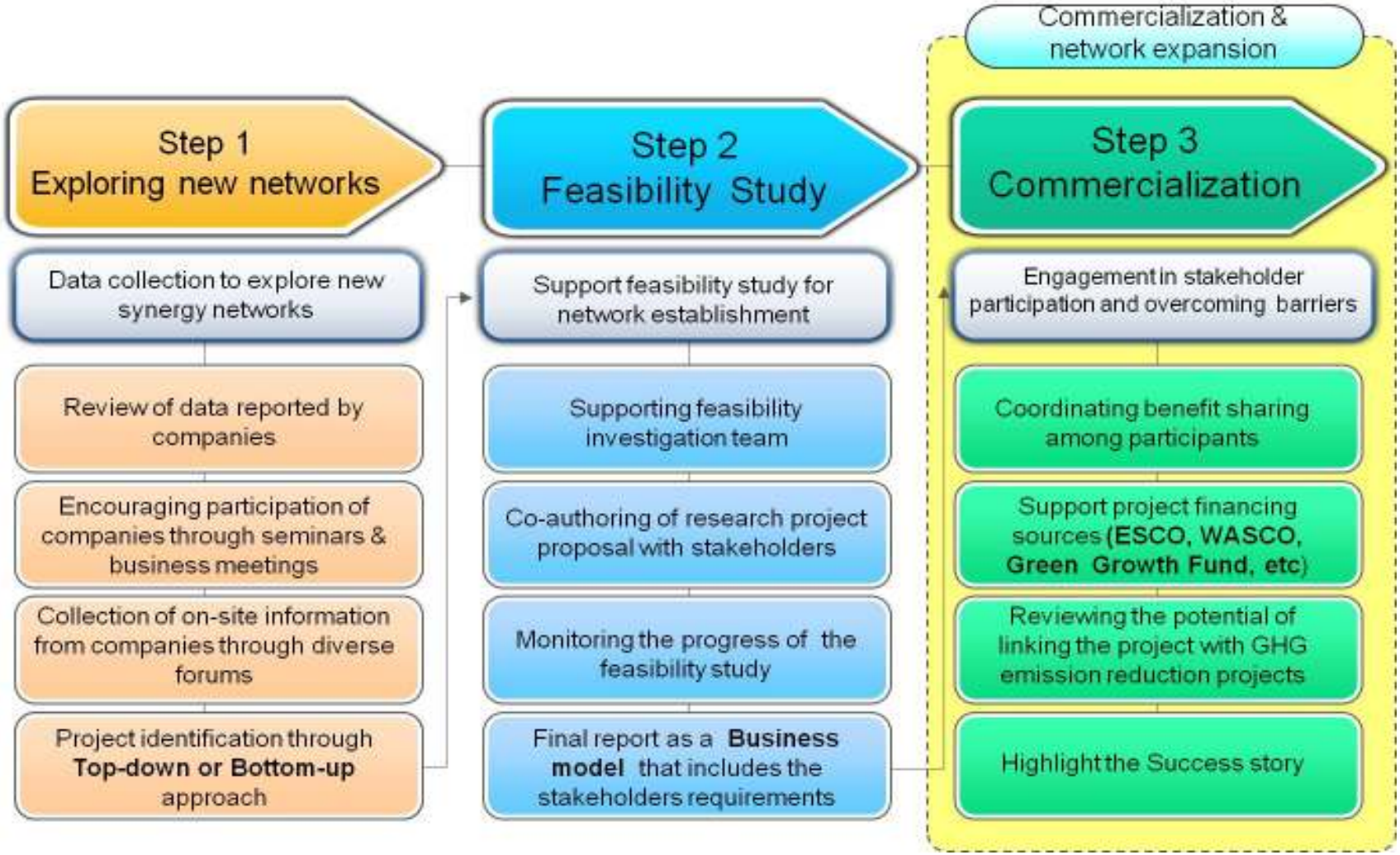
2~3 new Korean-type EID ($6.8million)

2015 ~ 2019

Design the new EIP based on the industrial ecology principle

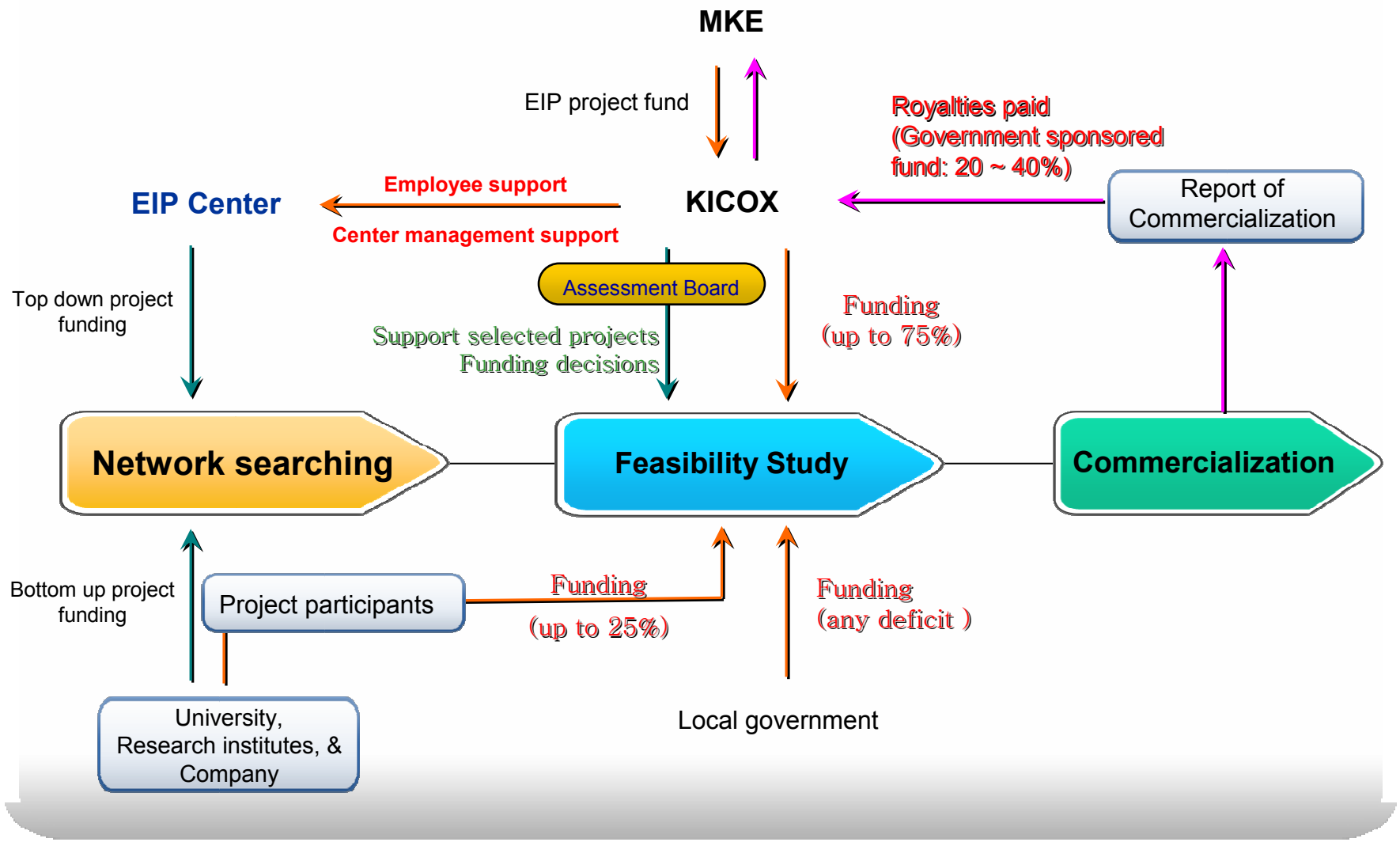
Role of Ulsan EIP center in synergy development

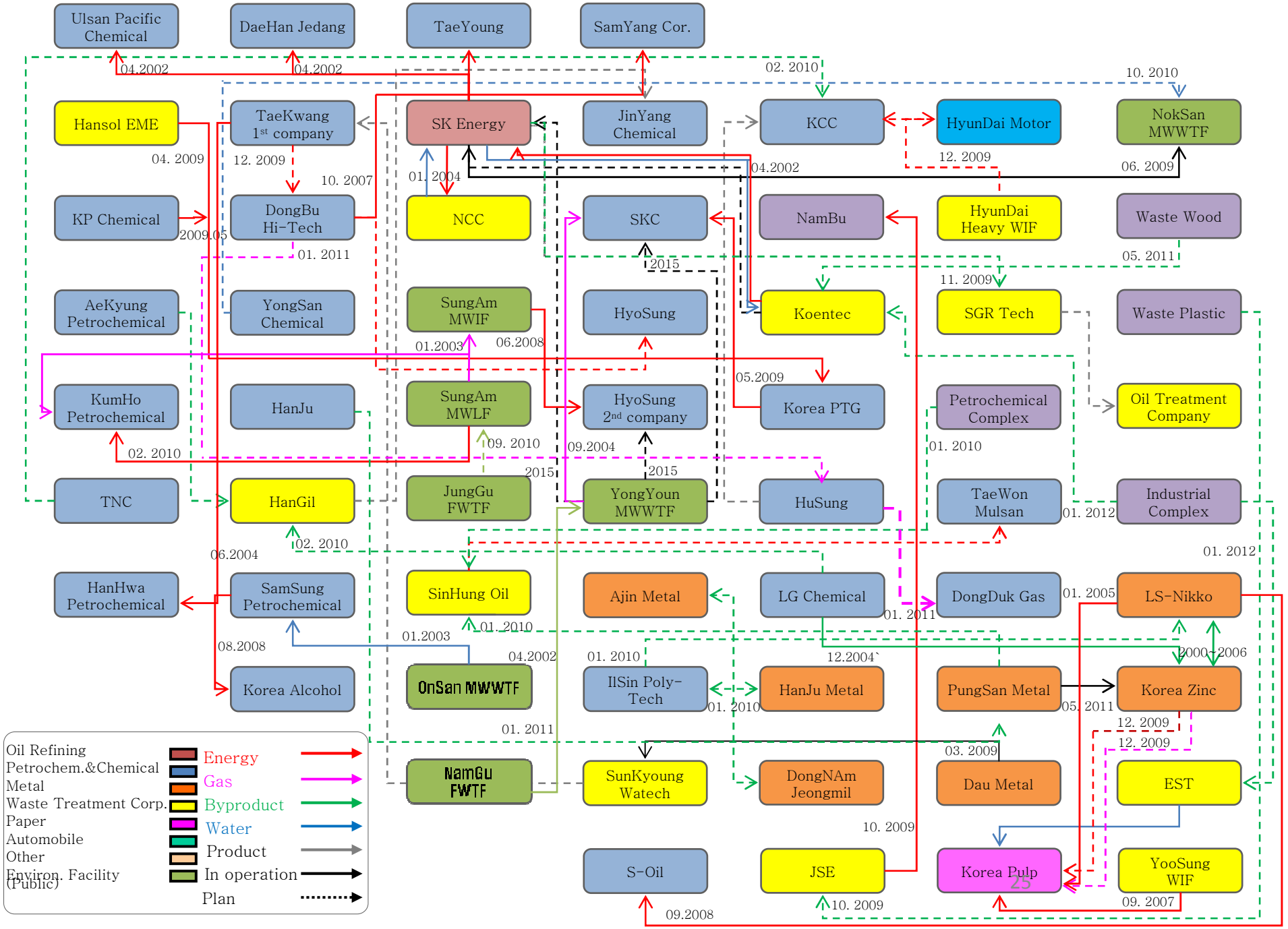
Research and development into business



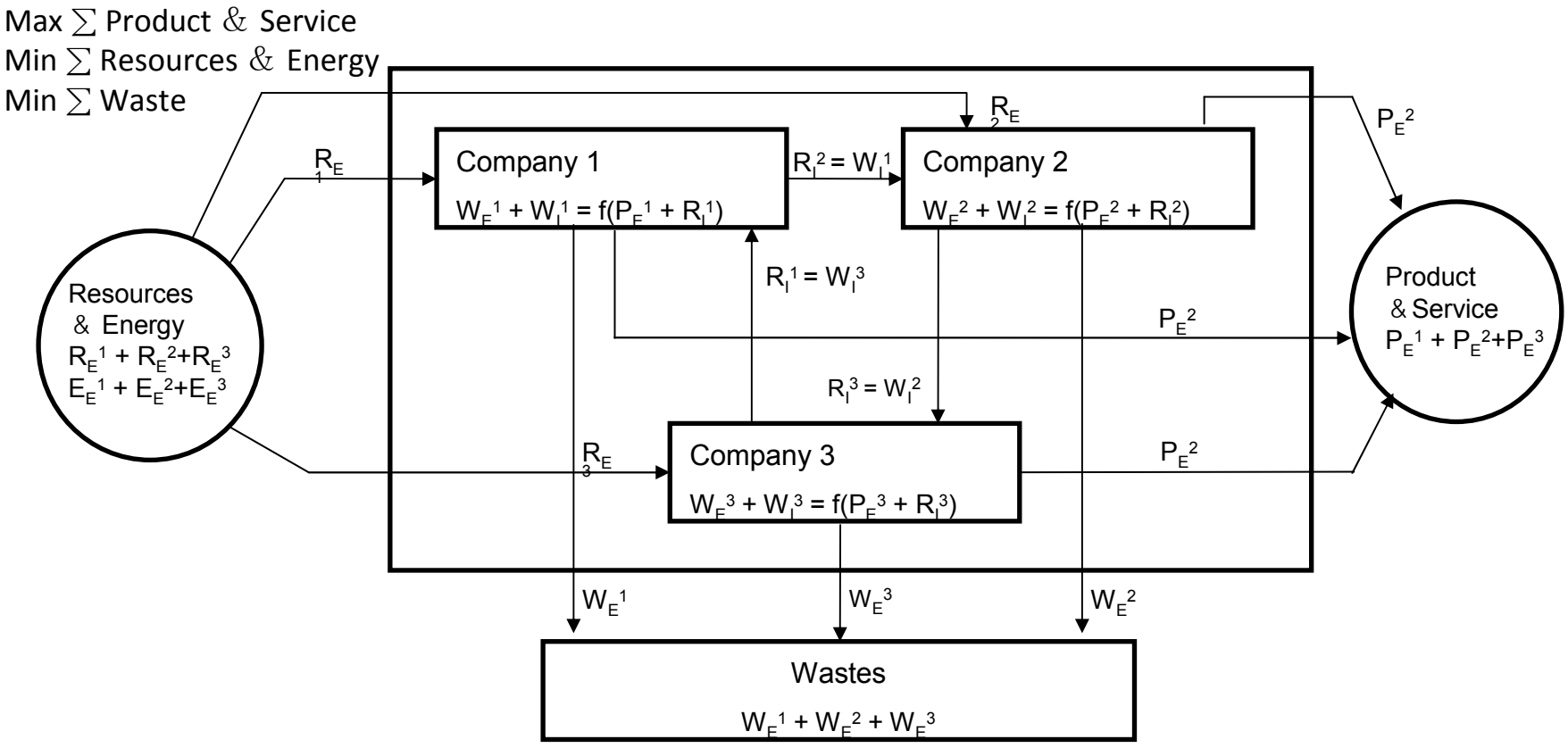
Enabling System: R&DB

Steps and procedures of project funding




Ulsan Pacific Chemical
DaeHan Jedang
TaeYoung
SamYang Cor.
04.2002
04.2002
02. 2010
10. 2010
Hansol EME
TaeKwang 1st company
SK Energy
JinYang Chemical
KCC
HyunDai Motor
NokSan MWWTF
04. 2009
12. 2009
10. 2007
01. 2004
04.2002
12. 2009
06. 2009
KP Chemical
DongBu Hi-Tech
NCC
SKC
NamBu
HyunDai Heavy WIF
Waste Wood
2009.05
01. 2011
2015
05. 2011
11. 2009
AeKyung Petrochemical
YongSan Chemical
SungAm MWIF
HyoSung
Koentec
SGR Tech
Waste Plastic
01.2003
06.2008
05.2009
KumHo Petrochemical
HanJu
SungAm MWLF
HyoSung 2nd company
Korea PTG
Petrochemical Complex
Oil Treatment Company
02. 2010
09. 2010
09.2004
01. 2010
2015
2015
TNC
HanGil
JungGu FWTF
YongYoun MWWTF
HuSung
TaeWon Mulsan
01. 2012
Industrial Complex
06.2004
02. 2010
01. 2012
HanHwa Petrochemical
SamSung Petrochemical
SinHung Oil
Ajin Metal
LG Chemical
DongDuk Gas
01. 2005
LS-Nikko
01. 2011
01. 2010
01.2003
08.2008
04.2002
01. 2010
12.2004`
2000~2006
Korea Alcohol
OnSan MWWTF
IlSin Poly-Tech
HanJu Metal
PungSan Metal
Korea Zinc
01. 2010
05. 2011
12. 2009
01. 2011
12. 2009
03. 2009
NamGu FWTF
SunKyoung Watech
DongNAm Jeongmil
Dau Metal
EST
10. 2009
S-Oil
JSE
Korea Pulp
YooSung WIF
10. 2009
09. 2007
09.2008
Oil Refining
Petrochem.&Chemical
Metal
Waste Treatment Corp.
Paper
Automobile
Other
Environ. Facility (Public)
Energy
Gas
Byproduct
Water
Product
In operation
Plan
25

Application of eco-efficiency to an industrial complex



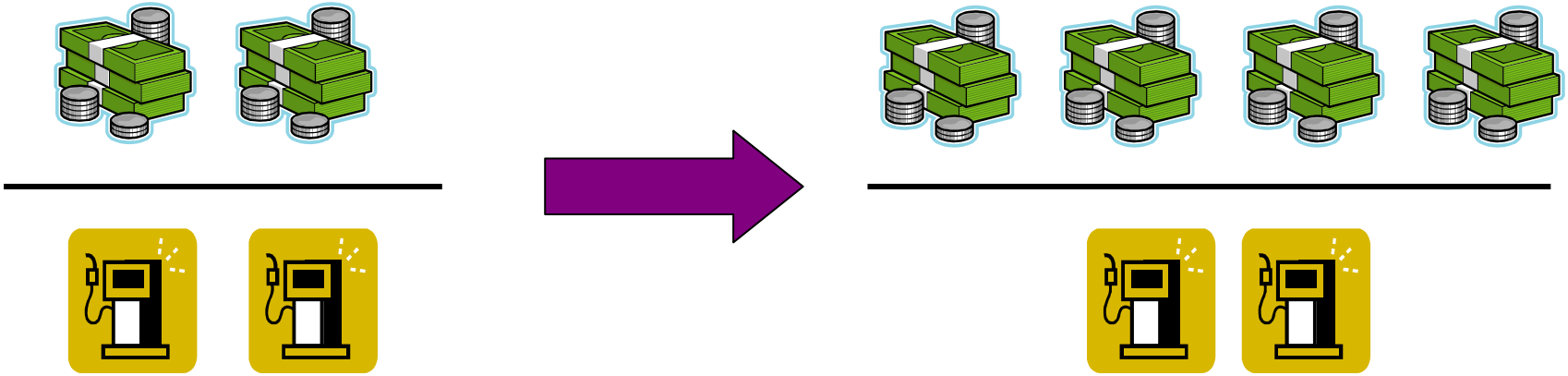
$$\text{Eco-efficiency} = \frac{\sum \text{Product \& Service}}{\sum \text{Resources \& Energy}}$$

Eco-efficiency

Value

Concept developed by the World Business Council on Sustainable Development (WBCSD) and successfully applied by many businesses

Environmental impact (resources, pollution)



Types of synergies and selected indicators

Network #	Type of exchange	Environmental indicators					
		Raw material consumption		Energy consumption		CO_2 emission	
		BN	AN	BN	AN	BN	AN
1	Steam	N/A		143.5 ton/hr	131.5 ton/hr	29.6 ton/hr	27.3 ton/hr
2	Wastewater	24.72 ton/day	15.1 ton/day	N/A		N/A	
3	Steam	N/A		176.8 ton/hr	156.8 ton/hr	36.991 ton/hr	32.976 ton/hr
4	Steam	N/A		526.2 ton/hr	496.2 ton/hr	47.2 ton/hr	39.1 ton/hr
5	Zinc powder	7900 ton/yr	6784 ton/yr	N/A		3157 ton/yr	2841 ton/yr
6	Steam	N/A		608 ton/hr	538 ton/hr	119.039 ton/hr	96.823 ton/hr
7	Steam	N/A		470 ton/hr	390 ton/hr	32.597 ton/hr	16.299 ton/hr

Note:- N/A: Not applicable; BN: Before network; AN: After network

Eco-efficiency evaluation

- EE evaluation is based on the WBCSD approach.

$$EE = \frac{EI}{\sum EN_m}$$

EI - economic performance indicator, US$

EN - environmental performance indicator

ΣEN_m - 'm' type of environmental factor is a function of various independent categories of resource consumption, energy consumption, and CO_2 emission.

- The calculations of resource consumption, energy consumption, and CO_2 emission are conducted separately.

Eco-efficiency evaluation

- Representation of multiple evaluation items by a single indicator was made by averaging the sum of squares of the items :

$$\sum_{i=1} EN_m = NEI = \sqrt{\frac{1}{n}\sum_{i=1}^{n} S_i^2} \qquad \Delta \mathrm{EE} = \frac{\mathrm{EE_a} - \mathrm{E}E_b}{EE_a}$$

NEI – Normalized Environmental Impact, *n* - number of factors

- Evolution of eco-efficiency due to 'n' number of IS networks can be expressed as:

$$\sum_{i=1}^{n} \Delta EE_i = \left[\frac{\sum_{i=1}^{n} P_a}{\sum_{i=1}^{n} I_a} - \frac{\sum_{i=1}^{n} P_b}{\sum_{i=1}^{n} I_b}\right] = \frac{\sum_{i=1}^{n} P_b}{\sum_{i=1}^{n} I_b}\left(\frac{\sum_{i=1}^{n} I_b}{\sum_{i=1}^{n} I_a} - 1\right) = \left(\frac{\sum_{i=1}^{n} I_b - \sum_{i=1}^{n} I_a}{\sum_{i=1}^{n} I_a}\right), \frac{\sum_{i=1}^{n} P_b}{\sum_{i=1}^{n} I_b} = 1.0 \ (assumed)$$

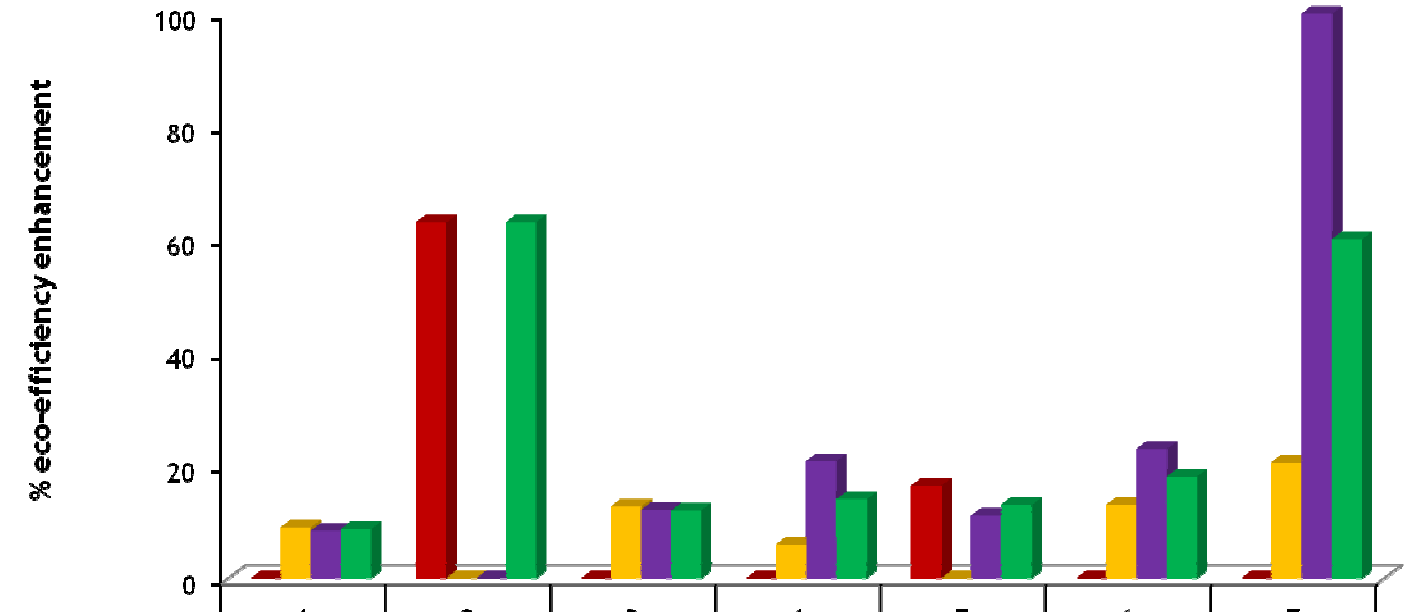
$$= \left(\frac{\sum_{i=1}^{n} I_b - \sum_{i=1}^{n} I_b(1-R_i)}{\sum_{i=1}^{n} I_b(1-R_i)}\right) = \left(\frac{\sum_{i=1}^{n} R_i}{\sum_{i=1}^{n}(1-R_i)}\right), \quad \sum_{\mathrm{i=1}}^{\mathrm{n}} \mathrm{I_b} = 1.0 \ (assumed)$$

R – Overall environmental impact reduction in each year

Assumptions

- The total economic benefit of the companies involved in the IS networks is normalized to 1.0.
- The total environmental impact of the companies concerned before IS network establishment is normalized to 1.0 (considered as a baseline for evaluating the relative environmental performance after the establishment of synergy networks).

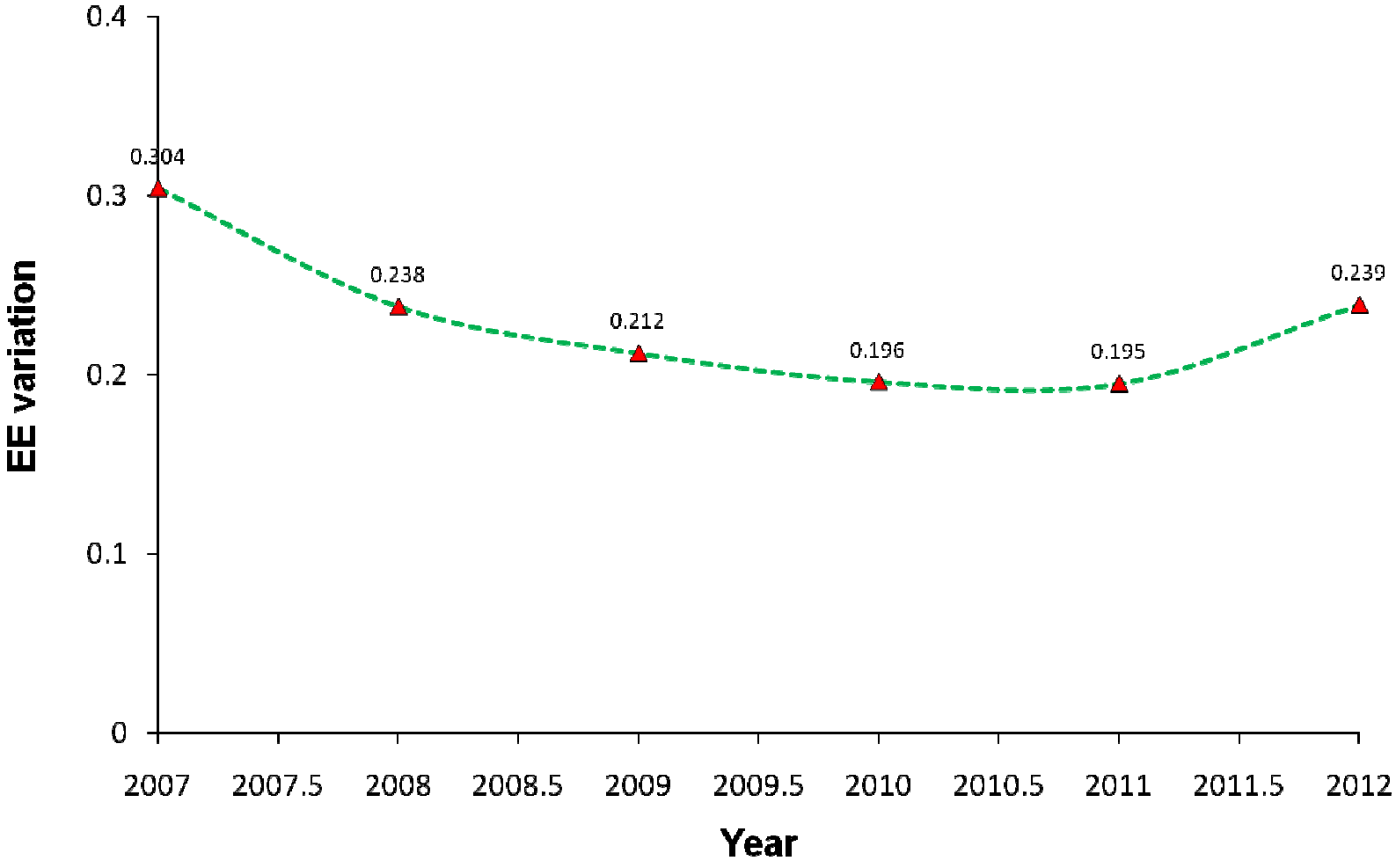
Enhancement of eco-efficiency of synergy networks with respect to each indicator



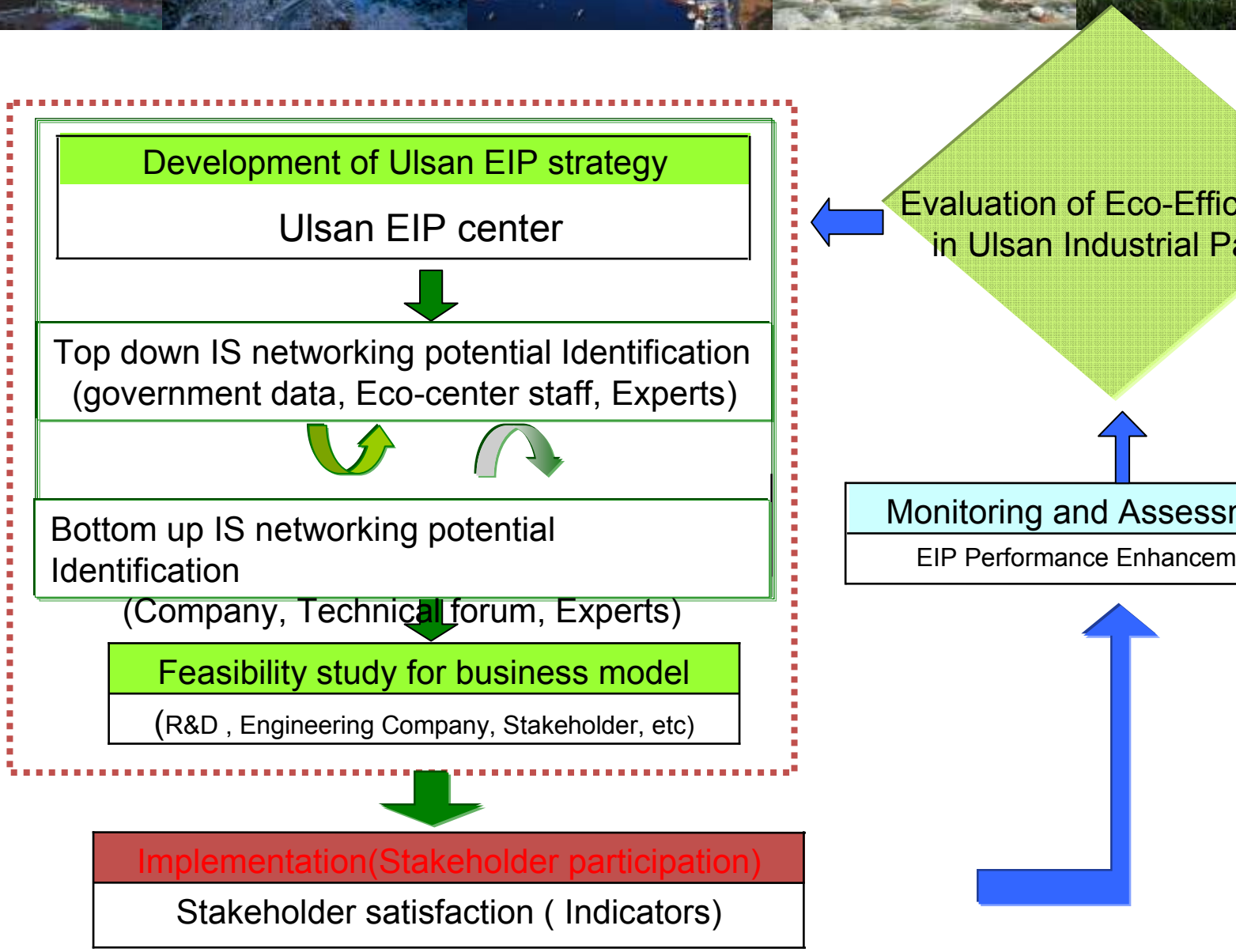
	1	2	3	4	5	6	7
Raw material	0	63	0	0	16.4	0	0
Energy	9	0	12.7	6	0	13	20.5
CO2	8.4	0	12.1	20.7	11.1	22.9	99.9
Overall	8.7	63	12	14	13	18	60

In submission: ***Journal of industrial Ecology***

Eco-efficiency evolution



Continuous improvement of eco-efficiency of Ulsan EIP



5. Conclusion

- Korea's Green Growth policy targets transformation of country's growth paradigm from "**quantitative growth**" to low carbon "**qualitative growth**".
- National GHG emission reduction target of **4% by 2020** from the 2005 levels (**30% of the 2020 BAU levels**) can be achieved by the green growth strategies.
- Korean EIP project which is aimed at the ***collective innovation of industrial complexes*** is one of the core elements of the Korean green growth strategy
- The objective can not be fulfilled by **technological innovation** alone. **Social and cultural innovations should also be considered as the integral parts of the green growth strategy.**

- The eco-efficiency of individual synergy networks in the post-EIP initiative in Ulsan have resulted in increases of up to 63%.
- The evolution of seven synergy networks have resulted in an overall eco-efficiency enhancement of ~20%.
- Establishment of more synergy networks in future could result in higher eco-efficiency of the industrial complex.
- The eco-efficiency enhancement of due to the synergy networks in the post-EIP initiative in Ulsan may be deemed as an example of eco-innovation.

Announcement of Global Green Growth Institute by President Lee at the UN Climate Change Conference (December 18, 2009)

UOU welcomes you to

2013 ISIE conference

(Jointly organized by China, Japan and Korea)

Thank you

Professor, University of Ulsan

102 Dehakro, Nam-Gu, Ulsan, South Korea

Tel: 052-259-1050

Fax: 052-221-0152

E-mail: parkhs@ulsan.ac.kr

Director, Ulsan EIP center

1599-23, Samsan Dong, Nam-Gu, Ulsan, Korea

Tel: 052-228-1580

Fax: 052-228-1589