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Culttz Kawasaki

Urban Symbiosis through Innovative Circularization of Material and Energy
: Urban E&M Infra Innovation Strategy

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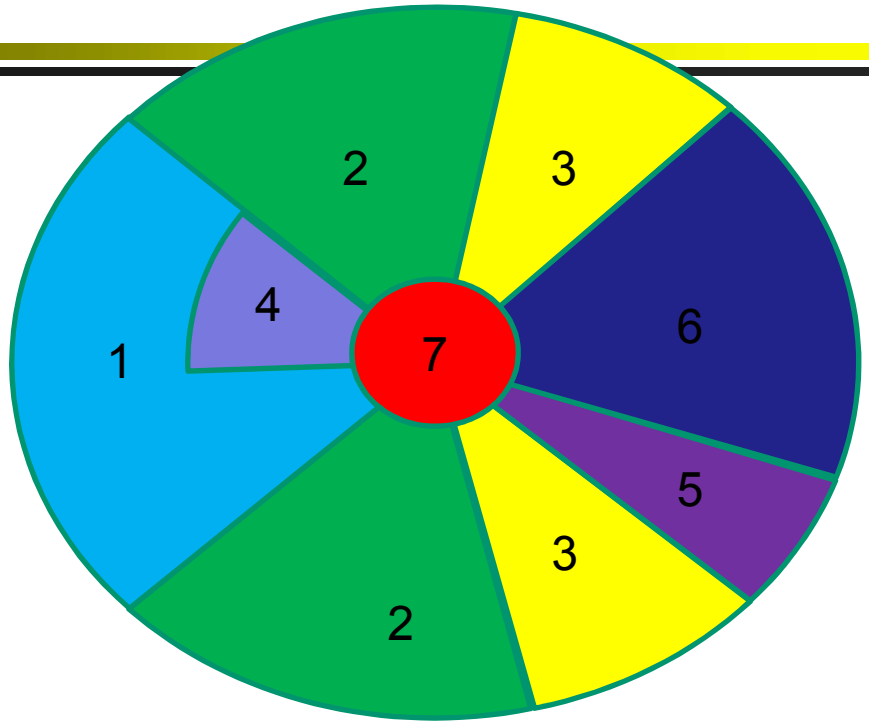
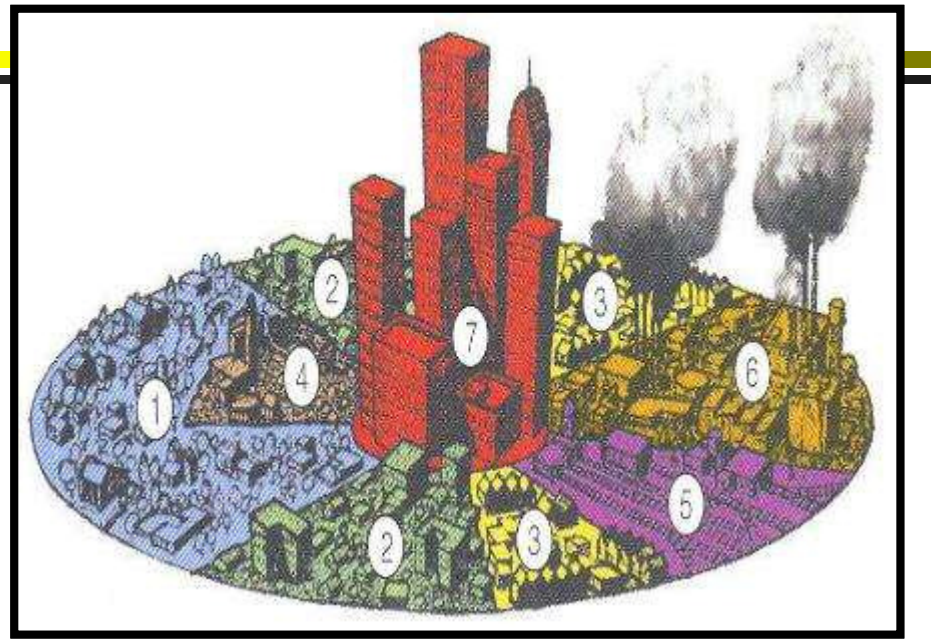
울산광역시 ULSAN METROPOLITAN CITY

Four major trends in Urban Areas

- Proportion of global population living in urban areas is increasing
- Number and size of urban areas is mushrooming
  - **Megacities, hypercities**
- Urban growth slower in developed countries
- Poverty is becoming increasingly urbanized; mostly in developing countries

Cities: Complex Organisms





1 High-rent Residental

2 Intermediate-rent Residental

3 Low-rent Residental

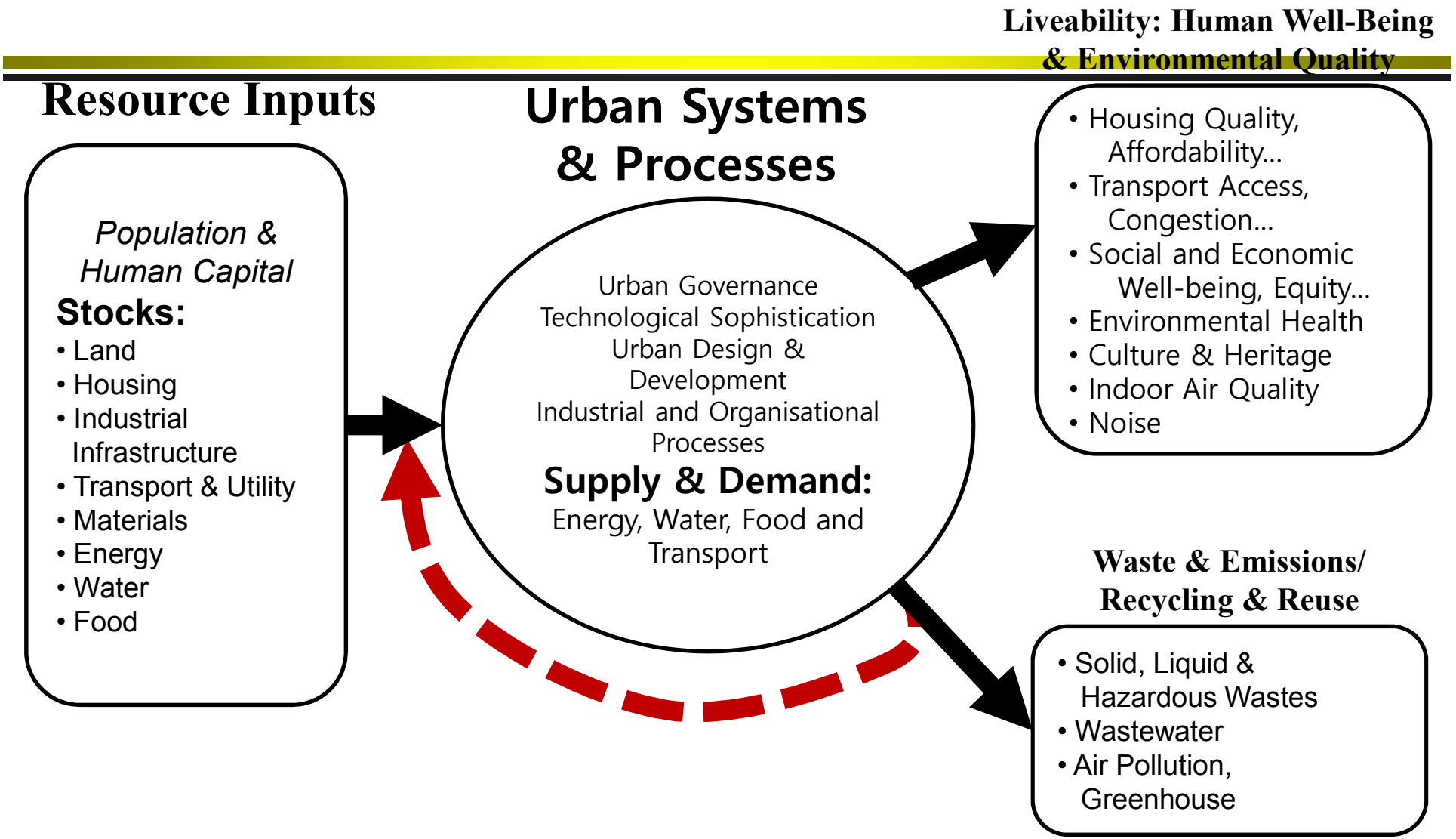
4 Education and Recreation

5 Transportation

6 Industrial

7 Central Business District

Cities: Complex Metabolic Organism



How can we make city sustainable ?

-through material and energy infra innovation

eco-innovation is “any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy” (Union 2006).

> International survey on eco-innovation parks

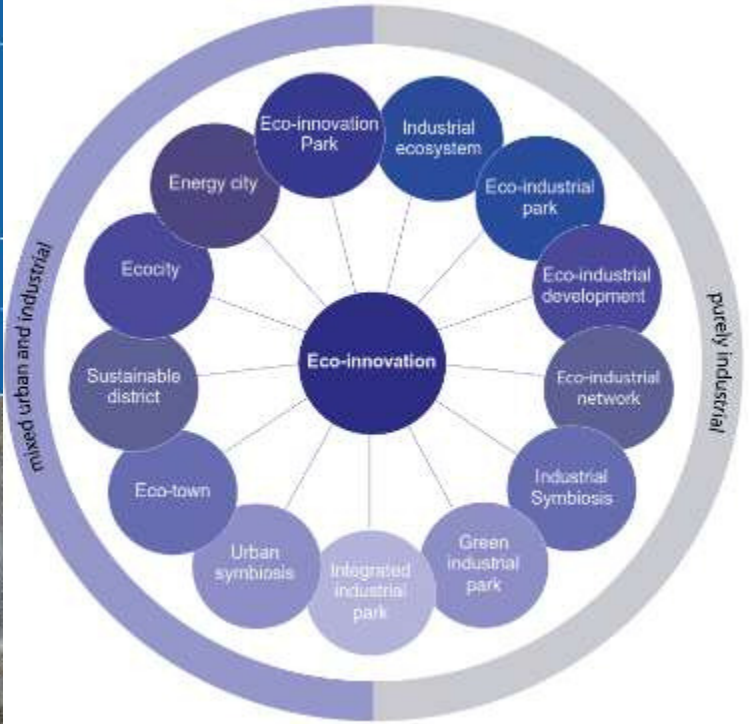
Learning from experiences on the spatial dimension of eco-innovation

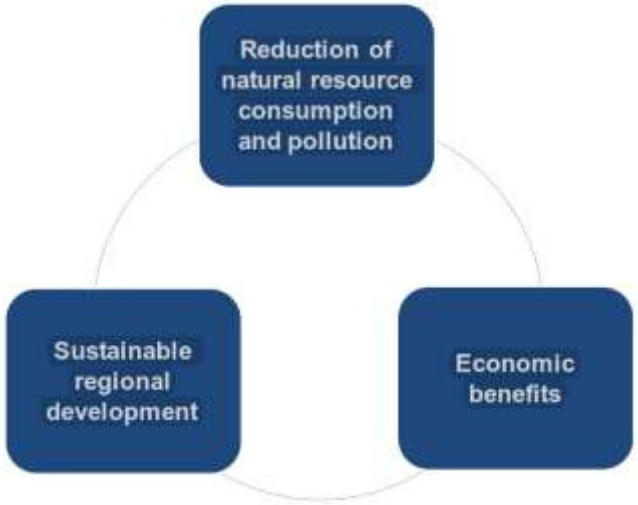
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Office for the Environment FOEN

ECO-INNOVERA





Eco-innovera, 2014

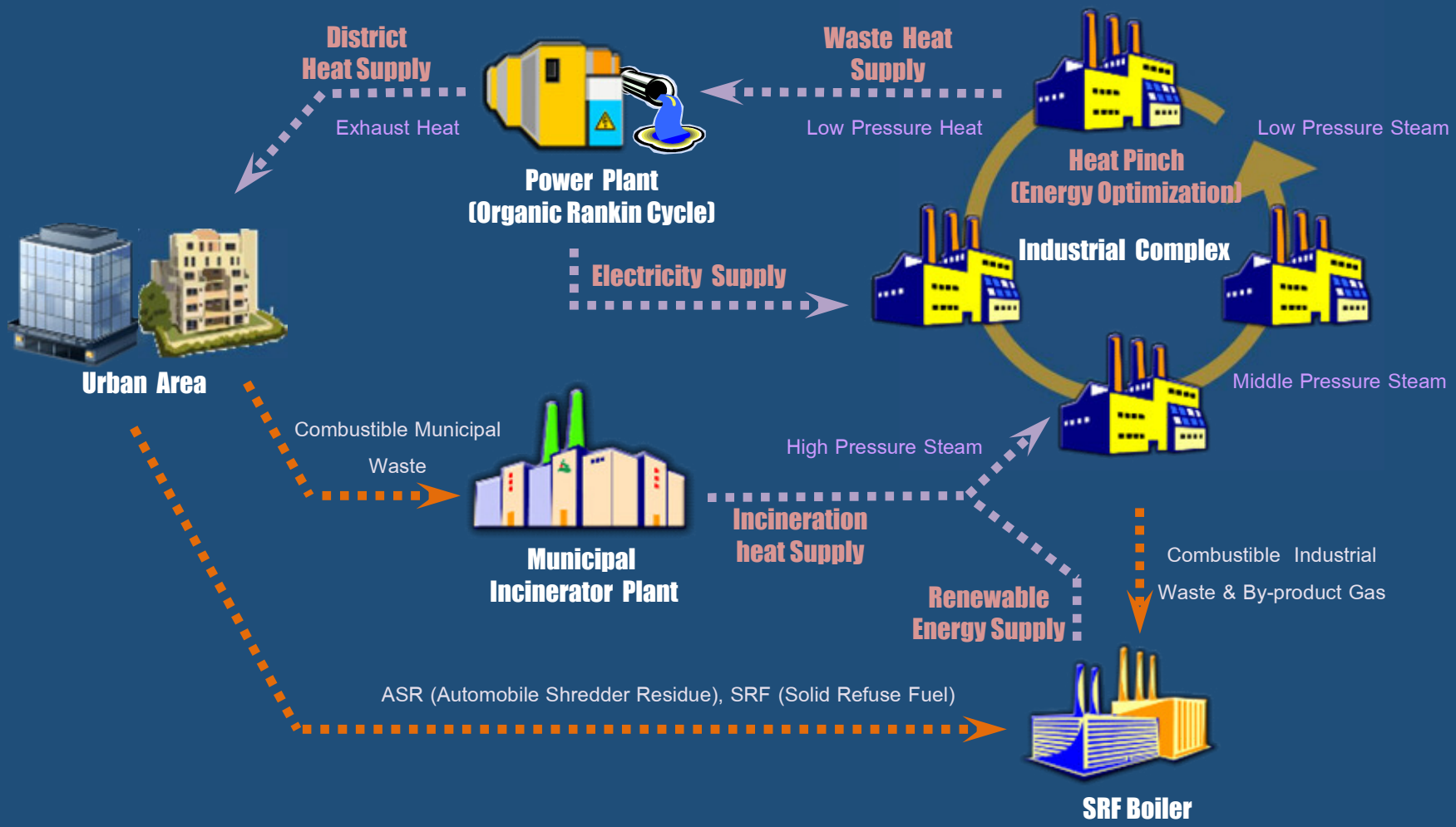
Distribution of success factors among Eco-innovation parks	
Energy efficiency	Optimization or reduction of energy use, including energy needed for buidlings and other infrastructure as well as for industrial production
Renewable energy	Use of and/or onsite production of renewable energy. This include solar energy, wind energy, hydropower, combined heat and power (CHP), energy production based on waste, geothermal energy, tidal/wave generated energy, biofuels
Waste management	Onsite collection, transport, onsite or external processing and recycling or disposal of waste
Water management	Onsite wastewater treatment, reduction/optimizarion of water use for infrastructure and production
Material/chemical flow	Synergies, exchange of materials (chemicals, waste, etc) among companies, inter-firm collaboration. Input-output scheme as theoretically defined by industrial symbiosis
Biodiversity	Biodiversity conservation or revitalization of ecosystems in the industrial/urban and surrounding area
Mobility, transportation	Efficient viable transport of goods or person with low environmental impact (e.g, public transport, electric vehicles, plug-in hybrids, carpooling systems)
Land use	Optimization/reduction of land use for indsutrial/urban infrastructure, revitalization of derelict land
Air pollution prevention	Reduction in pollution emissions through cleaner production processes or implementation of end-of-pine technologies
Environmental management systems	Certification and labels with environmental standards at the park scale such as ISO 14000 or EMAS
Cultural, social, health and safety	Cultural aspects include the preservation of cultural diversities and valorization of local specificities; Social aspects include gender equity, professional reintegration, child care, integration of disabled persons Health and safety aspects include a safe and clean natural and working environment in the industrial/urban and surrounding area

Eco-innovera, 2014

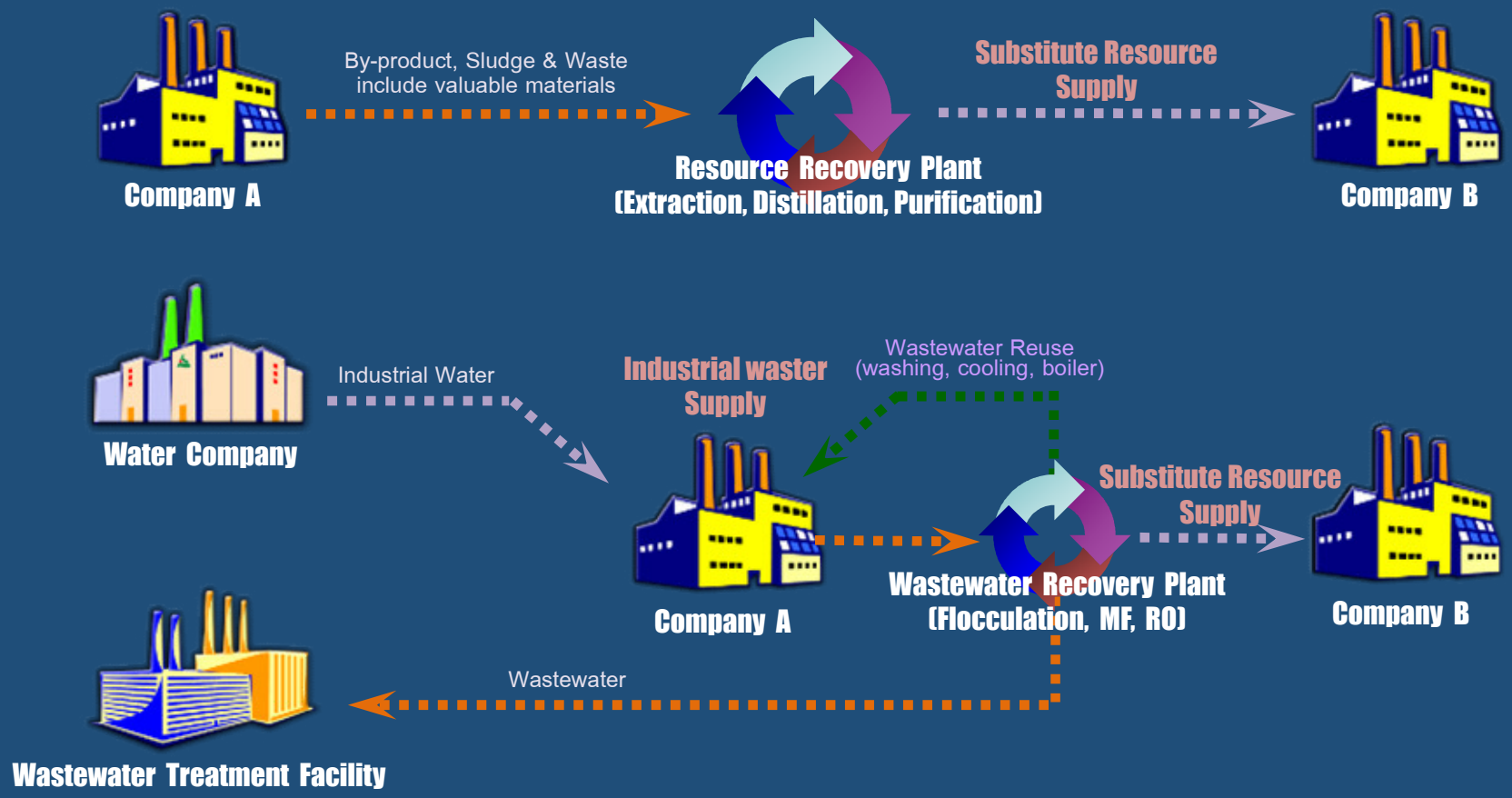
Discription of Success factors of eco-innovation		
Success factor	Description/example	Short name
Economic value added	Direct business interests of companies in reducing expenses and/or in increasing profit by implementing synergies with other companies in the park (implementation, development, perpetuation).	Value added
Policy & regulation frameworks	Legislation enhancing eco-innovation, sustainable development, public-private partnerships, industrial symbiosis and eco- industrial development strategies through local and regional policy action for implementation and regulatory instruments combined with innovative models.	Policy
Financial incentives	e.g. tax reduction and/or financial support for companies commiting to sustainable practices	Incentives
Organizational and institutional setups	Organization and setups for the operation of the park. Coordination bodies, e.g. trust companies in charge of the coordination and services for stake-holders (e.g. environmental services, risk analysis,information and training, marketing and communication, help for getting permits, “plug and play” services) and providing a platform for cooperation among stakeholder Monitoring through independent authorities and management of common mutualized infrastructures	Coordinators
Cooperation with Science and Technology institutions	Cooperation with e.g. universities, science and technology enterprises and research centers, knowledge sharing	Coop. S&T
Geographical factors and regional infrastructure	Location (close to seaport, airport, hightway, urban centers, historical and natural conditions), infrastructure, size, potential for expansion	Location
Local diversity of economic activities	Large opportunity to create sets of feedback flows due to the diversity of economic activities. Companies on site with activities in different sectors (e.g. wood industry, heat power generation, chemical operations and paper manufacturing)	Diversity
Clear designation of the park as eco-innovation park	Clear commitment, clear definition and differentiation from other parks (self-declaration must be reviewed) as marketing and communication standards.	Eco-innovation Park

Eco-innovera, 2014

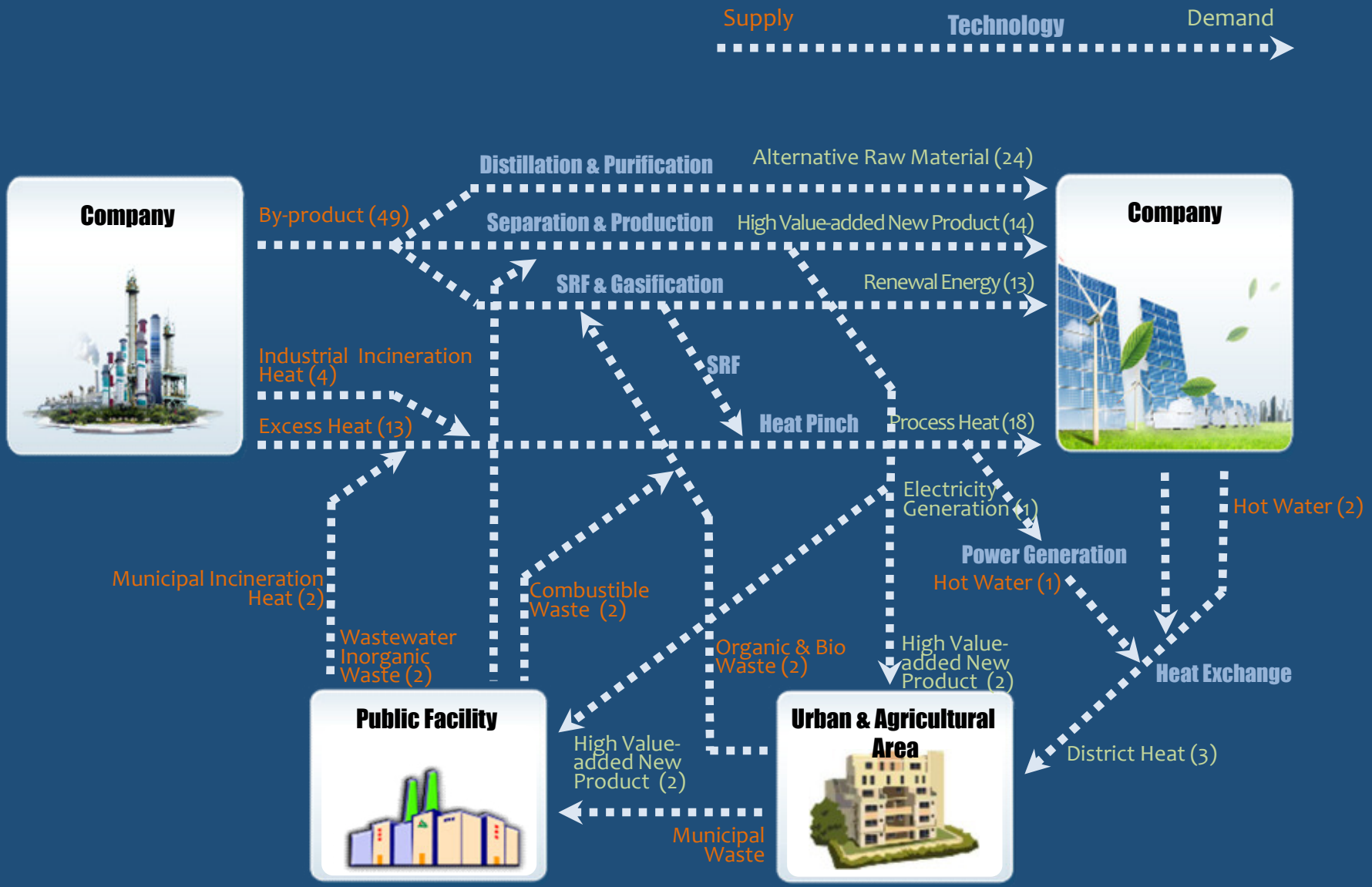
Concept of Energy Circularization (including waste to energy)



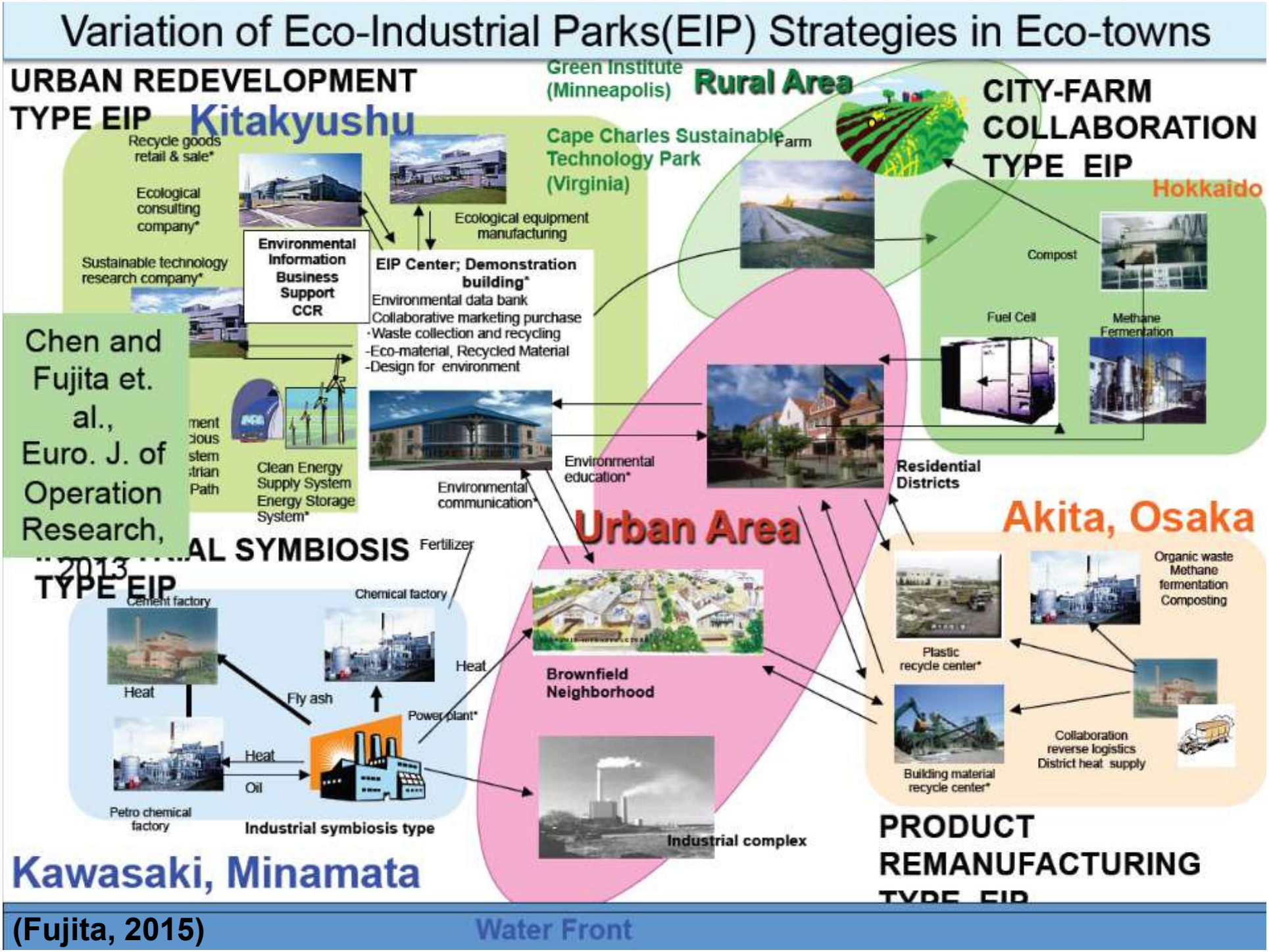
Concept of Material Circularization (including waste to resource)



US Cases: Industrial and Urban Symbiosis implemented in Ulsan

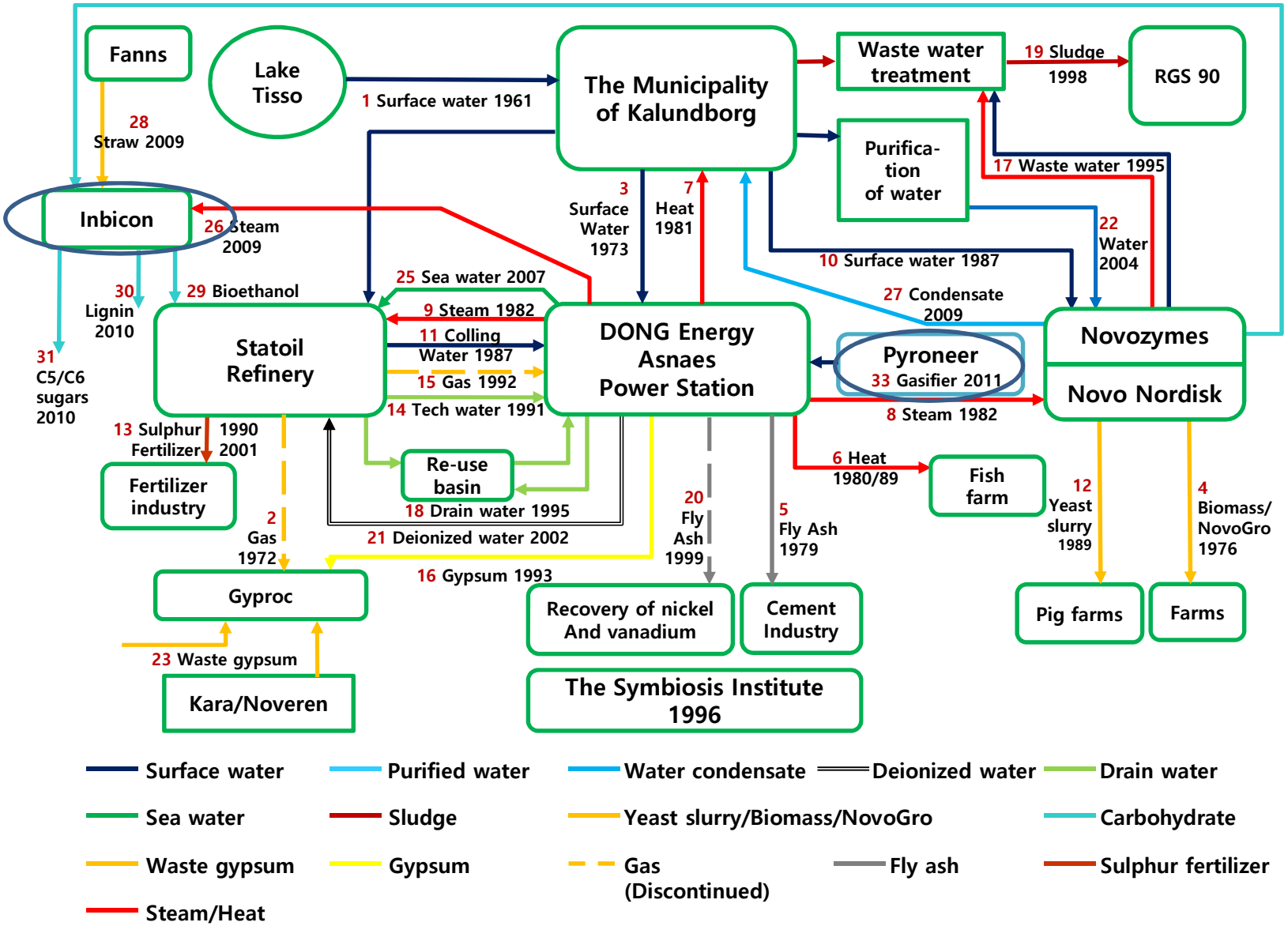


Variation of Eco-Industrial Parks(EIP) Strategies in Eco-towns

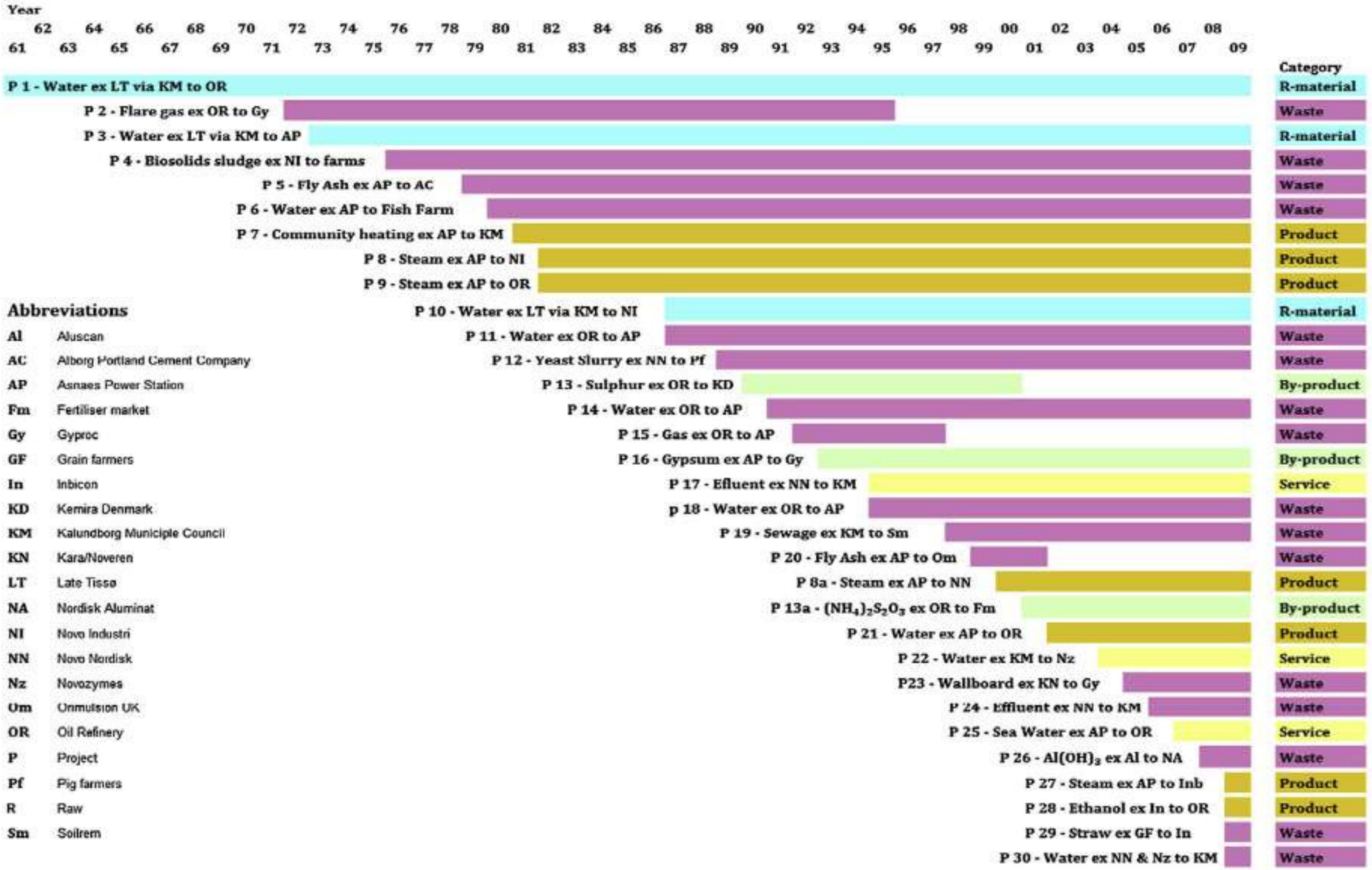


(Fujita, 2015)

Industrial Symbiosis and Urban Symbiosis in Kalundborg

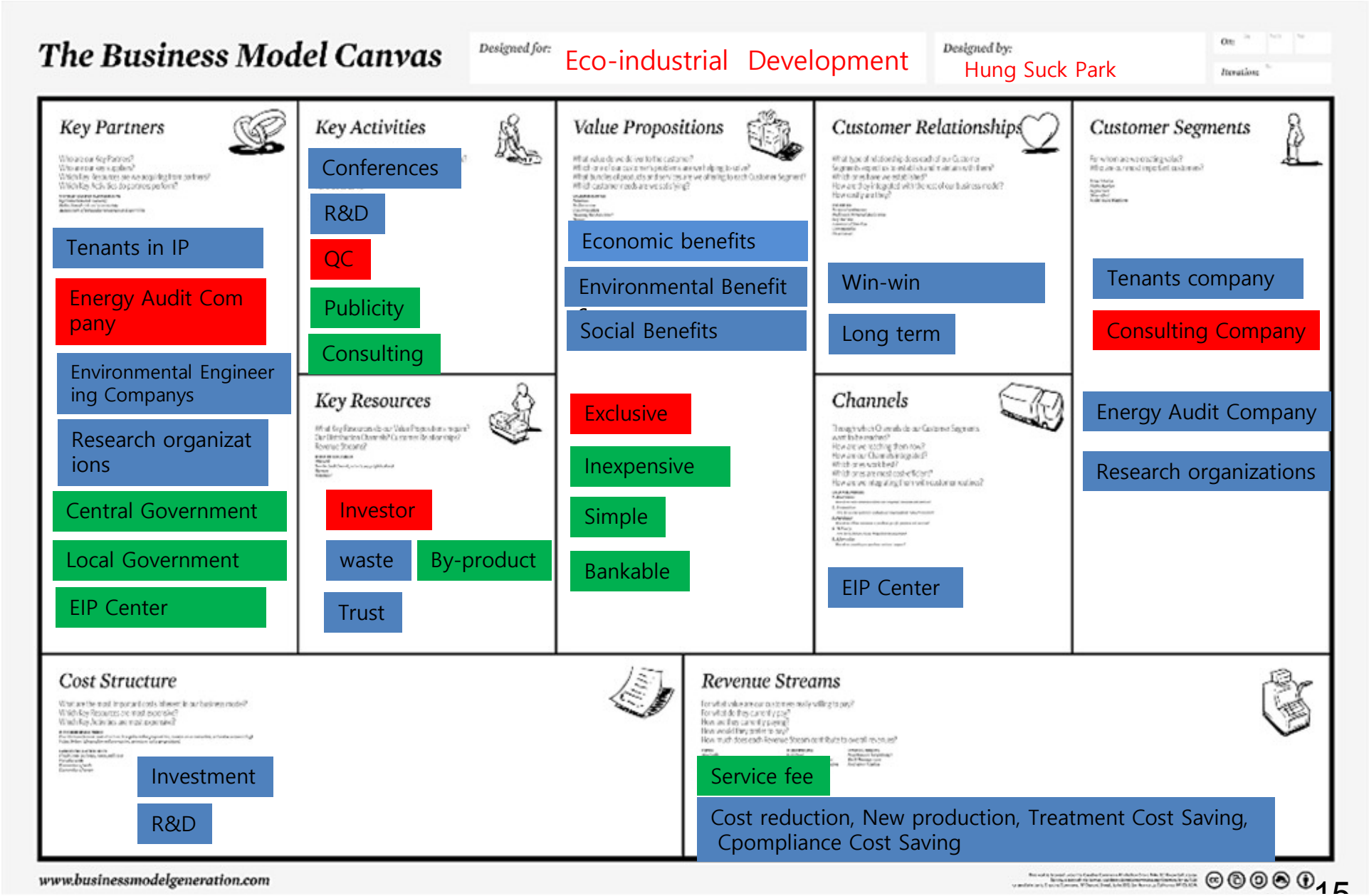


Kalundborg Industrial Symbiosis: B-to-B IS Contraction

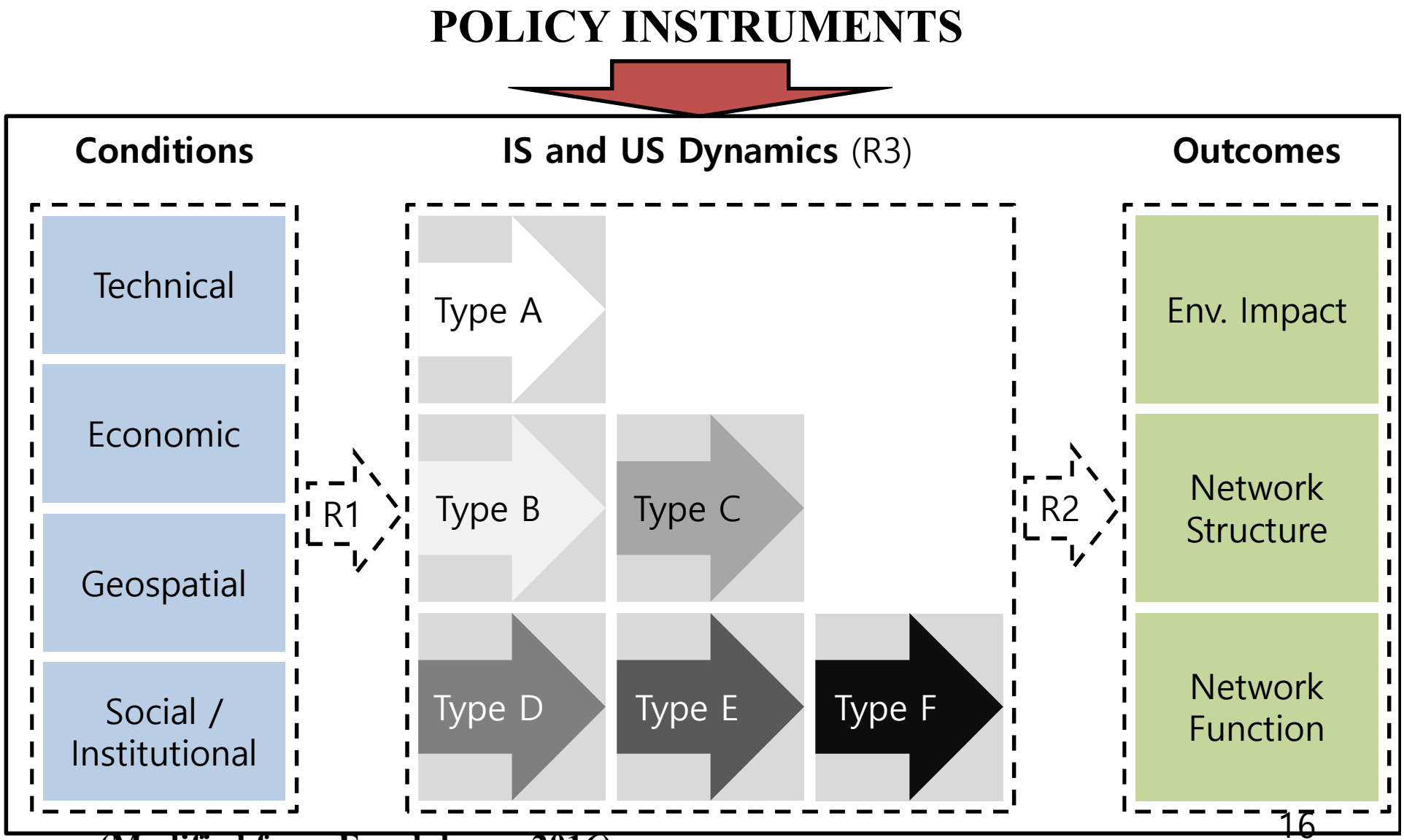


Robin Branson, 2016

IS&US Business Development Model



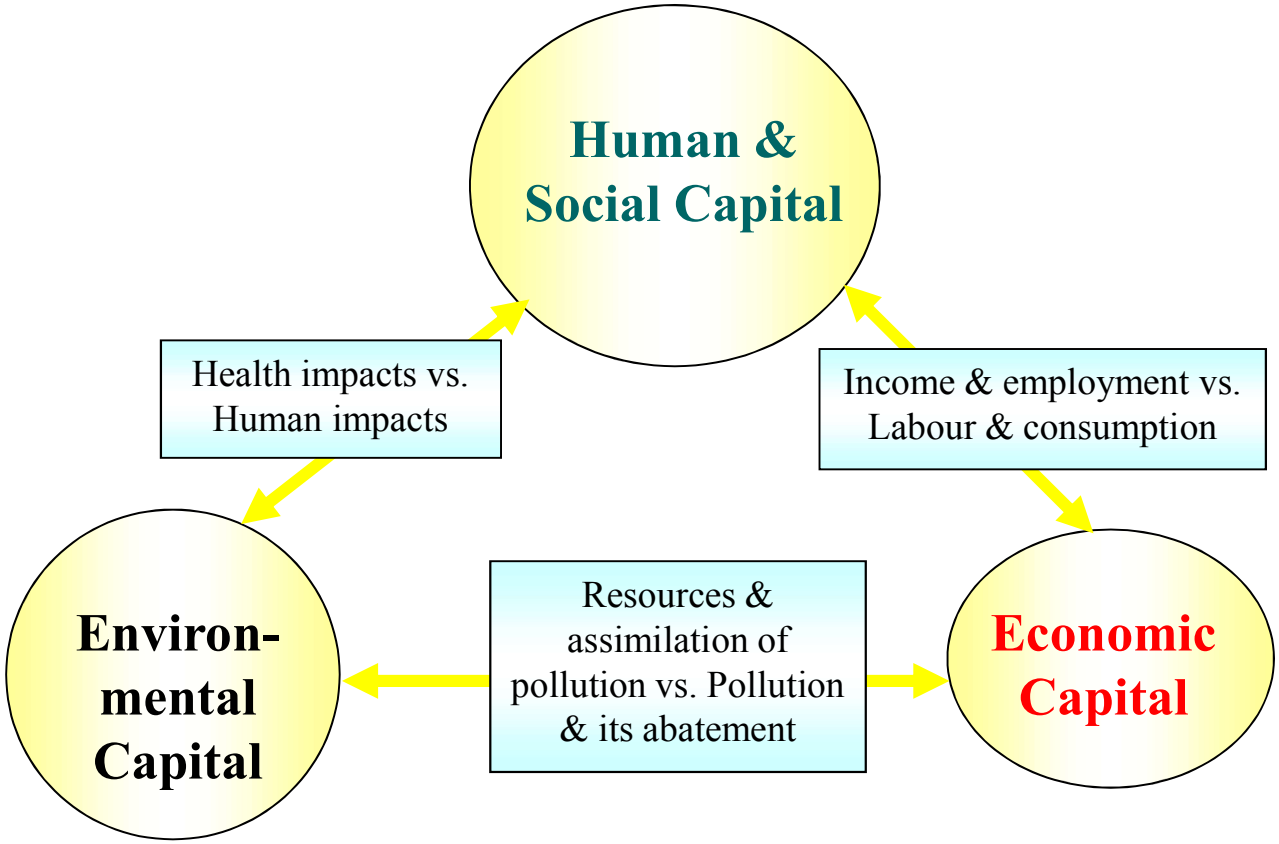
Innovative Approches



(Modified form Frank boon, 2016)

Innovation: Win-Win

Optimum use of Economic, Social & Environmental Capital



Interactions Between Economic, Social and Environmental Capital

Business Model Development:

Economic and Environmental Benefits Analysis

Economic Benefit

$$\frac{B}{C} = \sum_{t=0}^{n} \frac{B_t}{(1+r)^t} \Big/ \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

$$\Delta B = \Delta(Cost\ reduction + Revenue\ generation + Complinace\ cost + \text{Treatment cost})(\$ \text{ or } \$/yr)$$

C = investment ($ or $/yr)

Environmental Benefit(separate calculation)

$$EE = \sum_{i=1}^{n} (W_i + A_i + w_i)$$

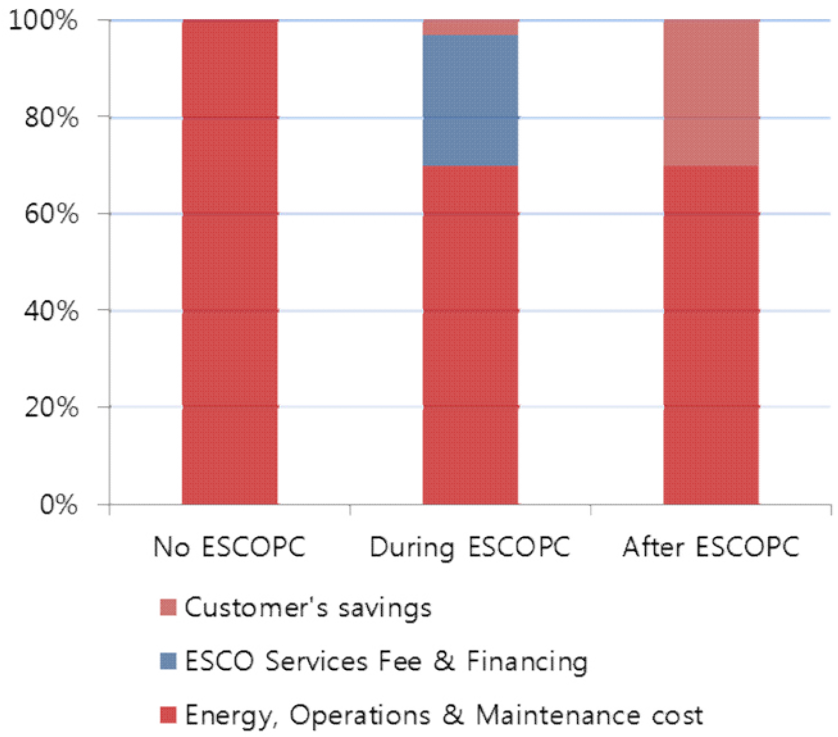
$$\Delta EE = EE_a - EE_b = (\sum_{i=1}^{n} W_{i,a} + \sum_{i=1}^{n} A_{i,a} + \sum_{i=1}^{n} w_{i,a}) - (\sum_{i=1}^{n} W_{i,b} + \sum_{i=1}^{n} A_{i,b} + \sum_{i=1}^{n} w_{i,b})$$

EE : Environmental effect, EE_a : EE of EIP project, EE_b : EE of Baseline project

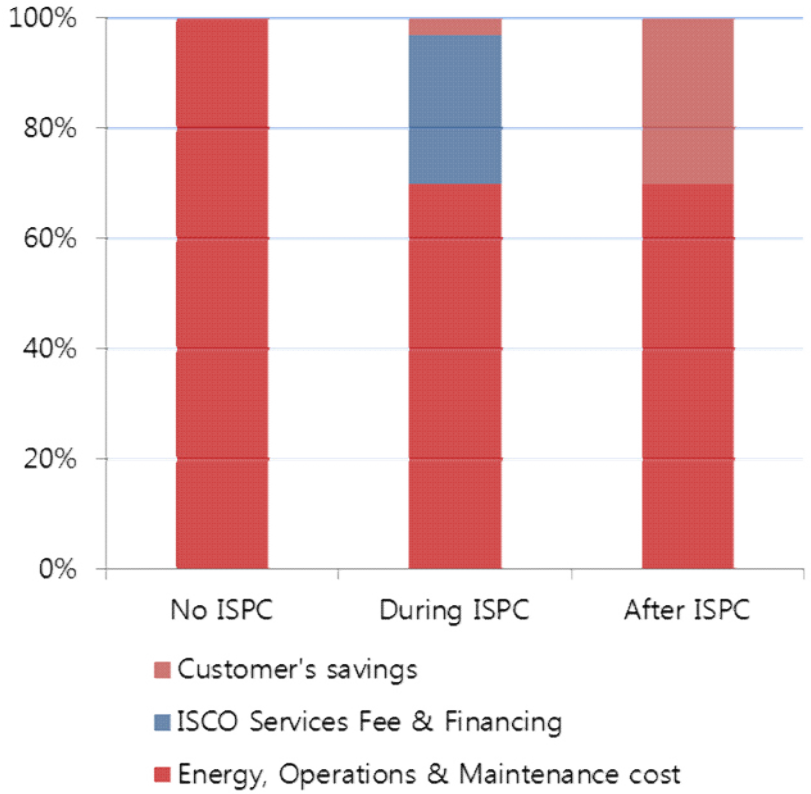
W_i : Waste generation, A_i : Air emission, w_i : Waste water generation

Innovative IS Business

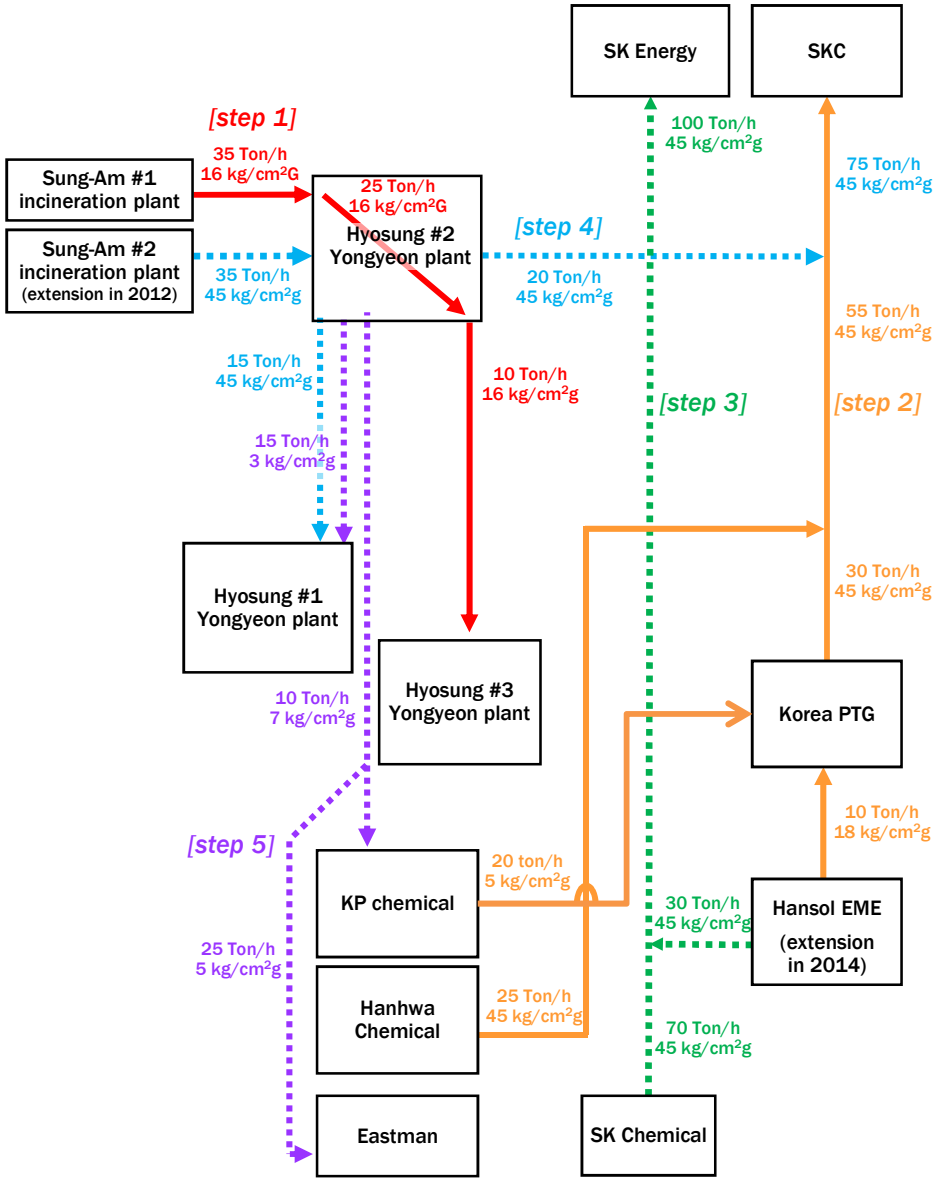
ESCO Principles



ISCO Principles



Stepwise IS Expansions: Segmented Business Model



Lessons learned

1. Incentivised National and Local Policy
2. Vision and Consensus on Urban Development
3. Competitiveness and Sustainability Strategies
4. Material and Resource Infrastructure Innovation
5. Business Approach

Future Direction

1. From EIP to EID(IS -> US)
2. Standard, Handbook and Manual
3. Integration of Big data and AI, ICT and Env. technolgy
4. Various Business Model development
5. Experience Sharing and International Collaboration

Thank you

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