Creating Economic and Environmental Value Through Industrial Symbiosis

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Agenda

• Definition of Industrial Symbiosis (IS)
• Natural Resource Examples
• Findings for Improving Economic and Environmental Impacts
• Policy Suggestions
Industrial Symbiosis

• A mechanism in the circular economy
• Exchange, sharing and/or reprocessing of waste from one firm into feedstock for another (Chertow, 2000)
  • Subset of Industrial Ecology with an Ecosystem metaphor
  • Economic and Environmental Value
  • Improvement through Cooperation (Gibbs, 2008)

• Different types of relationships
  • Self-organizing “uncovered” (Chertow, 2007)
  • Eco-industrial Parks
  • Facilitated

**Goal: Transforming “Waste” into Resource**
Value of Industrial Symbiosis

• Strategic tool for developing low carbon economies
  (European Commission, 2011)

• *Potential 2$ trillion USD in benefit for global economy*
  (Ellen MacArthur Foundation, 2012)

• IS creates ‘system-level’ economic and environmental benefit
  (Ehrenfeld & Chertow, 2002; Jacobsen, 2006)
Kouvola in southeastern Finland

Sokka et. al. 2011
Australia Kwinana Industrial Area

Figure 2: Existing by-product synergies in Kwinana. Figure includes only the Kwinana industries (both members and non-members of the Kwinana Industry Council, KIC) that are involved in regional synergies.

Source: van Beers and colleagues (2005).
Gladstone Industrial Area

Figure 4  Location of companies in Gladstone Industrial Area (Queensland).

Van Beers et. al. 2007
Empirical Setting - UK National Industrial Symbiosis Programme (NISP)

Launched nationally in 2005
• regionally from 2002

National industrial Symbiosis Programme (NISP) (NISP & Databuild, 2006)
For Each £1 million spent developing IS exchanges
  Economic Benefit
    £60+ million in regional economic activity
      Increased sales, reduced costs, new businesses / jobs, etc
  Environmental Benefit
    388K tonnes of industrial landfill waste diverted
    342K tonnes of industrial carbon emissions reduced
Economic & Environmental Value

- Economic outcomes
  - Reduced costs for waste disposal
  - Reduction in supply materials costs
  - New revenue sources through sales
- Environmental
  - Diverted waste reduce Co2e and landfill
  - Reduce hazardous waste
  - Reduce virgin material use
  - Decrease energy consumption and Co2e production
- Public sphere
  - New enterprises
    - Co-production opportunities
    - Specialized waste firms
  - Job creation
Improving Exchange Success to Capture Environmental & Economic Value

• We expect greater economic value between firms in disparate industry groups

• Trust and Learning are important to success

• Partner experience greatly increases probability of completing an IS exchange

• Exchanges more likely to be initiated with increasing economic gain

Paquin et. al., 2014
Marginal Effects
Eco Efficiency, Environmental and Economic Value

- More IS exchanges support financial over policy benefits
- Over half of IS exchanges provided business or policy benefits but not CO2 reduction
- Almost a third captured no benefit
- Most common eco-efficiency combination was achieving Co2e reductions and Increased Sales
- Landfill & Experience are key for both eco-efficiency and eco-development
- Waste Firms have differential impact
  - Appropriate ‘value’ from exchanges
  - Create new business opportunities around IS
  - Similar Partners more likely to create IS value
- Material types matter

Paquin et. al., 2015
## Eco-efficiency Combinations

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<th>CO\textsubscript{2}e Reductions &amp;</th>
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<td>Positive*</td>
<td>Positive***</td>
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<td>Partner Similarity</td>
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<td>Positive+</td>
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<tr>
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<td>No of Sites</td>
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*** p<0.001, ** p<0.01, * p<0.05, † p<0.10
Marginal Effects of Landfill & IS Experience

- Marginal Effects of Landfill Diverted
- Marginal Effects of Previously Completed Exchanges

[Graphs showing the probability of various outcomes against the quantity of diverted tonnes of landfill and the number of previously completed exchanges.]

- CO₂e ↓ & ↑ Sales
- CO₂e ↓ & ↑ Cost
- CO₂e ↓ & ↑ Savings
- CO₂e ↓ & ↑ Employment
- CO₂e ↓ & ↑ Bus Develop
Policy recommendations

• Set scope and plan
  • Target environmental/economic/social goals?
• Determine if trying to foster self-organizing, facilitated exchanges, or eco-industrial parks
• Develop institutional framework - Policy license to operate
  • Involve all necessary national, regional departments, and associations
• Compelling business case – expenses and benefits
• Interaction between participants essential
• Be willing to invest in infrastructure requirements and demonstration projects

O’carol et.al., 2017; van Beers, et. al, 2007; van Berkel, 2006
References


Paquin, RL, Busch, T., & Tilleman, SG. 2015. Creating Economic and Environmental Value through Industrial Symbiosis. Long Range Planning, 48(2)


