APPLICATION OF INDUSTRIAL ECOSYSTEMS PRINCIPLES WITHIN SMALL LOCAL COMMUNITIES

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ABSTRACT

The integrated management of resource flows is reproducing the functioning of the ecosystems, which are using the by-products of one species and are transforming them in raw materials for some other ones. Identification of by-products and secondary energy sources are stopping the pollutants' discharges into the environment, considerably reducing both waste quantities and waste treatment costs, thus contributing to reduction of climate change, by use of residual energy. The cost of materials and energy of economic units are subsequently reduced. Cooperation generates better results and provides opportunities for economic units to increase production without increasing the consumption of energy, water and raw materials. The idea behind such symbiotic approach is that units are using each other's residual and by-products on commercial basis (Kalundborg symbiosis institute, 2011). These ideas have been incorporated in a LIFE+ Project (ECOREG), active since February 2009. The Project is financed by the EU and tries to implement the industrial symbiosis approach to the Suceava County (ECOREG, 2011). The paper is presenting a methodology for implementation of industrial ecosystems within small communities, developed by INCD ECOIND based on the experience gained in industrial symbiosis projects. The main steps of the proposed methodology are:

- identification of possible focal points (economic units),
- characterization of their residual flows,
- identification of the possibilities to interconnect the units (identification of possible synergies between the economic units),
- assessment of the interconnection results from the environmental, economic, social point of view,
- development of the implementation plan.

As a case study an implementation plan for an industrial ecosystem developed for local small communities is also presented.

Keywords: Industrial symbiosis, industrial ecosystem, resources from waste

FOREWORD

Industrial symbiosis represents a part of industrial ecology, focussed on (but not only) material and energy flows exchanges. It involves sharing of energy and utility flows, resources from by-products, information, services, equipments, expertise, specialist between various industrial actors, in order to create value added, reduce costs and protect the environment.

The integrated flows management is replicating the functioning of natural ecosystems, the by-products of some species being valuable resources for others.
Industrial ecology processes and creation of the methodology for implementation of industrial ecosystems management are asking for a number of key conditions:

- *The symbiosis is working only in a heterogenous industrial profile*
- *The symbiotic area must be geographically restricted*
- *It is a need for maximum cooperation availability between all interested partners.*

METHODOLOGY

The methodology used has the following main steps:

Identification of potential participants / partners

- Identification of potential partners/ focal points
- Setting up selection criteria for focal points
- Interactive selection of focal points

Detailed analysis of resource flows

- Preparation
- Analyse of process phases
- Identification of potential synergies
- Evaluation of potential synergies

Implementation and monitoring of synergies

- Idea
- Discussion
- Negotiation
- Implementation
- Monitoring

The key conditions for a successful implementation of the methodology are:

- *Partners' compatibility and diversity*. The initial phases of an industrial symbiosis project are focussed on identification of suitable partners and to minimise the risk of wrong selection of synergies' partners;
- *Geographic concentration* – essential element for limitation of expenses related to material and energy transfers between partners. In the case of a local industrial ecosystem this condition is considered accomplished.
- *Availability to cooperation*. It is an intangible element, hard to be quantified, which depends on the specific level of technical, scientific and managerial knowledge of decision factors, but also on their cultural and awareness level on industrial ecology principles. The risks are high in such a project based on partnerships and collaboration. The experience from similar partners' projects is useful in order to control such risks.
- *Mutual benefits*. The implementation team must indentify and underline the benefits of all the partners to such symbiotic partnership.

CASE STUDY

The proposed methodology was adapted at the level of a pilot area from Suceava county, Campulung Moldovenesc – Gura Humorului area, on a radius of 20 km from european road E576.
In a first stage, a list of 30 representative economic units located within the pilot area boundary was developed. The information about the companies was retrieved using the databases on the level of:

- Local commerce chamber,
- Register of commerce,
- Local administration

Data on available resources, within these 30 units, were collected. Also the needs of resources for the units were identified.
The resources available at one company were matched with the resource needs of other economic units. Therefore a list of potential synergies between those 30 economic units was developed. For part of remaining resources, additional companies were identified in order to reuse the available resources. The identified units are located at the level of Suceava county, in which pilot area is also included.
The result was a list of 38 potential synergies that were assessed using a multicriteria decision matrix. In order to evaluate the effects of potential synergies implementation, a number of 7 criterions covering the economic, environmental and social aspects, were proposed:

1. Ease of implementation from technical point of view
2. Estimated costs/benefits
3. Conservation of natural resources
4. Reduction of CO2 as a result of adopting the synergy
5. Other environmental benefits
6. Issues related to approvals, transport, authorisations
7. Social impact

Table 3 Multicriteria analysis of identified synergies

No	Resource type	Unit that offer the resource	Unit that want the resource	Quantity	MU	Way of reuse	Score
1	Demolition waste	Solca Municipality	SC TERMICA SA	20	tons	Inert material for closing ash cell	**64**
2	Meat waste	SC Andelvero SRL	SC Superstar Com SRL	100	Kg	Incineration – energy production	**58**
3	Slaughterhouse waste	SC Andelvero SRL	SC Superstar Com SRL	5,53	tons	Incineration – energy production	**63**
4	Wooden waste	Suceava Forest Administration	SC Ritmic Com SRL	770	m^3	Production of briquettes	**84**
5	Wooden waste from wood exploitation	Suceava Forest Administration	SC Ritmic Com SRL	10000	m^3	Production of briquettes	**89**
6	Sawdust	Lagan Mobilex SRL	SC Ritmic Com SRL	10	m^3	Production of briquettes	**79**
7	Glass waste	Stroiesti Municipality	SC Apisorelia SRL	4	tons	Glass recycling - reuse in glass production	**75**
8	Domestic waste	Stroiesti Municipality	SC Ritmic Com SRL	270	m^3/ month	Separation and PET recycling	**85**
9	Plastic waste	SC Ritmic Com SRL	SC Mondeco SRL	2	tons	Incineration – energy production	**58**
10	Domestic waste	Ilisesti Municipality	SC Ritmic Com SRL	190	m^3/ month	Separation and PET recycling	**80**
11	Domestic waste	Balaceana Municipality	SC Ritmic Com SRL	180	m^3/ month	Separation and PET recycling	**80**
12	Domestic waste	Partestii de Jos Municipality	SC Ritmic Com SRL	200	m^3/ month	Separation and PET recycling	**80**

No	Resource type	Unit that offer the resource	Unit that want the resource	Quantity	MU	Way of reuse	Score
13	Domestic waste	Scheia Municipality	SC Ritmic Com SRL	620	m^3/ month	Separation and PET recycling	**85**
14	Radiologic film	Solca hospital	SC Mondeco SRL	0,15	tons	Incineration – energy production	**63**
15	Radiologic solutions	Solca hospital	SC Mondeco SRL	0,1	m^3	Incineration – energy production	**63**
16	Plastic	SC Vecovas SRL	SC Mondeco SRL	1	ton	Incineration – energy production	**58**
17	Plastic	SC Vecovas SRL	SC Apisorelia SRL	1	ton	Plastic recycling – production of plastic materials	**66**
18	Wood waste	SC Vecovas SRL	SC Ritmic Com SRL	8000	m^3	Production of briquettes	**89**
19	Firewood	SC Dophoris SRL	Vatra Dornei Municipal Hospital	100	tons	Incineration – energy production	**58**
20	Sawdust + wooden waste	SC Dophoris SRL	Vatra Dornei Municip.	200	tons	Incineration – energy production	**58**
21	Plastic + PET	Iacobeni Municipality	SC Ritmic Com SRL	400	kg/ month	Separation and PET recycling	**80**
22	Plastic + PET	Iacobeni Municipality	SC Rotmac Eco SRL	400	kg/ month	Separation and PET recycling	**80**
23	Domestic waste	Iacobeni Municipality	SC Ritmic Com SRL	90	m^3/ month	Separation and PET recycling	**80**
24	Cardboard + Paper	Iacobeni Municipality	SC Rotmac Eco SRL	150	kg/ month	Paper and cardboard recycling – production of recycled paper	**80**
25	Sawdust	Iacobeni Municipality	SC Ritmic Com SRL	15	m^3/ month	Production of briquettes	**75**
26	Sawdust	Iacobeni Municipality	Vatra Dornei Municip.	15	m^3/ month	Incineration – energy production	**69**

No	Resource type	Unit that offer the resource	Unit that want the resource	Quantity	MU	Way of reuse	**Score**
27	Cardboard + Paper	Scholar Group Iacobeni	SC Rotmac Eco SRL	30	kg/ month	Paper and cardboard recycling – production of recycled paper	**75**
28	Professors and students – volunteers for cleaning parks / protected areas	Scholar Group Iacobeni	SC Cascade Empire SRL			Cleaning of parks and protected areas	**80**
29	Wooden waste	SC Rotil Prest SRL	SC Ritmic Com SRL	710	m^3	Production of briquettes	**84**
30	Wooden waste	SC Liamold SRL	SC Ritmic Com SRL	40	m^3	Production of briquettes	**75**
31	Domestic waste	Ciprian Porumbescu Municipality	SC Ritmic Com SRL	540	m^3/month	Separation and PET recycling	**80**
32	Wooden waste	SC Divip SRL	SC Ritmic Com SRL	1600	m^3	Production of briquettes	**89**
33	Wooden waste	SC Iasimold SRL	SC Ritmic Com SRL	380	m^3	Production of briquettes	**84**
34	Wooden waste	SC Romhribia SRL	SC Ritmic Com SRL	320	m^3	Production of briquettes	**84**
35	Wooden waste	SC Marimold SRL	SC Ritmic Com SRL	40	m^3	Production of briquettes	**75**
36	Equipment for wastewater treatment	SC ACET SA	SC Vecovas SRL	6	m^3	Wastewater treatment – reuse of equipment	**72**
37	Wood processing equipment	SC Tanelcrad SRL	SC Dophoris SRL	1	pcs	Wood processing – reuse of equipment	**64**
38	Shredder for wood waste	SC Tanelcrad SRL	SC Dophoris SRL	1	pcs	Wood processing – reuse of equipment	**64**

An evaluation from the point of view of economic, environmental and social effects of the implementation of potential synergies was done. That set of indicators (which is not exhaustive, it can be extended) must be monitored by units managers. The indicators set should include:

- Reused quantity
- Preserved natural resources
- Reduction of generated CO2
- Other environmental benefits
- Economic benefits
- Social benefits (new jobs, preserved jobs, improvement of life quality, reduction of risk upon health), in those effects can be quantified.

The environmental benefits estimated based on the inter-connection scheme of units are consisting from:

- *Reuse of 8511,74 tones of resources per year*
- *Preservation of 31,96 tones of natural resources per year*
- *Conservation of 108,03 ha of forest per year*
- *Reduction of CO2 emisions with 1608,31 tones per year*

CONCLUSION

The assessment of economic, environmental and social benefits resulted from the implementation of such inter-connection model shows that industrial symbiosis is serving to the improvement of financial, economic, technical, environmental performances of the partners, contributing to new jobs availability, business opportunities, within the focal area. In contrast with other projects that are generating earnings to one specific economic unit, the advantage of such approach is that can participate and obtain earnings also economic units with a small number of employees, SMEs, which are ready to participate in a specific function of the symbiosis, and also organisations from outside economic area (local communities).

REFERENCES

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