World Business Council for Sustainable Development

Collaborative Action for Energy Regional Network Case Study

2008

US BCSD
By-Product Synergy Program

The business case

By-product synergy (BPS) is the practice of matching under-valued by-product streams with potential users, helping to create new revenues or savings for the organizations involved while simultaneously addressing social and environmental impacts. The benefits to participating companies are clear cut and can be substantial:

- Reduced operating expenses
- Reduced energy use
- Reduced emissions
- Surpassed regulatory targets
- Improved community relations
- Improved productivity
- Improved profitability
- Development of new products and markets

Situation

United States Business Council for Sustainable Development

Many US corporations are active members of the World Business Council for Sustainable Development, but until 2002 they did not have their own national affiliate organization. Companies in the Southern states and in Mexico, however, have been working together as the Business Council for Sustainable Development - Gulf of Mexico (BCSD-GM) since 1993. So in 2002 when the Mexican and American arms of the alliance went their separate ways, the United States Business Council for Sustainable Development (US BCSD) was born.

American industry consumes the energy equivalent of over two billion tonnes crude oil each year and generates around 7.6 billion tons of solid waste.[1] How can the US BCSD, with its 18 member companies and staff of four seek to make a significant dent into the national waste problem? The answer given by CEO Andrew Mangan is: “We take a very focused approach. The US BCSD seeks to make change not through huge numbers of member companies or widespread communication efforts, but through highly focused, collaborative projects that deliver both sustainable development benefits and business value and make change through the market. Dr. Gordon Forward, Chairman Emeritus of the US BCSD, sums up this approach: "There's nothing you can do with somebody who has decided that this isn't for them. My thought is ‘I love to compete with people who think that way’."

Background

By product-synergy has been a core activity of the US BCSD since its earlier incarnation as a US-Mexican coalition. The idea goes back much further, to the natural world. In ecosystems the by-products of one organism’s metabolism become the substrate for another’s. Forests do not need landfill sites for trees to dump their waste; instead the detritus of one generation of trees becomes the nutrient of the next generation.

Applying this concept to industry involves asking some startling questions:

- What if waste is not seen as a necessary outcome of activity, but an indicator of dysfunction, of wasted energy and resources?
- What if our so-called "wastes" weren't wastes at all, but were by-products or raw materials for other industries?
- What if we see “waste” in terms of business opportunity and not just cost reduction?
- What if every gram of raw material became product?

Just as in nature where closed-loop recycling systems have independently evolved many times, by-product synergy is championed under a host of different names: industrial ecology, green twinning, industrial symbiosis, zero waste/100% product operations, closed loop, and cradle-to-cradle manufacturing.

Often, realizing these opportunities to turn waste into profit involves not just closing loops inside one company, but making connections with other companies and industries. The most well known case of this type of by-product synergy was developed in the Danish town of Kalundborg. But until the early 1990s, the idea had not made inroads into US business. As Carlos Guimaraes, the first chair of the US BCSD explained “In the US, companies and even industries work in relative isolation; they integrate themselves into the marketplace through a supply chain, but they don't integrate themselves in terms of productivity.”

Getting started: Chaparral Steel

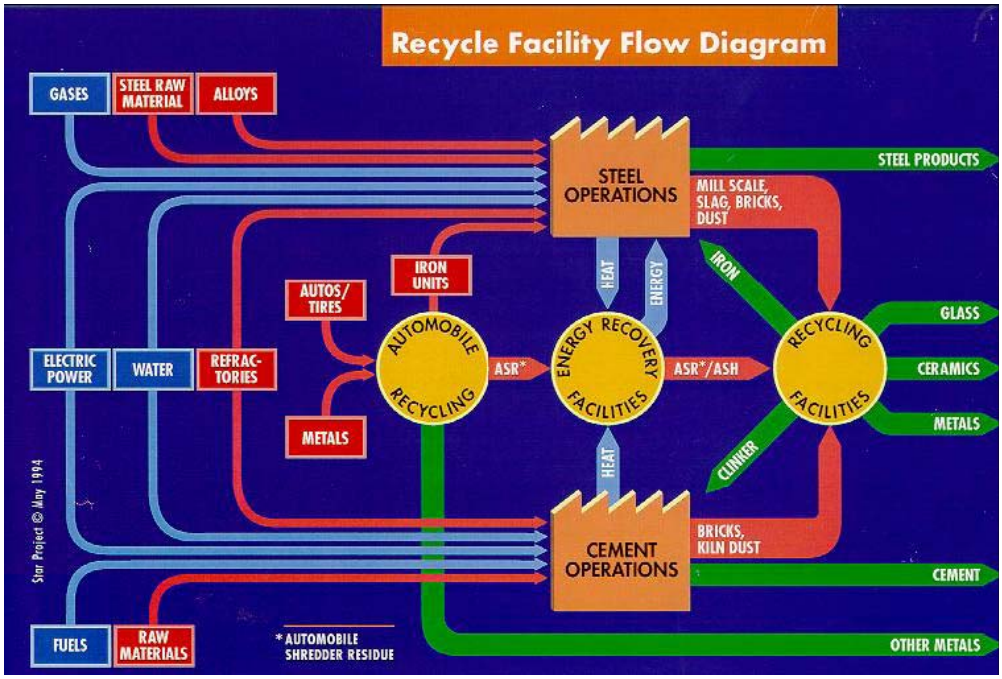
In the early 1990s Gordon Forward was CEO of Chaparral, a technologically advanced steel company, in Midlothian, Texas. He was also active in the American chapter of the BCSD. Chaparral Steel’s parent company, Texas Industries (TXI), also manufactured Portland cement. So when TXI asked Forward to take on the management of six cement mills, one literally across the street from the steel plant, his first instinct was to look for cost reductions that would help him save the company money and reduce redundancies.

As an accomplished metallurgist with a PhD from the Massachusetts Institute of Technology, Forward was confident that he would quickly get the hang of the cement business. “After all,” he told Mangan, “it is a pretty basic process; they have been doing it since the Romans.” But he soon came to the realization that not only did he not know anything about the nature of cement production, he also found that there appeared to be a number of potentially profitable synergies between the cement and steel plants. Why hadn’t these opportunities been discovered before? Because, he found, there were many obstacles that had to be overcome, starting with this mutual ignorance about the two operations.

Detailed material balances had to be drawn up in order to identify possible connections between the waste and resource streams of the two operations. But pulling together this data, identifying potential synergies, working out which were viable, and putting them into action meant not just overcoming technical puzzles but human factors as well.

> *“The first time representatives of the steel and cement companies got together to consider possible synergies, the gathering was awkward. They weren’t accustomed to thinking about—much less working with—managers from another industry. But as the talks continued, the awkwardness ceased and a palpable excitement filled the air.”*[2]

Within months the dedicated team of engineers from the two companies was able to bridge the different company structures and cultures and identify viable opportunities for synergy. They moved from defensive postures such as “don’t tell me about my business” and “this is the way it is always done”, to a shared goal of developing recycling facilities to feed materials between the steel, cement and automobile recycling operations to create a zero-waste operation.



One of their key discoveries was that steel slag could be readily converted into a valuable raw material for cement production. Together they developed a patented process they call CemStar that uses steel slag in a cement kiln to create high-quality Portland cement. In addition to increasing profits for both companies, CemStar reduces energy requirements by 10-15% and carbon dioxide emissions per ton of cement produced by over 10%. If the Cemstar process were applied to all the cement production in the United States it could reduce carbon dioxide emissions by 8.8 million tons annually.

Forward brought these results to the BCSD to share his experience with other members. Andrew Mangan was an early convert. He remembers thinking “look what they did with just two companies; imagine what we could do with twenty!”

Targets

The gains to be made through by-product synergy are substantial, so Forward and Mangan asked themselves: “Why isn’t everybody doing it?” They identified three critical obstacles:

- **Narrow focus** of businesses on competition within their own industries means that they just don’t consider the possibilities of cross-industry synergies.
- **Inflexible regulations** discourage companies from seeking creative alternative uses for waste streams.
- **Lack of forum for identifying synergies.** Simple waste exchange directories already existed in many states, where firms could list their marketable wastes. But this approach was limited, because it depended on both buyers and sellers already knowing which materials could be reused and having full trust that all parties would do the right thing with the materials to avoid liabilities.

Creating a generally applicable by-product synergy approach

Building on the Chaparral steel experience, they set out to develop and demonstrate a process for creating by-product synergies across a wider group of companies. In October 1997, the BCSD-GM launched a demonstration project in Tampico, Mexico with a group of 21 local industries. This process would address the three obstacles identified by demonstrating the significant gains to be made through by-product synergy, creating a dynamic forum where companies could explore the potential for by-product synergies in a safe place and helping to overcome regulatory obstacles to potential synergies.

Changing the way businesses think about waste

The goal of the BCSD was not just to save energy and resources in Tampico Mexico, but to make by-product synergy standard practice. This goal was ambitious for such a small organization, and this case study focuses both on the results and lessons learned in developing the by-product synergy approach, and in achieving wider impact.

Activities

The Tampico By-Product Synergy Project

The first major test of the by-product synergy concept in North America brought together 21 major companies operating around the Mexican seaport of Tampico. These included numerous chemical and petrochemical companies as well as the local Coca-Cola bottling company and an electricity producer.

The driving forces behind the project were the BCSD-GM, the powerful local business network, Asociación de Industriales del Sur de Tamaulipas (AISTAC) and the strong leadership and support of Mexican industrialist Eduardo Prieto Sánchez Mejorada, director of GRUPO PRIMEX and president of the BCSD-GM Mexican Chapter. The US Environmental Protection Agency, the Ford Foundation, the AVINA Foundation and NAFTA's Commission for Environmental Cooperation (CEC) also supported the project.

The project organizers developed a four step process that has become the core of US BCSD's by-product synergy model:

- **Awareness raising** - Project organizers explained the concept to more than 40 company executives and 21 signed a Declaration of Intent to participate in the project. This high response rate was facilitated by the fact that with funding from the AVINA Foundation and The Ford Foundation there was no charge for participation. The local project manager then began working down the corporate chain to explain the process to plant managers and engineers.
- **Data-collection -** Participants began cataloging their operations' inflows and outflows in a confidential database using a common set of data definitions and a template. Process and environmental engineers could then use it to identify potential synergies.
- **Analysis -** Opportunities for synergies were identified through analysis by Bechtel, a San Francisco-based engineering and consulting firm, and through bi-monthly facilitated brainstorming meetings. Sixty-eight potential synergies were identified in all, of which 29 were deemed to have commercial possibilities.
- **Implementation –** Thirteen projects were selected for initial implementation. These included one where an industrial-gas company captured waste CO_2 generated by several nearby businesses. Another company found use for 51,000 tons of unusable butadiene from a rubber plant as a combustion gas, while another converted its polyvinylchloride residuals into shoe soles.

Problems and difficulties

If Gordon Forward had found it hard going to get engineers from two parts of one parent company in Texas to work together, the experience of facilitating a much larger process in Mexico brought home to the organizers the importance of overcoming "soft" as well as "hard" obstacles. Andrew Mangan and the other American partners found the Spanish culture much more formal than they were used to. "The first time the company representatives were together in a room it was very stilted, awkward and formal," he says, "and there was also the added complication of translation to contend with." But by the third meeting the silence had been broken. "When we walked into the room it was loud with conversations. Everyone had got to know each other and to feel more comfortable. They had all caught the virus, and seen the opportunities."

While the awareness-raising and data-collection phases took longer than expected, the trust-building effect of ongoing meetings between the participants and site visits by BCSD staff began to pay off. At first many participants were uncomfortable sharing information, despite the reassurance of a signed confidentiality agreement. Many chose to give only rough material quantities with no cost information. However, as people become more

comfortable, they put more information on the table, realizing that they had more to gain by disclosing than by concealing.

The confidence, trust and enthusiasm developed by the participants also paid off in identifying synergies. Brainstorming sessions identified all but one of the synergies that expert analysis found, as well as finding 10 additional synergies. The technical side is rarely a big problem says Mangan "you have a room full of engineers who know their operations inside out and who can develop and evaluate the technical solutions." Bigger barriers are economic, regulatory and habitual:

- **Economic feasibility and investment risk** - Economic feasibility is affected by the supply and demand of materials set by the market, the costs of disposal and how far these reflect environmental impacts, the distances involved, the availability of finance for green measures and whether consumers take life-cycle impact into account. In each of these areas current trends (particularly rising oil prices and climate change concerns) are pushing by-product synergy investments into the black.
- **Regulatory barriers** - Once something is defined as a waste, it is subject to a unique set of regulations governing its transportation and disposal. Uncertainty in law as to who is responsible for the risks associated with hazardous waste re-use is also a barrier to realizing by-product synergies.
- **Overcoming organizational inertia** - Putting potential synergies into practice depends on the person or people assigned responsibility for the project, and the time and resources available to them. The more potential synergies identified by a particular company, the greater the human resource burden will be. Not only was it important that the people involved in the project had sufficient time, it was also critical that they had sufficient influence in the company and the ability to make decisions.

Mangan and his colleagues identify four keys to success in their approach to by-product synergy that help to overcome these barriers:

- **Diversity** - Participants brought together in these projects represent a wide variety of industries and organizations, which broadens the markets in which participants can find business opportunities.
- **Communication** - BPS provides a safe forum in which participants can share ideas without fear of legal, regulatory or other threats. The process stimulates creative thinking to look beyond company fence-lines for opportunities.
- **Partnerships** - By leveraging technical consultants, regulatory agencies, research organizations, and funding sources to assist participants, the barriers to implementing the synergies are greatly reduced.
- **Quantifiable Benefits** - All BPS programs carefully track associated environmental, economic and social benefits. This provides current and prospective participants, as well as funders and other interested parties, with a continuing incentive to maintain and expand the program.

Furthermore they found that the forum developed a dynamic of its own that started with easy wins with low risk and a quick payback cycle, and then enabled participants to demonstrate and learn from these successes, encouraging them towards more ambitious projects with higher stakes.

Turning waste into profit on a wider scale

Building on the experience of the Chaparral Steel and Tampico projects, Andrew Mangan and the BCSD faced the challenge and opportunity of scaling up the approach to achieve more widespread impact. Over the past ten years they have taken a number of different approaches to this, developing into a web of mutually reinforcing influencing strategies.

Championing the process - From the beginning, Mangan and his colleagues have sought to extract lessons from each BPS project experience to develop and refine a model which can be used more broadly. To this end they speak and publish widely about the process in regional, national and international forums, and have become recognized as international leaders in the field. In 1997 the BCSD-GM published a Primer on the

concept, practice and potential of by-product synergy, some of the first how-to guides in this area.[3] The US BCSD has played a key role in supporting and inspiring the development of national level BPS programs in the UK and Japan and initiatives by BCSDs in China and Portugal.

Commercializing the process - Having demonstrated that by-product synergy can be a profitable investment for participant companies, Mangan and his colleagues decided to commercialize the broking process, setting up Applied Sustainability LLC in 1999. Gordon Forward joined as company chairman. “We knew the process was workable,” says Mangan, “so we said, why not take it out as a true business proposition with investment from our members. That is what WBCSD is all about: demonstrating how business can create sustainable development solutions.” However, despite setting up BPS projects in Texas, Montreal and Alberta and succeeding in getting regulatory support for the concept from the EPA, the revenue-sharing business model took too long to pay off and in 2001 the business ran out of funds and was dissolved. Looking back, Mangan believes that they went to market to early “with oil at sixteen dollars a barrel, and the small resources of a start up company, we did not have the staying power that the revenue model demanded. Now I think it would be a different story.” US BCSD continues to work with commercial partners in delivering and supporting BPS programs.

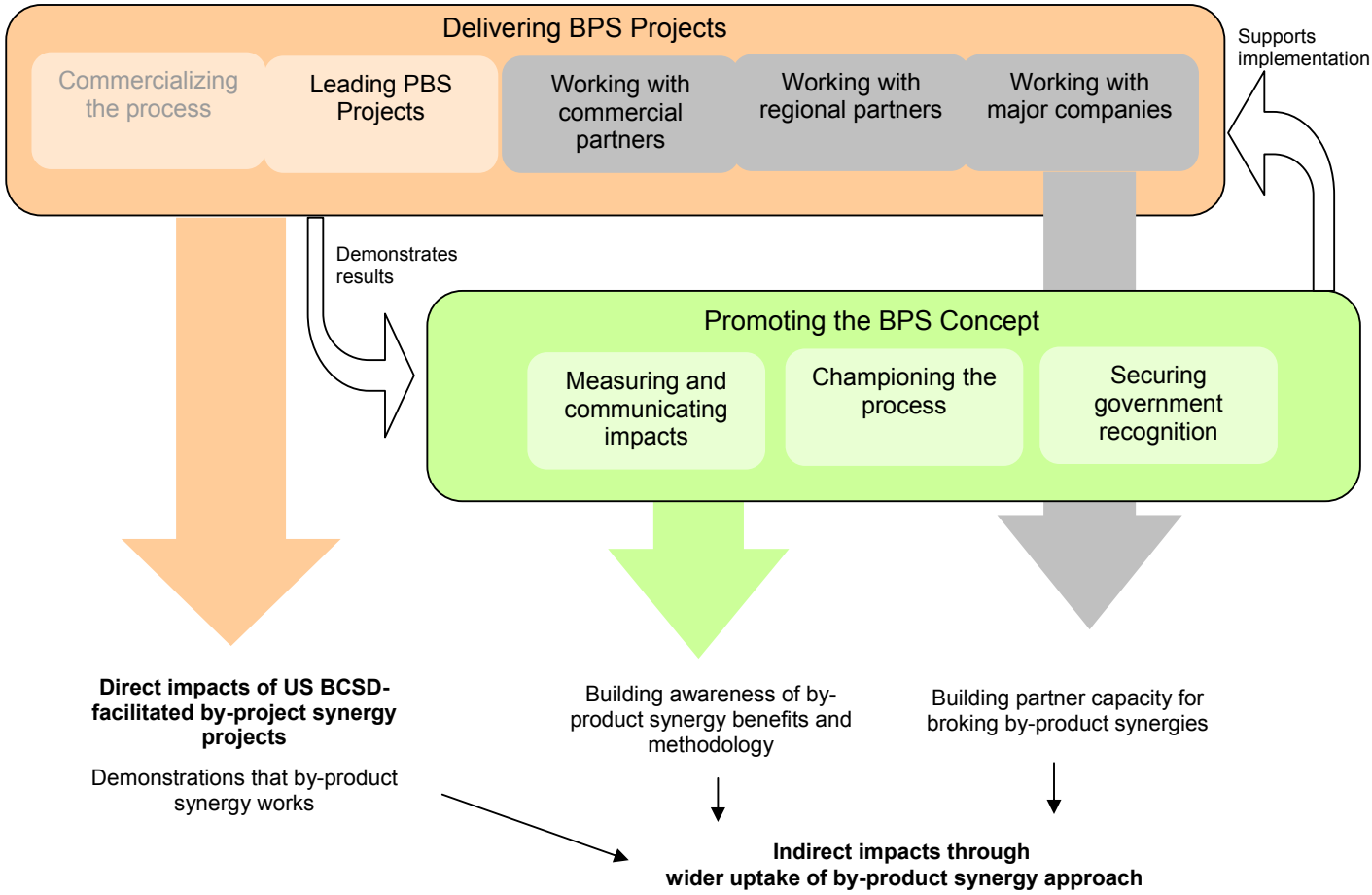
Partnering with local entities - In 2002, following the end of the Applied Sustainability venture, by-product synergy was championed once again by the newly formed US BCSD. One of the clear lessons from Tampico was the importance of having a local champion for the process. Mangan and the US BCSD have worked with local partners in New Jersey, Chicago, Seattle and Kansas City to establish local initiatives. Typically the US BCSD will be involved for the first year before leaving a growing and self-sustaining entity to continue the process.

Supporting major companies to implement the process worldwide - One of the businesses involved in the New Jersey BPS project was Dow Chemical. The New Jersey project enabled them to become familiar with the BPS process and to gauge its success firsthand. Recognizing the potential cost savings and environmental benefits of by-product synergy, they decided to implement it more broadly through their operations. By combining the BPS methodology with their own Six Sigma approach they are unlocking synergies between Dow chemical plants on the US Gulf Coast and other nearby chemical, petroleum refining, and electronics companies. Synergies already identified just between Dow’s own plants could divert 155 million pounds of materials from waste each year, saving 900,000 MMBtu energy and 108 million pounds of CO_2 emissions and saving US$ 15 million.

Securing government support for the concept - Although the US Environmental Protection Agency (EPA) has long offered support for the idea of by-project synergy, more formal endorsement, guidance, regulatory incentives and even funding have been critical in strengthening the case for BPS projects. The EPA put up funding for Chicago’s BPS program and has also helped to navigate the regulatory barriers the can hinder the sale and reuse of some wastes. Mangan believes that the support of the EPA has made a difference in the time and cost of developing projects from the ground up. “If you can say this approach is recognized by the EPA that speeds things up considerably.”

Measuring impacts - By-product synergy pays off in financial, waste reduction, energy savings, water use and job creation terms. Measuring these impacts and the return on investment for both participant companies and public supporters is crucial to scaling up their impact. Although the US BCSD can display some impressive examples from individual projects and synergies, they have not been able to measure and report on the full range of impacts in a universal and robust way, across all the projects. This is one area that they would like to improve in future. They are working with the UK’s NISP to understand how best to measure and communicate aggregate impacts.

The diagram below illustrates how these elements of the US BCSD's strategy fit together into a twin track approach to achieving impacts through directly facilitating BPS projects and promoting the concept more broadly.



Results

Outcomes

The USBCD's overall strategy of both supporting the delivery of individual BPS projects and promoting the concept more broadly creates impacts directly in terms of tons of waste diverted from landfill, energy and resource savings and indirectly through the development and delivery of BPS programs by others.

The results from regional BPS projects that the US BCSD is involved in are promising, for example:

- **Chicago Waste to Profit Network** - Launched by Mayor Richard Daley on 31 October 2006, the Network began with 27 company members and 7 City Departments. They have so far diverted 13,500 tons from landfill, including, for example, using glass cullet in asphalt and counter tops.
- **The Kansas City By-Product Synergy Program** has identified fifty synergies with 29 classified as commercially-viable in a foreseeable future. These have the potential to divert 30,000 tons annually from landfills.

Mangan says that the greatest impacts from a regional program can take 3 to 5 years to come to fruition. "We get the easy wins in the first year; these are straightforward examples that show that the idea works. Then people begin to look at broader market opportunities as well as cost savings."

One example of this is Cook Composites and Polymers, a participant in the Kansas City project. At first the company only wanted to find a better way to dispose of 500 tons of a material. But then they begin to look at how they could change their products to meet the needs of new markets. They are now developing alternatives to fiber glass boat hulls using organic fibers.

The impact of UK's National Industrial Symbiosis Program illustrates the potential impact of US BCSD's wider influencing role. Over the past two years NISP reports that, its 8,000 participant companies have:

- Diverted more than 2.2 million tons of business waste from landfill
- Saved 4.8 million tons of virgin material
- Saved 2.5 million tons of potable water
- Created 490 new jobs and safeguarded 768 jobs
- Reduced carbon emissions by 2.1 million tons
- Generated £104 million in new sales for members
- Saved members £81 million

Lessons learned

The US BCSD's By-Product Synergy program shows how a small organization can have a big impact by creating a replicable approach to realizing business, environmental and social gains.

The key lesson learned is that while by-product synergies can release huge energy, resource and financial savings and pave the way for new market opportunities, this process is not automatic. "Synergies which could save millions of dollars are out there, but don't always happen," says Mangan. "It is as much about change management as identifying technical possibilities."

The by-product synergy process methodology, based on diversity of involvement, enabling communication and leveraging partnerships, is documented and proven to work and is supported by both government and a growing cadre of experienced technical consultants. However, rolling it out nationally and internationally depends on influential support and leadership at regional and company level. Having an influential leader champion the project is invaluable in encouraging others to participate. Similarly, within each individual corporation commitment from top management is crucial to enabling opportunities for by-product synergies to be taken up, whether they come from the head office or the factory floor.

Resources

WBCSD (2006) Dow Chemical Company By-Product Synergy = Energy Efficiency Case Study.

BCSD-GM (1997) By-product Synergy: A Strategy for Sustainable Development A Primer
www.usbcsd.org/byproductsynergy.asp

For further information, please contact

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[1] WRI Earthtrends Country Profile earthtrends.wri.org/pdf_library/country_profiles/ene_cou_840.pdf and Environmental Protection Agency www.epa.gov/industrialwaste/

[2] Forward, G and Mangan, A (1999) "By Product Synergy" in The Bridge, Vol. 29, No. 1, Spring 1999, National Academy of Engineering, Washington DC.

[3] BCSD-GM (1997) By-product Synergy: A Strategy for Sustainable Development
A Primer