



Examples of By-Product Synergy

By-Product Synergy (BPS) is defined as the practice of matching under-valued waste or by-product streams with potential users, helping to create new revenues or savings for the organizations involved while simultaneously addressing social, economic and environmental impacts. BPS is related to other concepts including industrial ecology, industrial symbiosis, and cradle-to-cradle manufacturing.

Joining a BPS Network enables companies to realize some of following benefits:

- Increased revenues from by-product sales
- Reduction in waste disposal costs
- Substitution of lower-cost, locally sourced recycled feedstocks
- Reduction in solid waste and other environmental burdens
- Reduction in energy use and greenhouse gas emissions
- Reduced demand for virgin materials leading to resource conservation
- Stimulation of regional entrepreneurship and economic development
- Enhanced corporate reputation for sustainable practices
- Interaction with other leading companies and technical experts

The following are examples of BPS successes enjoyed by companies involved in BPS networks:

- **Non-Chlorinated Waste Reuse**

Forty Dow Chemical manufacturing units, including chemical, plastic, and agricultural products at six Gulf Coast facilities, participated in an intra-company BPS Network aimed at finding ways to reuse non-chlorinated wastes. Each of the 40 units generated more than one million pounds of waste per year. Dow discovered 27 potential synergy opportunities involving six different technologies, translating to \$15 million in potential annual cost savings, 900,000 MMBtu/year in potential energy savings, and 155 million pounds per year of potential waste reduction, as well as potential CO₂ emission reductions of 108 million pounds per year. Diverted wastes include volatile materials such as spent solvents and hydrocarbons, sodium hydroxide by-products, sulfuric acid wastes, and hydrogen by-products.

- **Rinse Styrene as Resurfacing Material**

Cook Composites and Polymers (CCP), whose core business is production and distribution of gel coats, unsaturated polyester resins, coatings resins and emulsions, discovered opportunities to reuse spent rinse material as resurfacing material for factory floors, municipal polymer concrete, and protective coatings. Through the Kansas City Regional BPS, CCP realized that there might be demand for a surface coating based on rinse styrene. Harley-Davidson found that the anti-corrosive properties of the rinse styrene-based polyester concrete coating would be effective in its manufacturing environment. CCP realized that this coating could be sold in the infrastructure resurfacing product market. CCP's gross profit on the coating would typically be \$0.20 per pound. CCP estimates that producing one gallon of conventional concrete coating results in life-cycle emissions of 21.4 pounds of CO₂. If rinse styrene is used instead, 7.3 pounds of these emissions are eliminated.

- **Paint By-Product to Power Wash Material and Kiln Fuel**

AkzoNobel, an aerospace coatings manufacturer, was exploring reuse opportunities for its waste paint material and partnered with a Missouri cement kiln organization that discovered it could save money by using the paint by-product in a power wash for the kiln's tanker trucks and railroad car interiors. That created an intermediate step that reduces AkzoNobel's waste disposal costs. The high BTU (What?) solid in the by-product forms a gritty spray that is power-sprayed with a nozzle, similar to sand blasting. After the car is cleaned, the by-product material is captured and fed as supplemental fuel for the cement kiln. In Missouri, this BPS project is considered a beneficial reuse project – a case the company made to the U.S. EPA to get permission for the exchange.



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- **Reuse of Spent Caustic Soda by Paper Mills**

The Shell Puget Sound Refinery was able to cut disposal costs and environmental transportation risk by shipping spent caustic soda (NaOH) from the refinery to a pulp and paper mill in the northwest. The spent caustic was reused in the mill's Kraft process, replaced fresh caustic in the green liquor. This resulted in a cost savings, since the caustic soda had previously been shipped by rail from Anacortes, Washington more than 2,000 miles to a waste facility in Texas. In addition to high shipping costs, the refinery had faced an increased risk of an unwanted release during shipping. By using spent, rather than fresh caustic as a feedstock in its manufacturing process, the mill saved money and the refinery cut its transportation costs. Total cost savings are estimated at about \$400,000 per year.

In a similar case, a Weyerhaeuser Kraft mill in Alberta, Canada and a Husky refinery in Saskatchewan, Canada discovered that spent caustic from the refinery, which was being deep well injected at a significant cost, could be used in the Kraft process, displacing virgin caustic purchased from Dow Chemical. The two companies found that the Husky caustic was almost an ideal chemical fit for the mill and would save both companies significant money. At the Weyerhaeuser mill, the spent caustic is introduced to the Kraft process at the recovery boiler stage, which removes contaminants from the spent NaOH and renders the salt cake at the right chloride level needed for passing smoothly through the boiler without plugging, an expensive delay that had required several million-dollar washings per year prior to the synergy. The spent caustic costs one-tenth as much as the virgin material, which Dow Chemical had shipped from Vancouver across the Rocky Mountains at Weyerhaeuser's expense.

- **Sulfur Dioxide Scrubber By-Products to Primary Ingredient in Gypsum**

A partnership was established between American Electric Power and CertainTeed, a subsidiary of St. Gobain, to convert flue gas desulfurization (FGD) residue into a feedstock for wallboard manufacturing. FGD residue consists largely of gypsum, which is a key input to the production of wallboard. To take advantage of this natural synergy, CertainTeed built a new manufacturing facility in close proximity to AEP's Kammer-Mitchell and Cardinal power plants in Moundsville, West Virginia. The plant began operation in 2008, and is capable of producing up to 800 million square feet of product a year. The FGD systems at the power plants use both chemical and mechanical methods to remove sulfur dioxide (SO₂) from the flue gas produced during coal combustion. The SO₂ is absorbed into limestone slurry, and then reacts with the calcium in the limestone to form gypsum. CertainTeed receives the gypsum via a specially designed two-mile conveyor system that spans a four-lane highway to transport the product from Kammer-Mitchell directly into the wallboard plant's gypsum storage facility. Located in Brilliant, Ohio, Cardinal Plant is nearly 40 miles from the wallboard factory, and the gypsum produced at Cardinal is transported to CertainTeed on the Ohio River by barge. An estimated 800,000 tons of gypsum is used annually to produce wallboard at CertainTeed instead of being sent to landfills. In addition, the wallboard plant will utilize 99% recycled paper in the manufacturing process.

- **Shoe Manufacturing Waste to Feed for Polymer Company**

Texon International generates a substantial amount of polymer-based waste when manufacturing shoe components such as insoles for the footwear industry, a large proportion of which was being sent to landfill. As part of a BPS network, Texon is working with Polymer Industries UK, which is reprocessing up to 1,000 tons Texon's polymer based waste per year and saving Texon more than \$83,000 in diverted landfill disposal costs 2,324 tons and 3,645 tons of CO₂ offset, through recycling polymers and fewer trips to the landfill, respectively. Discussions between the two companies also resulted in Polymer Industries being able to supply a polymer bead derived from the original waste material, which could then be fed back into Texon's manufacturing process. In addition to this, Polymer Industries has now produced synthetic suede from recycled material, and Texon International is considering using it for their products.