

A WORLD WITHOUT WASTE

TECHNOLOGY: GUNTER PAULI

Solutions inspired by nature.

IF I WERE TO ASK the world's leading scientists, executives and policy-makers to name the classical Five Kingdoms of Nature (animals, plants, algae, fungi and bacteria), few would be able to do so. This lack of eco-literacy, a failure to understand ecosystems and how they work, is a barrier to reducing pollution and making more efficient use of materials.

Nature does not generate waste or pollution: waste produced by one kingdom becomes food for another. Since humanity seems to have forgotten this simple rule, epidemics like 'mad cow disease' take us by surprise. It is generally accepted now that mad cow disease was the result of feeding slaughterhouse waste, especially bone meal, to cows as a source of protein. By feeding cows' waste to other cows we were violating one of the most basic principles of nature.

The ZERI concept (Zero Emissions Research and Initiatives) proposes a system of production and consumption based on a 'waste-less' system. It offers a framework that encourages industry to think in terms of systems and design systems. ZERI's network benefits from the input of some 3,000 scholars worldwide, has initiated some fifty projects around the world, and operates twenty-five project centres on five continents. I would like to offer here a summary of two projects — 'the rice cluster' and 'cement goes organic'. The projects demonstrate that the same methodology can offer impressive results for both a rural project in the South and an industrial project in the North.

RICE FARMERS, OWNING over one million hectares of land in Southern Brazil, are suffering from globaliza-

tion. Poverty is rampant and growing. The forced elimination of subsidies rendered rice uncompetitive against Asian varieties. The World Bank suggested a structural fund to convert the uncompetitive rice industry to something else. The question became, what?

ZERI helped the local communities look at their assets, their investments, their unique successes of the past, and their hidden opportunities. This assessment identified two major industries and five minor ones, which jointly represent an innovative cluster of businesses. ZERI showed farmers how to reuse the massive (previously wasted) material and energy streams from rice production and thus enabled them to continue growing their traditional crop.

What is the critical success factor for rice? Water. So, a Brazilian project team used the ZERI methodology to analyse water and noted the massive investment needed for irrigation. The conclusion was that Brazilian rice farmers should dedicate effort to the simultaneous production of *Spirulina platensis* algae.

Spirulina algae are very nutritious: rich in betacarotene, vitamins and trace minerals. Spirulina (one of the Five Kingdoms of Nature) convert the water, and the existing investments in irrigation, into a unique opportunity to eliminate malnutrition, which is on the rise across Brazil. Spirulina is a commodity, sold to health-conscious Americans, Japanese and Europeans at US\$30/lb. The ZERI Brasil Foundation offers the highly nutritious algae to local authorities, which has initiated a school 'ginger cookies' programme (enriched with one gram of Spirulina each) at only \$2/lb.

ZERI has no desire to market



BEFORE

spirulina to traditional health food stores at lower cost creating a global price war, but rather aims to build up the supply chain of food with the priority to reduce malnutrition among local schoolchildren. The world price for rice is less than \$300/ton. Yet by growing spirulina Brazilian farmers are now generating a margin of \$2,000/ton, without the need for processing, other than drying. This situation creates more wealth for farmers while responding to a pressing social agenda.

A second industrial product can be derived from rice: silica. Rice husks contain up to 11% silica, which can be extracted through an energy-efficient process. Currently, mountains of rice husks (which are considered waste) are shipped off to cement factories where the rice husks are burned to produce a minute amount of energy. Scientists from the ZERI network are now developing a technology to recover the silica. Since rice mills already separate husks from all other waste, the husks represent an easy-to-recover renewable silica source with an attractive volume and cost. Rice mills may soon become centres of 'silica mining'. The first product series is now under development and within three years the greenhouse of the future could be built with a silica frame, silica glass, and silica glue.



AFTER

In addition, leftover rice straw can be used to construct homes applying traditional straw-baling techniques and as substrate to farm straw mushrooms (from plants to fungi). The spent substrate from mushroom farming is added to the spirulina as a feed for pigs (from fungi and plants to animals). The pigs provide manure, which is processed in a digester (from animals to bacteria). The energy from the digester pasteurizes the substrates (bacteria to plants), and leaves a slurry which after an algal treatment (from plants and bacteria to algae) leads to an outstanding source for stimulating the feed for fish (from algae to animals). Thus, the Five Kingdoms are integrated into a productive system!

How could the rice farmer ever end up in a crisis? Why do the development strategists and competition experts of the globalized economy look at the future of just the rice kernel — which represents perhaps 10% of the biomass of this crop — and discard everything else as waste? Not only does such a myopic view of rice create unnecessary waste streams and pollutants, it disregards the massive capital investment in irrigation, and rice husk separation techniques at the mills.

THE SAME WHOLE-systems approach was applied to an old cement factory

Household waste before composting and the end product – compost pellets

PHOTOGRAPHS: LUIS CAMARGO

and solid municipal waste around the City of Stockholm. Bedminster (now a publicly-quoted company on the Stockholm Stock Exchange) converted a defunct cement factory south of Stockholm into what may become Europe's largest composting centre. Solid municipal waste is processed daily through a continuous process in an old cement kiln. The factory's old silos store the compost pellets and a boat transportation system, including docking berths, permits cheap and high volume transportation anywhere in the region. As a result, today Bedminster owns a portfolio of patents and machinery designs, converting the know-how of creating a composting centre out of an old cement plant into intellectual property, selling patents worldwide.

This innovative approach to defunct cement plants goes beyond the engineering challenge. It permits regions to become 'waste-free', converting organic waste into compost. On the basis of the close analysis of all waste which could not be composted going through the system, one can start redesigning products and packaging for their real sustainability.

Just imagine an island which is waste-free, and a centre for sustainable design made possible by a defunct cement plant which was the ultimate symbol of unsustainability! Gotland, a Swedish island in the Baltic Sea, is working to make that idea reality, and will one day be able to promote the slogan, "No more landfill, no more incinerators". In Gotland, 45% of the solid municipal waste is organic and can be easily converted into pellets. Since the cost of removing all the waste from the island by boat equals the cost of buying back one's own pelleted organic waste for local farming — which previously had to import synthetic fertilizer — a unique buy/sell-back arrangement has been created. It stimulates demand for compost, and stabilizes cashflow.

Local authorities have invested heavily in landfills, but capacity is limited. Thus, Gotland communities operating landfills are prepared to pay Bedminster for each tonne of solid waste which does not end up in

the landfill, so that the remaining space can be reserved for solid waste which has no alternative but to be dumped. The service of not using a waste dump or an incinerator generates a direct economic value, comparable to the 'negawatts' concept developed by Amory Lovins, co-founder of Rocky Mountain Institute.

ZERI'S APPROACH IS a systems approach. Value generated by the whole is greater than value generated by the sum of each of the individual components. When businesses operate in an integrated open system, they are not only capable of funding the processing of waste through market mechanisms, generating profit and securing a positive cash flow; they even manufacture better core products in high demand (for instance organic fertilizer or spirulina) at zero cost!

This doesn't mean that the valuable by-products described are free. Rather, it means that the costs related to their production are covered, and any additional revenue is profit.

We've learnt from some of our projects that we can indeed set the toughest standard for industry ever articulated: zero waste, zero emissions, emulating nature where waste does not exist. But more importantly, we are now in a position to pursue this 'new and open economy' within a competitive framework, through market financing. In addition, these projects based on systems design simultaneously address social and ecological agendas, without requiring subsidies. Since cash flow is positive and transparent, even in its pioneering stage, financing follows through.

ZERI will direct itself in the future towards the envisioning of systems and implement them wherever relevant. Wherever a problem emerges, ZERI will be prepared to catalyse change. ●

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