Local Economic Development: Project Ideas

Some Useful Information on
Job Creation and Poverty Alleviation
through Maximising use of
Abandoned and Underutilised Resources

"Our biggest challenge in this new century is to take an idea that seems abstract - sustainable development - and turn it into a daily reality for all the world's people."

Kofi Annan, UN Secretary General, March 2001

This workshop kindly co-sponsored by the
Development Bank of Southern Africa

A Consultative Workshop
Held in eThekwini
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South Africa

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“Be the change you wish to see in the world”
Mahatma Gandhi

Introduction.

IZWA (the **Institute for Zero Waste in Africa**, a Durban, South Africa-based not-for-profit NGO) is pleased to produce this booklet, as the main outcome from the workshop referred to in the text.

The intent is to share project ideas, draft proposals and budgets for use by other South Africans, and further afield, with regard to the promotion of sustainable development at the most local and localised levels, while beginning to develop Renewable Energy Technologies in the process.

The booklet is structured as follows:

- Research carried out by IZWA in preparation for the workshop.
- Report from the workshop, complete with register
- Draft proposals for some selected projects, identified by the workshop process.

We hope this document helps move our society and economy towards genuine sustainable development and the provision of safe and sustainable energy, while assisting in the provision of safe and viable livelihoods for our people.

Muna Lakhani
National Co-ordinator
IZWA

"He who blazes the trail determines the straightness of the path."
African Proverb.

What is Zero Waste?

Zero Waste is a goal that is both pragmatic and visionary, to guide people to emulate sustainable natural cycles, where all discarded materials are resources for others to use.

Zero Waste means designing and managing products and processes to reduce the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Implementing Zero Waste will eliminate all discharges to land, water or air that may be a threat to planetary, human, animal or plant health.

Zero Waste International Alliance – 2004

(IZWA is a proud member of the Zero Waste International Alliance)

A Message from our co-sponsor, the Development Bank of South Africa:

The Development Bank of Southern Africa (DBSA) is a development finance institution whose core business is the creation of infrastructure in South Africa and the Southern African region. In fulfilling its mandate, the DBSA is committed to promoting the concept of Sustainable Development in its activities, as well as building the capacity of its borrowers as part of the developmental initiative. It recognises that the integrated and sustainable management of the environment, now and in the future, is the essential basis of sustainable development in all areas of human activity.

The Zero Waste philosophy includes job creation within the sustainable development paradigm, thereby fulfilling vital aspects of the country's and the DBSA's development mandates. The DBSA is committed to sustainable development, job creation and the Zero Waste philosophy, and fully supports IZWA and its partners in their drive to benefit South Africa and her people.

DBSA
Development Bank of Southern Africa

Saphira Surina Patel

Project Ideas for consideration.

It is clear that it is proving difficult to create large numbers of well-paying jobs, given the lack of resources within cities, and affordability of such resources by the poor and un- or under-employed. Our entire economy is run on resource usage percentages of between 5 & and 25% (we throw the rest away) - it is therefore logical to assume that the longer (and more efficiently) we use our resources, the stronger the local economy will become. Large volumes of resources are either made unavailable, or destroyed on a daily basis, so it makes sense that such resources are diverted for further value adding and re-use. The most obvious ones are wastes, be it paper, tyres, organic (mainly garden waste), metals, or glass and ceramics (the last is normally seen as a highly problematic material).

This document begins to outline some possibilities in this regard, and would be valuable in setting up multiple business opportunities, where the input costs are low to zero, enhancing the financial viability of projects.

A key intervention that government can make, is to specify such products in their procurement policies, thereby guaranteeing a minimum market for such products. The export potential can also be explored, once the local economy has reached saturation. It will also be useful for the city to promote partnerships with other projects (such as organic food growing, permaculture, manufacturing, electronics, etc), so that all needs for projects are satisfied by other projects themselves. A good example would be packaging produced on-site for packing organic food or electronics, or local food take-aways using packaging manufactured by communities.

Approach used

All roleplayers share their ideas and current state of projects, and then decide which projects to prioritise, share expertise and research, and carry out feasibilities and implementation plans. A key problem with such processes in the past has been the lack of Life Cycle and lateral thinking, especially with regard to

development of Terms of Reference for researchers. A further lack of understanding is that the current lack of Extended Producer Responsibility, where brand owners take responsibility (financially or physically) for all their products and packaging, is critical in making waste recovery a self-sustaining operation.

This document provides some information to enable such implementation, around some prioritised and proven resource stream. It must be remembered that the costing of such projects should also look at the issue of avoided costs (i.e. costs that would have been incurred by the city should these resources be, for example, dumped, or the impact on transport and landfilling).

It was also decided to include projects around Renewable Energy, at various levels.

Paper

While people do indeed scrape a living from collecting scrap paper for sale, the low prices paid for paper do not allow such people and their families to live adequately. The vast majority of such persons live at a pure survival level, with the work being hard and undignified. While continuing to encourage collection, but helping by setting up projects that will help people add value to the materials they collect, will mean a significant upward change in their income and quality of life.

Small Scale Paper Bag Manufacturing

(full document available)http://sleekfreak.ath.cx:81/3wdev/VITAHTML/SUBLEV/EN1/PAPERBAG.HTM
This process is for the manufacture of small, box-shaped paper bags (our specific process turns out one and three quarters kilo bags, but a similar process is possible for other sizes as well.) It is designed to make 500 bags per day with a labor force of 3 to 5 people. This method uses labor as much as possible, and simple machinery where necessary to provide speed. The machinery is completely hand operated, and consists of a device for folding the bag tube and simple aids in hand-folding the bag bottoms. This has potential in the corporate and gift markets.

Asphalted Roofing Sheets

(full document available) as above
Low-quality, low-cost roofing sheets with a life of about five years can be made from the very lowest grades of mixed waste paper, grades that would not be acceptable for papermaking due to the amount of dirt and contraries present. A factory with three molding machines costs about $200,000 for plant and machinery and can produce about 8,000 sheets daily, each about one square meter in area (over two million square meters annually). About 35 people are employed and 50 tons of paper per week are used. In India, the roofing material retails at around $0.25 per sheet; in South America, at about $0.60 per sheet. The manufacturing process consists of the following steps:

1. The waste paper is washed and pulped in a hydropulper. A mechanical hammer mill or a Hollander beater may be used instead.
2. The pulp is passed through a screen, to remove dirt, grit, or other impurities, and a board-forming machine to produce a continuous length of board that is cut to length as it comes off the machine.
3. The board is spread on the ground and dried in the open air. The edges are trimmed on a rotating slitter.
4. The board passes through an oven at the end of which are corrugating rollers. The corrugated sheets are then trimmed again and stacked in cradles.

5. Next, they are dipped in a bath of hot asphalt. (Asphalt is flammable so the means of heating must be carefully chosen). The asphalt hardens rapidly at air temperature and the sheets are unloaded and stacked.
6. When quite hard the sheets are either:
- taped in bundles for sale as third quality;- sprinkled with mineral chips (while asphalt is soft) prior to packing as second quality; or- hand painted and packed as first quality.

The demand for such products is high worldwide.

Pulp Products

Example: Production of egg boxes, fruit trays, etc.

For production of traditional moulded-fibre packaging like trays for egg and fruit, complete, full automatic machinery set-up right from processing of raw materials to after-treatment and packing of the products are available, with the capacity of the production lines starts at 1,800 pcs. and goes up to 18,000 pcs. per hour (calculated for 30-egg trays). When producing retail cartons (egg boxes with lid), product after-pressing is required to obtain a smooth surface suitable for application of print and/or labels. The smooth surface also contributes to a uniform and tight stacking of the cartons, being advantageous in automatic packing lines.

Another process makes egg cartons from paper pulp using a small-scale paper plant called the Super Melbourne. Waste paper is first soaked, then pulped and refined. Pulping can be done in a domestic washing machine. The equipment includes a refiner that reduces the pulp to basic fibers. The slurry that results is poured onto a sheet of mesh stretched over the forming tank of the Super Melbourne and a valve in the tank is opened. The water draining from the tank sucks moisture from the layer of pulp, which is then pulled from the tank on its sheet of mesh. The layer of pulp is folded over once and pressed between specially shaped dies, then it is laid to dry.

The process employs four people, but labour costs are reduced when Super Melbourne machines are batched together for greater output. Output is 60 egg trays per hour, or 60 sheets of paper 84 x 66cm. The machine requires only 300 watts of electrical power. Most of the water used is recycled. Floor space required is 2 square meters for the machinery and 5 square meters for drying.

More sophisticated machinery is available for producing from 200 to 4,000 30-egg trays or equivalent products per hour. Such a machine is made by Tomlinsons, but careful market research is essential before contemplating the heavy cost of a machine that tends to saturate any but the largest market. Because of this concern, it is intended that small, preferably hand operated equipment is used to begin with, so that small scale production, of a range of products, can be manufactured for local and localised use, helping ensure the ongoing financial viability of such SMME's. Similar machinery is available or can be specially designed to produce flower pots, seed flats, hospital trays, etc.

Other Moulded Paper products:

Food Containers, Hamburger Containers, Moulded Paper Containers, Moulded Paper Products, Paper Fibre Pots, Peat Pots, Pizza Containers, Produce Trays, Packaging for electronics; plates and bowls; electrical piping and junction boxes, etc.

Bio Cups Recycled paper cups with cornstarch lining, not polyethylene. More suitable for cold drinks.
Plates & Bowls Paper pulp from pre-consumer off-cuts or pre-consumer recycled milk cartons makes an attractive, sturdy, single use plate or bowl.

Moulded Paper Pulp Plates & Bowls
Bread and Butter plate 18cm; Dinner plate 23cm; Cereal/dessert bowl 12oz; 18cm plates; 23cm plates; 12oz bowls;

Pressed Recycled Paper Plates Bread and Butter plate 18cm; Dinner plate 23cm

More Paper Products

Found at www.eiolca.net (I personally like the products in bold)

- **Building paper, laminated-mfpm –**a potential project already exists – speak to Wolfgang H Plückhahn; P.O.Box 1596, Umhlanga Rocks 4320; Tel.: 032 - 946 34 92; Cell: 082 324 09 25 - E-mail:whpluckhahan@telkomsa.net
- Cigarette paper, book-mfpm
- **Conduits, fiber (pressed pulp)-mfpm**
- **Confetti-mfpm**
- Crepe paper-mfpm
- **Cups, pressed and molded pulp-mfpm**
- **Dishes, pressed and molded pulp-mfpm**
- Doilies, paper-mfpm
- **Egg cartons, moulded pulp-mfpm**
- **Egg case filler flats, molded pulp-mfpm**
- Excelsior, paper-mfpm
- False faces, papier-mache-mfpm
- Filter paper, converted-mfpm
- Foil board-mfpm
- Fuel cell forms, cardboard-mfpm
- Gift wrap paper-mfpm
- Halloween lanterns, papier-mache-mfpm
- Hats, paper-mfpm
- **Honeycomb core and board-mfpm**
- Insulating batts, fills, and blankets: paper-mfpm
- **Insulation, cellulose-mfpm**
- Masks, papier-mache-mfpm
- Novelties, paper-mfpm
- **Pallet spacers, fiber-mfpm**
- **Paper, building: laminated-mfpm**
- Paper, corrugated-mfpm
- Paper, crepe and crepe paper products-mfpm
- **Papier-mache articles, except statuary and art goods-mfpm**
- Pin tickets, paper-mfpm
- **Pipe and fittings, molded pulp-mfpm**
- **Plates, pressed and molded pulp-mfpm**
- **Pressed products from wood pulp-mfpm**
- **Pulp products, pressed and molded: except statuary-mfpm**

- Rolls, paper: adding machine, telegraph tape, etc.-mfpm
- **Spoons, pressed and molded pulp-mfpm**
- Tags, paper: unprinted-mfpm
- **Utensils, pressed and molded pulp-mfpm**
- Wallcoverings: paper-mfpm
- Wallpaper-mfpm

Wood Waste

A great many products can be made from organic material and wood waste, so for a start, all Municipality organic / garden waste can be either made into products listed below, or made into compost. The organic material going into one landfill alone has the potential to make R2 million per annum from composting alone, as well as generating methane gas for local use. Further details of the following available.

- Animal Bedding and Litter
- Boiler Fuel
- Compost Amendment
- Erosion Control
- Ethanol
- Hardboard/Fiberboard
- Landfill Cover
- Landscape Mulch
- Methanol
- Oriented Strandboard/Waferboard
- Packaging Filler
- Particleboard
- Pet Litter
- Playground/Handicapped Access Groundcover
- Potting Soil
- Pulp and Paper
- Road Stabilization
- Soil Amendment
- Topsoil

Glass and Ceramic Wastes

Value Adding to Waste Glass

Glass, and ceramic waste in particular, in the City have been problematic waste streams, with erratic markets for the collected glass material, due to lack of deposits and re-use, and no Extended Producer Responsibility, as well as problems with separation of different colours and qualities, with no after market at all for broken ceramics. This could be resolved by firstly, developing a market for whole bottles (deposit system, return to wine industry, adding value within organic and other agriculture, pickling, re-use by fillers, etc. amongst other things), then recycling, and for the non-recyclable residue, to crush the glass into various levels of particle size for different applications, such as for addition to road-building material, or cement and septic tanks.

"From Glass to Sand; The Benefits Abound
The transformation of discarded glass into a substance resembling sand is now being performed at the Council Bluffs Recycling Center in Council Bluffs, Iowa with the introduction of new pulverizing equipment. Iin the past, discarded glass had been difficult to recycle because bottles and jars often were contaminated with residues of their previous contents, and it was cost-prohibitive to bring some of the material to a condition where it was acceptable to glass remanufacturers.

With the pulverizer, the recycling center can now accept all types of glass - mirror, ceramic and plate glass, in addition to ordinary container glass. Because the machine can crush all categories of glass, it represents a major step forward in recycling items that at one time were routinely thrown away and ended up in landfills. But the equipment provides another benefit.

By turning the glass into an aggregate, the pulverizer creates a reliable supply of raw material that the city can use in public works projects - thereby eliminating the need to purchase a comparable product from an outside vendor. "Expenses can be lowered by using the crushed glass," Ingham said, noting that the material will become part of the "glassphalt" that will be put down on city streets during improvement projects scheduled this year. Pieces with diameters of three-eighths of an inch are used for seal coating work on streets, while pieces with diameters of one-eighth of an inch or less are used for sand. Ingham said the material would be suitable for commercial landscapers and individual homeowners. He said that in some places in New Jersey, the pulverized glass is spread on beaches near the ocean.

At present, all the aggregate produced at the recycling center is scheduled to be used by the city's public works department. But Ingham said once the output capacity of the pulverizer has been increased, plans are to offer the material for sale to businesses and area residents. By adding a sifting unit to the equipment, he said, "we'll be able to make sandblast grade material. There's a good market for this, so it would be a way to generate more revenue. "The pulverized glass is also now being incorporated into septic systems of rural homes - a use that represents another viable market. "Studies have shown that water flows better through the glass granules," Ingham said. Along with crushing bottles and jars brought in by consumers, the equipment will be in operation breaking up and converting ceramic drain tiles that are being replaced in the city with metal pipes.
—Reprinted with permission from Daily Nonpareil"

Products from crushed Glass:

Bricks

Powdered glass can be used as a ‘fluxing agent’ during brick and tile manufacture, leading to significant savings in energy and reduction in harmful emissions.

Water filtration

Potentially the most exciting application, recycled glass filter media can outperform traditional sand filters to conform with ever-tightening legislative standards.

Grit Blasting

“Glass grit” is a totally inert material that will match, or perform better, than existing abrasive performance at far less risk to the environment.

Cement & concrete

As a natural sand replacement, recycled glass has many potential applications in cement and/or concrete based products.

Sports turf

The use of ‘processed sand’ is a popular and efficient means for this industry to meet the challenge of reducing its environmental impact.

Fibreglass insulation

Already used extensively by this industry, there is still room for market growth where colour sorting is less critical than other applications.

Container glass

Largely centred on clear (or ‘flint’) glass, the re-melting of glass is highly efficient without any adverse effects on quality or physical property.

It must be remembered that converting USABLE bottles and other containers into ‘sand’ must be seen as a last resort, as the most efficient (materials, labour and energy) approach is to re-use the container in its original form. It is worth investigating how this can be achieved, as it will provide the highest use and highest benefit to the poor and unemployed.

Food value adding (jams, pickles, pesto, tapenades, preserved fruit, wine, naturally flavoured vinegars, relishes, sauces, etc.) would be one option – this could link up with community gardens, and be sold to city (or other) conference and catering operations, for example. City operated food businesses would also be a potential market.

Products from scrapped tyres.

Tyres are a known problem, even at rubbish dumps, and include being a potential breeding place for mosquitoes, etc. Dumping or burning them does not make sense, as burning tyres releases much higher levels of toxic pollution than even coal, and the energy and raw materials are lost to the economy, with negative health impacts.

A proven solution is to crumb the tyres, and make a whole host of products. A simple one to start with, would be that 20% to 30% of tar for road construction / repair can be safely replaced by crumbed tyres, which also has the effect of making better roads that last well. This is positive for the city, and the city could specify this in its purchasing policy, ensuring that local communities reap the major benefits. This will lower costs for maintenance of roads, as well as make roads last longer. This will be resisted by companies that make money from roadbuilding currently.

Rubber material (both tyres and conveyor belting) can be used to make a variety of products:

Road and Rail Applications

- Rubber modified bitumen
- Hot mix bitumen
- Reflective crack sealant
- Waterproof membranes
- Gap seals
- Stress absorbing membranes
- Acoustic barriers
- Road base
- Portable traffic control devices
- Ripple strips and speed bumps
- Rail crossings, sleepers and buffers
- Roadside safety railing

Construction & Industrial

- Foundation material Industrial flooring & footpaths
- Anti-static computer mats Acoustic barriers
- Sprayed up roofing, insulation and waterproofing
- Adhesive sealants
- Mounting pads and shock absorbers
- Membrane protection
- Airfield runways
- Shoe soles
- Carpet underlay
- Children's playground surfacing

Compounding with a wide range of plastic such as:

- ABS
- Thermoplastic rubbers of ethylene and propylene
- Flexible foam
- Rollers
- Pond liners
- Compression moulding compound
- Extrusion compounding for rubber products
- Injection moulding

compound

- Solid tyres for industrial equipment
  - Conveyor belts

- Packaging Filler
- Bag
- Recycling bins

▲Bases for Traffic Signs

Products from tyres – cont.

Bulk Products & Mining

§ Filter for landfill leachate ponds
§ Erosion control landfills
§ Road base / stone replacement
§ Leachate pond liners
§ Oil spill absorber
§ Aggregate surfacing
§ Mulches and perma-mulches

Automotive

§ Filler in new tyre manufacture
§ Tyre retreads
§ Solid and pneumatic tyres
§ Oil spill absorber
§ Floor mats, mud flaps, moulded protection strips
§ Special friction brakes
§ Automotive door and window seals
§ ALLTRACK segmented earthmoving tyres
§ Gaskets

§ Adhesive sealants
§ Sprayable sealant for automobile wheel housings
§ Vehicle bumper bars
§ Flooring for truck trays and tipper bodies

Marine

§ Wharf buffers
§ Floating docks
§ Non slip flooring

Sporting

§ Flooring
§ Sporting fields, athletic tracks, tennis courts, etc
§ Gymnasium flooring and matting
§ Equestrian surfaces and workout areas

◄Hosepipe made from scrapped tyres!

Rural and Landscaping

§ Flooring
§ Turf and horse training tracks
§ Watering systems, rubber hosing & low pressure irrigation drip hoses
§ Agricultural pipes
§ Flower pots, wall hangers, pot plants
§ Animal bedding
§ Protective fencing
§ Sprayable linings for grain silos, storage tanks, etc
§ Mitigation of floods from rivers
§ Tyres for agricultural machinery

The majority of the above applications rely on a crumbing process, which separates the waste into three streams: rubber, steel and in certain cases, fibre. The crumb is used in production, the steel generally sold to a recycler, and the fibre composted, or other uses can be found for non-cotton fibre.

A needs analysis should be carried out, to identify which products of the above will prove the most viable and sustainable, and then implemented. The projects could supply existing businesses with raw material; replace imports; and set up further projects that would use the raw material, as well as satisfy many current needs of government at all levels.

Bamboo

A vastly underrated material is bamboo – it is fast growing, strong, with many varieties with many different uses – as food, furniture, housing, structural materials, craft raw material, cutlery, paper, art, sculpture, scaffolding, the list is literally endless. One book alone contains thousands of uses for bamboo. It would be useful to begin to plant bamboo in various areas of waste land, and develop local capacity to make use of the raw material.

BAMBOO IS:

The fastest growing plant on this planet; A critical element in the balance of oxygen and carbon dioxide in the atmosphere; A viable replacement for wood; An enduring natural resource; Versatile with a short growth cycle; A critical element of the economy; An essential structural material in earthquake architecture; A renewable resource for sustainable agro forestry production.;A natural controllable barrier; An ancient medicine; Integrally involved in culture and the arts

Uses of Clumping Bamboo

- § Building and construction all over Asia: house foundations, flooring, walls, blinds, roof frames, scaffolding, shuttering and plumbing.
- § Bridges made from a combination of bamboo ropes and whole culms.
- § Utensils and implements, domestic and agricultural such as cups, pipes, rakes, brooms, ladders, carts, walking canes and furniture.
- § Bicycle frames: manufactured and used in Europe in the late 1800s.
- § Food: shoots are high in trace elements and vitamins and are a common ingredient in Thai, Chinese and Japanese food.

Uses of Clumping and Running Bamboo

- § Baskets: very widespread in Asia and used for all kinds of carrying container as well as for steam-cooking baskets.
- § Matting, screens, fences: often culms are split and used like basketry willow.
- § Ropes made by splitting culms into fibres, then twisting them.
- § Weapons such as bows, arrows, spears and blowpipes.
- § Kites, particularly in Japan.
- § Fishing poles and spears.
- § Seeds can be brewed into bamboo beer and sake[7]. They can also be used as a cereal.
- § Musical instruments, such as flutes and pipes.
- § Paper pulp: bamboo fibres are long and the leaves as well as the culms can be used.
- § Animal fodder: shoots and leaves are relished by ruminants, including pandas.

A to Z of possible bamboo uses

this is NOT a full list!

A

A-Frame houses, Activated charcoal, acupuncture needles, Airplane wing members and stress skin for fuselage, alarms, alcohol, anchors, antenna supports, aphrodisiac, arbors, arrows and arrow tips, ashtrays, awnings

B

Baby carriages, bagpipes, barrels, baskets, beads, beanpoles, beds, beehives, beer, bicycles, bilge pumps, blinds, blowguns and darts,

boards, boat hoods, boats, bolts, bookcases, books, booms, bottles, bowls, bows (archery) , boxes, bracelets, bridges, brooms, brushes, brush pots, buckets, buttons

C
Cables, cages, candlesticks, canes, canteens, carts, castanets catalyst(tabasheer), caulking, chairs, charcoal, chisels, chopsticks, churches, cigarette holders, clothes, clothes racks,clubs, colanders, combs, cooking vessels, chicken coops, couches, cow bells, cradles, crates, cribs, crosses, crutches, cultures for bacteria, cups, curtains

D
Dams, defensive fortifications, deodorizers, desks, diesel fuel, dikes, dirigible, dolls, domes, dowel pins, dredge (fishing), drouges, dustpans

E
Eggcups

F
Fans, Farming uses, fences, fenders, fertilizer, fiesta assistant, fifes, firearms, fire starters, firewood, fireworks, fishnets, fish poles, flagpoles, flails, floats, flooring, flowerpots, flutes, flying art, food, forage, forms, frames, fruit pickers, fuel, furniture

G
Gabions, games, garments, gates, grain, grain storage, graters, greenhouses, guns, gutters, gypsy vans

▼Plywood from bamboo

H
Hairpins, hampers, handles, hats, hawsers, hay and forage, hedges, helmets, hen houses, hinges, hoops, hookahs, house plants, houses, humidors, hummers

I
Iceless coolers, incense sticks, insect cages, irrigation waterwheels and pipes

J
Jackets, jars, jewelry, joss sticks, junks

K
Kiosk, kites

L
Laquerware, ladders, ladles, lamps, lampshades, landing docks, landscaping, lanterns, lathing, laundry poles, levees, light bulb filament, lofts, looms

M
Marimbas, markers, masts, mattangs, matting, mattresses, medicines, mills, mobiles, mushroom culture, musical instruments, mahjong tiles

N
Nails, napkin rings, net floats, nets, needles, netsuke

O
Organs, ornaments, outriggers, ox cart beds, ox goads, oyster cultivation

P
Packaging, paper cutters, paper pulp, pegs, pen and pencil holders, pens, pillows, pins, pipes, plant stake, plates, plybamboo, poison, poles, polo balls, polo mallets, posts, printing pads, propellers, props, punishments

R
Racks, rafts, raincoats, Rain spouts, rakes, rattles, rayon, record needles, reeds, reinforcement for concrete and adobe, rings, ritual objects, roofing, ropes, rug poles, rulers

S
Sailcovers, sails, sailstays, sake, salt well drilling, sandals, scaffolding, scales, scarecrows, scoops, scratchers, screens, scrubbers, sedan chairs, shades, shakuhachis, shavings, sheaths, shields, shingles, ship design, shoehorns, shoe soles, shoots for food, shovels, shuttles for weaving, sieves, silk industry, skewers for cooking, ski poles, slide rules, sluices, snow fences, spears, splints, spouts, spray guns, springs, stakes, staves, sticks, stilts,

stools, string, sugar, sunning floors, swimming pools

Multi Storey Car Park Built out of Bamboo!

T
Tabasheer, tables, tallies, tea houses, tea strainers, tea whisks, tents, temporary structures, tiles, tortures, towers, toys, trailers, transport, traps

U
Umbrellas

V
Valiha (musical instrument)

W
Wagons, walking sticks, walls, war, water jugs, water pistols, water storage, waterwheels, waxes, weapons, weaving shuttles and looms, weirs, well sweeps, wheelbarrow, whetstones, whips, whistles, wicks, windbreaks, windmills, wine storage, winnowing machines, writing brushes and pens

X
Xylophones

Y
Yurts

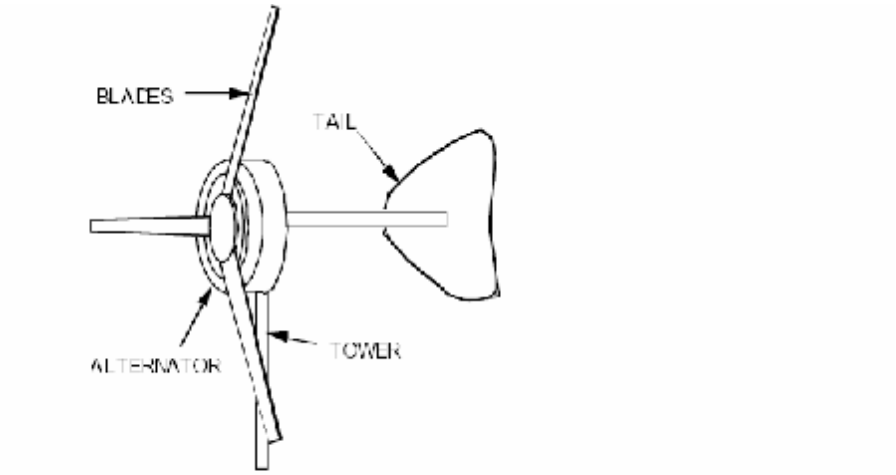
Z
Zithers

Bamboo Web Links:

American Bamboo Society - http://www.bamboo.org/abs/ ; Bamboo Society of Australia - http://www.bamboo.org.au ; European Bamboo Society - http://www.bodley.ox.ac.uk/users/djh/ebs/ ;
Australian Bamboo Network - http://www.ctl.com.au/abn/abn.htm ; INBAR—International Network for Bamboo and Rattan - http://www.inbar.int/ *Especially see the Information Services section with its Working Papers and Technical Reports;* Introduction to Hardy Bamboos - By Earle Barnhart - http://www.bamboo.org/abs/GeneralInfoPages/BarnhartIntro.html ; *Article from Fine Gardening magazine in 1989* 1999 WSU On-Farm Bamboo Variety Trial - WSU Cooperative Extension Agricultural Systems http://agsyst.wsu.edu/bambooarticle.htm; Bamboo Shoots - WSU Cooperative Extension Agricultural Systems - http://agsyst.wsu.edu/bambroc.htm;
Planting Bamboo Benefits the Farmer - By Daphne Lewis http://www.dogscooter.com/bamboo/more/index.html; Thin Your Grove to Increase Productivity - By Daphne Lewis, August 1998 - http://www.dogscooter.com/bamboo/more/boothin.html ;
Maintaining and Harvesting a Bamboo Grove - Text and photos by Joe Crookston July, 1998 - Footnotes by Daphne Lewis - http://www.dogscooter.com/bamboo/more/boomaintain.html
Bamboo Products - http://esi.athenstn.com/wwt/Bamboo_Products.html *Informative summaries of bamboo products: Food, Wood Products, Paper, Charcoal, Biomass, Bio-remediation, Composites;* 1000 Things Made of Bamboo http://www.bambus.de/infos/1000/index.html *Image gallery of bamboo products: Music, Outdoor, Fun, Art, Building, Other;* Uses of Bamboo - http://kauai.net/bambooweb/bambooa2z.html ; *Alphabet soup of bamboo uses at Bamboo Web* - Bamboos at EarthCare Nursery, Australia - http://www.earthcare.com.au/bamboo.htm ;
High-quality photos of bamboo species with descriptions; also see online slide shows; BambuBrasileiro - http://www.bambubrasileiro.com/i1.html *Informative bamboo web site in Brazil;* Sorting the Names of Bamboo - The University of Melbourne, Australia - http://gmr.landfood.unimelb.edu.au/Plantnames/Sorting/Bamboo_names.html; *Comprehensive list of bamboo species with botanical nomenclature, synonyms and notes; crossindexed in different language* - Grass Genera of the World - http://www.biodiversity.uno.edu/delta/grass/index.htm; *Authoritative notes and descriptions for bamboo genera* - Bamboo Names and Synonyms - http://www.rsl.ox.ac.uk/users/djh/ebs/synonyms.htm ; *Comprehensive list of bamboo plant names and their synonyms*

Renewable Energy

Wind turbine manufacture



The wind generator is suitable for family needs such as lighting and radio, powered by a 12-volt battery. It is for low and medium windspeeds, common in Peru and Sri Lanka, where the wind turbine is being built.

The experience of NGO's that work in the South (in this case, Peru and Sri Lanka) has shown that communities can make wind turbines at a small local scale, that are very good for generating electricity, especially at the level of battery charging.

ITDG has done very good work in this regard, and two booklets are freely available to enable people to begin to manufacture their own turbines. This can be a platform for increased scale and scope for larger turbines in the future, and will deliver on the job creation promised by renewable technologies, as opposed to fossil fuel or nuclear.

In the interests of saving space, it was decided not to cover the entire booklet here – ITDG makes them available through their website**:** www.itdg.org

Low cost water heaters

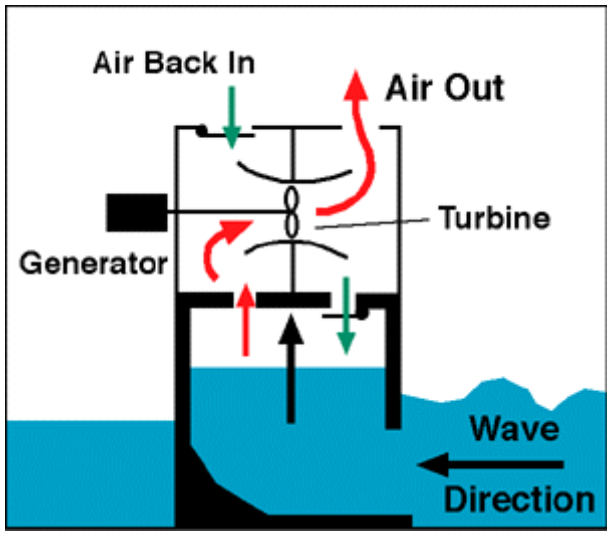
It is easy to see that making energy appliances is not as difficult as we think, mainly because this knowledge is kept from us in the interests of selling us more fossil and other fuels; however, the potential is great. While many people know about solar cookers, very few people use them, due to either ignorance or cultural issues. Similarly, it is possible to build low cost water heaters from waste, for example, from a radiator from a car or truck, together with pieces of windscreen.

The key is to make an enclosure that is painted black inside, and to place the radiator in there. Then, the top is covered with the glass windscreen, so that heat (sunlight) can enter, but not leave easily – with pipes from the inlet and outlet connected up (the outlet should be a tap of some sort, and the inlet can be either connected to a tank, or just filled up with a bucket), will mean that even very poor people without electricity can have warm or hot water for many days of the year. While the sun does not shine everyday, even if this makes hot water for 4 out of 7 days, it will mean a great improvement in the quality of life of people, as well as a business opportunity from waste.

Oscillating Air Column – wave power

"At the Kiama blowhole, south of Sydney, tourists watch from a discreet distance as geysers of spray burst from a hole in the cliff top. Growing up in the area, Tom Denniss was fascinated by these eruptions, caused when waves rushing deep into a cave force a mix of compressed air and water out through a gap in the roof. Now, a few miles south of Kiama, in the industrial city of Port Kembla, Denniss and his company, Energetech, are using the principles of the blowhole to turn wave energy into electricity.

In place of a cave, Energetech's four-story-high floating power plant has an open-based, dome-roofed chamber with a narrow opening at the top. As the waves rise and fall inside the chamber, compressed air is forced in and out of the opening, past a turbine that drives a generator. The device, which has been dubbed an "oscillating water column," has been the basis of several plans for generating useful energy. But Denniss, a former lecturer in mathematics and oceanography, curved one wall of the chamber to amplify the wave, much as a car headlight's concave reflecting surface intensifies the light from the low-wattage bulb. And he designed a turbine that rotates in the same direction no matter which way the column of air is moving.



His oscillating water column successfully generated power during trials outside Port Kembla harbor in June. (A rival system called Pelamis, using 120-m-long hinged cylinders, was successfully tested in Scotland in April.) Once commissioned, Energetech's plant is expected to feed into the local grid enough clean power for 500 homes. Energetech is developing several commercial-scale projects from Israel to Rhode Island. Wave energy, Denniss says, is "more consistent, predictable and concentrated than wind. It's also inexhaustible." Having studied the ocean's power all his life, he's in no doubt that it will soon be turning on our lights."

EThekwini is suited for this type of application, and warrants further investigation.

Medical waste treatment

"Meanwhile in Costa Rica, the National University won US$133,000 for a solar-powered oven that can produce temperatures of 180–200 degrees Celsius needed to sterilise biological waste in hospitals.

The oven protects both environmental and human health because, unlike fuel-based ovens, it does not produce toxins. It is also cheap to maintain and durable — lasting approximately 30 years. The oven can be used on-site, enabling hospitals to make waste biologically inert
for safe disposal. This also eliminates risks of transporting waste."

As the medical industry moves away from the toxic incineration based processes, to autoclaving, this application, has particular relevance for our peri-urban and rural hospitals and clinics. It must be remembered that the KZN Department of Health has taken a decision that they will not use incineration, which is applauded, and this product could assist them in this regard.

Biodiesel and ethanol

Transport is a key concern with regard to sustainable development, given the high level of dependence on imported fossil fuel (petrol and diesel) today. It is possible to make fuels that are not dependent on imports, and that are also renewable fuels, leading to long term sustainability.

Rudolf Diesel invented his engine in the late 1890's. He literally wanted to empower farmers and designed his engine to use peanut oil. That engine is what we know as a diesel engine, so the original engine was designed to run on biodiesel. Diesel engines are very rugged, and can handle the extreme level of use that we put them through. Engine manufacturers are making efforts (admittedly under pressure) to improve the engines all the time, but the best way to reduce pollution is to change the fuel, from "normal" diesel, to biodiesel.

Rudolf Diesel was on the right track. Biodiesel is empowerment in every sense. If you can obtain vegetable oil, wood, or grain alcohol, which is methanol and ethanol and lye, you can make diesel fuel. Biodiesel can be made from any vegetable oil, including recycled waste vegetable oil, palm, coconut and other oils. There are many biodiesel plants in the world, including Pacific Biodiesel in Hawaii and uses waste oil that's being discarded at the Maui landfill. On Maui (Hawaii), they are fortunate to have a manufacturer of quality biodiesel fuel from waste cooking oil (FOG). See the details at ttp://www.mauigreenenergy.org/biodiesel.htm

Pacific Biodiesel (www.biodiesel.com) makes a fine fuel that has been used in a car, a 2001 VW New Beetle diesel (since new) for over 18,000 problem free miles. They get 40 fossil free miles to the gallon. One person has driven his 2000 VW Golf over 35,000 miles on B100 as well. They also fuel their two International multi compartment trucks on B100, too. See the details at http://www.mauirecycles.com/

Biodiesel is non-toxic, biodegradable, and does little harm to waterways. It is virtually edible and is less toxic than table salt. People are impressed by the sustainability of the fuel and the potential for local production. Another use of biodiesel is for home heating oil

◄ A small biodiesel plant.

Prior to making the switch on an existing diesel engine, it is important to trace the fuel system of each truck checking for cleanliness and to ensure there were no natural rubber lines and gaskets. Some people suggest that you remove your fuel tank and clean it at a radiator shop. Believe it or not, there is a species of bacteria that lives in diesel tanks and forms sediments. The tanks looked clean, but they had to take this precaution since biodiesel is a solvent and is even used to clean oil spills. Biodiesel had the potential to break loose deposits and clog the fuel system. It is possible to change over vehicles one at a time, cleaning the tank and changing

the fuel filters. An immediate effect will be a decrease in engine vibration, and of course a more pleasant odor for the exhaust..

Biodiesel is a product of transesterification. Transesterification converts a vegetable oil molecule from a triglyceride, which is a glycerin with three esters attached to it to a molecule that is a chain of esters -no glycerin. We change the esters hence the term transesterification. The glycerin can then be used for soap or even composted. This can be done to vegetable oil to decrease the viscosity or ease at which the fluid pours. This process changes vegetable oil something thick and syrupy to a fluid resembling regular diesel fuel. As anyone who has cooked has learned, you can also do the same by simply heating the vegetable oil. But that will require modifications to trucks.

Biodiesel can be safely made in your backyard!

Transesterification is also a relatively simple process two stage base catalysis. It is possible to make biodiesel in your backyard, or in your village if you live in one, or on your farm if you live in the country. And regarding empowerment let's not forget about economic empowerment. The University of Missouri calculated that an annual production of 100 million gallons of biodiesel in a metropolitan region would yield 6000 new jobs. The USA loses 80 billion dollars a year to oil imports and spends over 250 billion defense dollars a year to defend the ability to spend that money. There are many guides and recipes for making biodiesel on the internet, www.veggiepower.org.uk, www.journeytoforever.org, and many more.

We forget that people are dying from the application of military force to secure access to oil. Kuwait and Iraq, of course comes to mind but lets remember the Karen people of Burma many of whom have died for the Unocal pipeline, or the Ogoni of Nigeria who have suffered for Shell Oil, and the U'wa of Columbia who have suffered at the hands of Occidental, and lately, the Iraqui people.

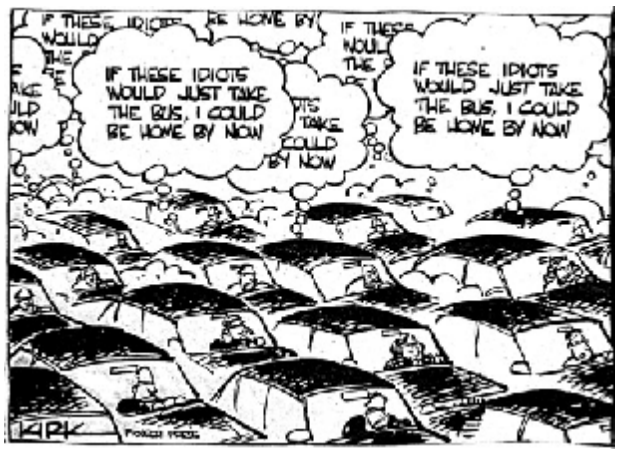
Proponents of biodiesel as a substitute for diesel fuel (in blends or in its neat form) can point to a number of potential advantages for biodiesel that could support a number of strategies for addressing national issues.

- **Reducing dependence on foreign petroleum…**

Our transportation sector relies almost exclusively on petroleum as a source of energy. This is due to the high level of demand for petrol and diesel fuel. Biodiesel can be produced domestically from agricultural oils and from waste fats and oils. With its ability to be used directly in existing diesel engines, biodiesel offers the immediate potential to reduce our demand for petroleum in the transportation sector.

- **Leveraging limited supplies of fossil fuels….**

Regardless of whose perspective one chooses to believe on the future supply of coal, oil and natural gas, it is indisputable that the supply of these fuels is, ultimately, limited. Biodiesel has the potential to leverage our use of limited supplies of fossil fuels.



- **Mitigating greenhouse gas emissions….**

The burning of fossil fuels over the past century has dramatically increased the levels of carbon dioxide (CO2) and other "greenhouse gases" that trap heat in our

atmosphere. The implications of the increasing levels of these greenhouse gases are serious. The levels of these greenhouse gases have risen at unprecedented rates in the context of geological time. To the extent that biodiesel is truly renewable, it could play a role in reducing greenhouse gas emissions from the transportation sector.

- **Reducing Air Pollution and Related Public Health Risks….**

One of government primary tasks is to reduce public health risks associated with environmental pollution. Biodiesel can play a role in reducing emissions of many air pollutants, especially those targeted in urban areas. These include emissions of particulate matter (PM), carbon monoxide (CO), hydrocarbons (HC), sulphur oxides (SOx), nitrogen oxides (NOx) and air toxics.

- **Benefiting our domestic economy….**

Spending on foreign imports of petroleum sends money out of our economy. Biodiesel offers the potential to shift this spending from foreign imports to domestically produced energy. It also offers new energy-related markets to farmers, communities and creates new business opportunities..

We can hardly do better in decreasing toxicity than by using biodiesel. Biodiesel is the only alternative fuel that has passed the EPA's Clean Air Act Tier II testing. Both adult and juvenile rats were subjected to biodiesel exhaust and no pathologies were detected.

A happy benefit of biodiesel is that it is composed of a uniform carbon chain as opposed to regular diesel that has hundreds of carbon chains. These chains are what cause aromatics, benzene, toluene, and xylene to be emitted in diesel exhaust. Biodiesel virtually eliminates aromatics, which are very harmful.

Biodiesel has 11% more oxygen by weight, which enables it to combust more thoroughly. This aids in the elimination of other pollutants. Biodiesel has 43% less Carbon Monoxide and 55% fewer particulates than conventional diesel. Those particulates are the soot that you see in diesel exhaust and causes cardiac and respiratory problems. The mutagenicity, which measures the ability to cause cancer, is decreased by as much as 90%. And over its life cycle biodiesel emits 78% less carbon dioxide the global warming gas than conventional diesel fuel.

The testing process calculated that when a blend of 20% biodiesel was used, particulate emissions were reduced by 24% and when 100% biodiesel was used, particulates were reduced in the test vehicle by 84%.

The pollutant that biodiesel does not mitigate or eliminate is nitrogen oxides or NOx. NOx causes smog or ozone and can be mitigated with the use of a catalytic converter. The nitrogen oxides result from the oxidation of atmospheric nitrogen at the high temperatures inside the combustion chamber of the engine, rather than resulting from a contaminant present in the fuel.

We don't have to go to the Middle East to get biodiesel. It is available anywhere there is a deep fat fryer. Anecdotally one fast food restaurant produces over 200 liters of waste oil every day.

People also looked into the feasibility of using waste oil directly in their trucks and it is possible with the addition of heaters and filters and extra fuel tanks. This is because in cold weather, the thick oil does not flow well until the engine is heated up. This is only an issue in cold areas, and not an issue at all for biodiesel that has been made from transesterification.

People have also begun to manufacture biodiesel on a micro level. People in South Africa already know how to make biodiesel, and we can spread the skill relatively easily. The Austrians have developed several interesting processes that use Ethanol instead of methanol, and thus source the feedstock entirely from plants. Unfortunately most methanol, which is wood alcohol, comes from natural gas.

The current energy crisis has hammered home the fact that energy is made by the few and is consumed by the many. The price of biodiesel is now becoming highly competitive, and even more so with local small scale manufacture, from waste vegetable oils. As the oil price increases, it will become even more attractive, with a large reduction in pollution at the same time.

So beginning with a proposal from a student, they:
- evaluated the fuel and then significantly decreased their toxic impact.
- they demonstrated the feasibility of petroleum independence to municipal agencies and other truck fleets
- they make it themselves and train other people how to do it.
- they have researched cutting edge manufacturing technologies.

It is important to note that it is not a diversion of food plants that is being advocated – while there is no shortage of food (people are hungry because they cannot buy the food there is, and not having land and skills, are unable to feed themselves) there are many ways in which alternative fuels can be made within a permacultural agricultural system If we made ethanol from sugar cane waste, we would have large amounts of fuel.

Acknowledgements: Dave Williamson - Director of the Berkeley Recycling Program; Maui recycles; Maui green energy

Algae based bio-diesel.

Simply put, algae is grown on media such as sewage, and then harvested (about 60% of the algae is oil) and then converted, as any vegetable oil, into biodiesel.

You can visit http://www.energybulletin.net/2364.html where they show that results obtained the US Dept of Energy funded 18 year "Aquatic Species Program" at the National Renewable Energy Laboratory demonstrates that it is possible to generate all of the US car vehicle fuel needs with a less than 4 year payback period (not counting the cost of converting all petrol engines to diesel). It is therefore possible to produce enough biodiesel to satisfy SA vehicle fuel demand on less than 90 000 hectares.[1]

[1] Thanks to Mark Wells

The model that most makes sense is to produce locally as much as possible – and by all accounts, the waste left over still has good value for further value-adding! Of course, fossil fuel companies will resist or refute these possibilities.

Vermiculture for Waste Recycling

One of the most conspicuous features of the modern consumerist society is the generation of massive quantities of waste, which is both costly and difficult to dispose of through conventional methods. It has been computed that India, as a whole, generates as much as 25 million tonnes of urban solid waste of diverse composition per year. But per capita waste production in India is miniscule compared to the per capita production of wastes in the industrialised countries, as even in South Africa we produce 556 million tons per annum that go to rubbish dumps – so, we produce more than 20 times the amount of waste, yet we are only one-twenty fifth of the population! Even so, the problem of waste disposal everywhere has of late attained serious proportions posing as it does immense health hazards and an environmental crisis of the first magnitude.

The Zero Waste philosophy (designing out unusable waste, and recovering and remanufacturing sustainable and safe materials) takes care of waste very efficiently. Currently the most popular and widely employed technique for organic solid waste disposal relies on earthworms generally referred to as “farmers’ friend”. For centuries, earthworms, as biological natural agents, have been in the business of decomposing wastes and enriching the soil structure.

An innovative discipline of vermiculture biotechnology the breeding and propagation of earthworms and the use of its castings has become an important tool of waste recycling the world over. Essentially, the vermiculture provides for the use of earthworms as natural bioreactors for cost-effective and environmentally sound waste management. The process evolved by Bhawalkar Earthworm Research Institute has been successfuly employed in the urban centres of India and elsewhere in Asia for recycling of bio-degradable domestic waste, as well as making highly efficient sewage treatment plants using worms only. The energy input in the processing is very small compared to the existing waste disposal systems and the processing cost is next to the nothing. Different kinds of wastes can be collected in specially designed bins and subjected to vermicomposting using vermicastings secreted by the earthworms. As things stand now, the vermiculture technology is all set to emerge as a big business of the next century. For this versatile technique yields organic fertilisers, recovers energy rich resources, makes for safe disposal of organic wastes and helps combat the spreading problem of environmental pollution. Today, many corporate units and business agencies are making a fortune by marketing vermicompost—an excellent soil conditioner—to farmers and gardeners. For thousands of years now, the process of vermicomposting has been working in nature due to the activities of earthworms which excrete droppings called vermicastings. It has been estimated that about 5,000 earthworms can degrade a heap of organic wastes of the dimension 1.2x2.4mx0.6m speedily and efficiently. However, for

further increasing the efficacy of vermicomposting, care should be taken to see that worms thrive on organic matter, breed faster, tolerate moisture and withstand climatic fluctuations. The most beneficial feature of vermicomposting is that it eliminates the foul smell of decaying organic wastes. Each house should have a worm bin, which is clean, safe and does not smell bad, while saving the city costs of waste collection and disposal, while improving the fertility of our local soil, instead of dumping such valuable organic material that gets contaminated with chemicals, etc.

Interestingly, Japan imports 3000-million tonnes of earthworm per annum for waste conversion. But India and Sputh Africa are still a long way behind in fully exploiting the promises of vermiculture technology for waste disposal and manure generation. With the amount of waste produced in India, the country could easily produce 400 million tonnes of plant nutrients and considerably reduce the outflow of foreign exchange towards the import of fertilisers. Today, many industrial units covering paper, pulp and tanning make use of vermiculture technology for waste treatment.

▲This is a water free toilet – there is no need for ecological sanitation to look bad!

Now there is an all-round recognition that adoption and exploitation of vermiculture biotechnology would, besides arresting ecological degradation, go a long way towards meeting the nutrient needs of the agricultural sector in a big way. On another front, widespread use of vermicultural technology could result an increased employment opportunity and rapid development of the rural areas. It is hightime that the scientific and other communities of the country gave a serious attention to standardising and popularising vermiculture technology on a countrywide basis. There is no reason why every home, restaurant, school and business cannot have a worm bin, and we should also be vermicomposting at a large industrial scale in South Africa.

Decentralised sewage and sanitation systems

Safe sanitation is a Millenium Development Goal, yet we are looking to satisfy this need by the terrible VIP toilets, which get filled up; are a danger to children; and are not sustainable in anyway. All toilets should be safe, and dry one – no flush required – this must be our end goal, including for the houses of the rich. This is the only way we can provide safe sanitation that is sustainable.

A family of 4 only generates about 50 kg of solid waste from toilets per year – all the rest is water, and we use 18 000 lt (minimum per family – 4 flushes per day) per year to “get rid” of this waste, using approximately 350 lt per kg! Not only are we wasting water that is safe and clean enough to drink, but we are also losing the water and nutrients for local use and economic development, as well as food security. Most of the barriers are cultural, not technical or practical.

A compromise can be a low flush system, that is linked to a very localised “treatment” plant – say for 20 or 50 households, which allows the community an opportunity to produce some bio-gas for local use; recover grey

water for and compost for food production; and get full local value for the water they do consume, as all the downstream (post-flush) water and compost is free. A practical, safe and clean method of using vermiculture (above) for toilet waste is also being used elsewhere in the world, which has an added benefit of working more efficiently the longer it runs! These can also be part of a polyculture system mentioned below.

"Specific and immediate benefits of ecological sanitation

- Reduce the load on the existing treatment plants and thus save on long term costs on sewage treatment plants that are already overloaded.
- Save water that is necessary to transport the waste to treatment plants and thereby taking away the pressure on water policing and water affordability measures to optimise water use.
- Reduce capital and recurring costs both for residential areas as well as reduce recurring costs at the water treatment site.
- Save maintenance of pumps and other costs in the long run. The expenditure on maintenance of pumps, repairs of blocked sewage and relaying of new sewage pipes can be diverted to better use with long term over all sustainability.
- The waste water if and when it joins the treatment plant is already treated locally to take care of antibiotics, hormones and other polluting agents disposed through urine etc.
- Create a system where by decentralized sewage decomposition process can add value by generating multiple revenue options, contribute to energy needs by generating methane, contribute to the local job creation process through a decentralized system that opens up a whole new area for local training and community ownership as well as partnership with the local government service delivery mechanisms.

Proposed Technologies

Decentralised, location specific alternatives that are easy to install, with an added advantage to create value added for the output that did not have any value in the past, but was costing the council to dispose of it as `waste'.

1. Separation and dry toilets where water supply is problematic and costly, or where additional water consumption would lead to an excessive stress on the sewage system
2. Retrofitting system permitting the existing toilets to consume less water, as little as 1.5 to 3 liters per flush and ensuring a high sanitation standard through the separation of solids and liquids after the flush, and the drying out of the solids to control pathogens
3. Bio-digester combines the low flow water flushing system but instead of a dry treatment of the solids, here the system provides a wet treatment through a digestion process that at the same time as controlling the pathogens, permits the generation of methane gas. For details on the decentralized sewage treatment designs contact ZERI Southern Africa or Nirmala Nair at nair@zeri.org"[2]

[2] Courtesy Nirmala Nair

Polyculture.

Simply defined, polyculture is making sure that everything has more than one use, and as much of the resource is used and re-used as locally as possible. The following are some models:

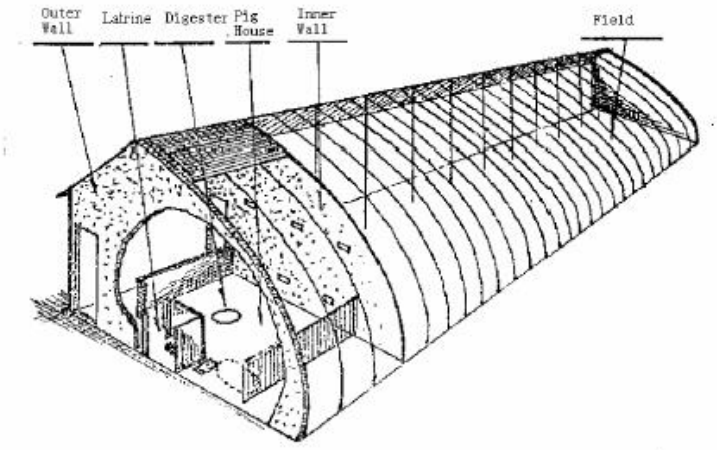


Figure 2.2 General Layout of a "4-in-1" Model in Rural China

Polyculture using integrated farming and waste management

"Current farming practices does not allow inbuilt design process to create value added resource generation from the agri-waste including livestock waste. Integrated farming and Waste management involves the use of bio-digesters where livestock and human waste can be introduced in an anaerobic chamber, Field vision for capturing methane as well as using the effluence as fertilizers. A combination of digesters plus series of shallow ponds using the effluent creates the basis for polyculture introducing more than one kind of fish species as well as horticulture in rafts. For more details on these ZERI designs by Prof. Chan contact nair@zeri.org"[3]

So, in practice, this could be a situation where vegetables are grown, and certain vegetables grown for both food and secondary use, for example, feed for chickens, pigs, etc. The waste from the chickens could be fed directly into a pond, where it will be eaten by fish, ideally more than one kind of fish, making the process less vulnerable to diseases, etc. The excess water from the pond can be used directly in the vegetable garden, ensuring that as much of the nutrients remain within the process as possible. The waste from pigs and people, for example, can be fed into a bio-digester, which can provide methane gas for cooking or heating (e.g. both houses and greenhouses), and the leftover waste ma Outer wall – Toilet – Digester – Pig House – Outer wall

High value Mushroom Production.

If we can find adequate resources, such as straw, water hyacinth, compostable materials, etc. then the production of high value mushrooms is a key possibility. This also indicates that we need a resource assessment process for all projects.

An example of a Zero Waste hub

Organic waste –(from making beer, or from water hyacinth, which is a pest in our waterways) used as a basis for growing mushrooms and food to eat and/or sell; the used mushroom base becomes animal feed and the compost on the vegetables for us and other animals to eat – the waste from people and animals go to a digester, from which we get bio gas, and then the waste goes onto algae ponds (now that the nutrition level has increased by digestion) and then becomes food for a fish pond, which has carp that aerate the water (no air pump required) and bottom feeding fish (no need to empty the tank every year, making better money) and the fish are harvested, with waste water going to grow more food – and as there are more than one type of fish, there is no need for antibiotics, which means that the fish are organic, provide better nutrition and higher value for sale; and the water from this can go back, via a constructed wetland if need be, to growing plants. The fish

[3] Courtesy Nirmala Nair

can also be directly fed by chickens, who would drop their droppings directly into the water; other options that can be included are various forms of ecological safe sanitation and grey water harvesting systems; value adding to vegetables (pickles, bottled health drinks, sauces, etc). There are also additional opportunities to be had with regard to solar energy, for example adding value to tomatoes by drying them (or simply to improve the storage potential of food by drying). Other plants, for example bamboo above, could also be part of this production process, resulting in many benefits outlined already. The use of wind energy and solar PV energy can be added to that of the biogas (which can also be used to run a generator if need be), and provide further value for the community. In colder areas, solar water heating (as described elsewhere in this document) can be used to ensure a low cost higher temperature for the water for fish to grow well.
So, by designing one system, we have:

- a re-use option for grey water from homes
- alien vegetation removal
- grow mushrooms
- grow food – vegetables, mushrooms, chicken and fish
- manufacturing food products for sale
- produce good quality animal feed
- safe ecological sanitation
- water saving technologies
- natural flood control
- bio gas production, saving energy impacts and costs
- increase nutrition for aquaculture
- minimise malaria, by the fish eating the mosquito larvae
- aquaculture – various fish for local consumption, local sale and potentially export
- and financial cost reductions for all of the above, as we are using each resource many times.

A More Urban Zero Waste Hub.

The resource that comes to mind easily in towns and cities is of course waste. This includes sanitation waste, which can also be treated as already described, and can be set up to divert organic resources to food production in the nearest place, often in small scale urban agriculture.

Other waste, generally known as Product Waste (as they are products manufactured to become waste, and waste from the process of buying and selling products - packaging) which usually comprises paper, glass, metal and plastics. We will ignore plastics, as they are both toxic in their life cycle, as well as difficult to separate and recycle.

So, a company that produces oil waste would feed a biodiesel and soap manufacturing plant; paper waste a pulp plant; Bottles for value-adding; organic material for biogas or compost; etc. These kinds of systems can only really be designed for specific local areas, as one will have to do an analysis of the waste streams in that area first, and then look for the Zero Waste complementary processes.

A Palm Tree Zero Waste Hub

Another example from Malaysia on palm trees:
Normally, only oil is extracted and the rest becomes simply waste or at best compost. However, it is possible and practical to make: biodiesel; wood products (particle boar, fibre board, furniture), pulp / paper; animal feed; glucose; cellulose substrate; fuel; palm heart (food); activated carbon; Vitamin E; mushroom growing

substrate; roofing tile; betacarotene production; potting medium; animal feed supplement; ethanol / amino acid production; anaerobic slurry for fertiliser use and biogas for heat / power generation.

(Source: Teoh Cheng Hai, Malaysia – Upsizing)

As you can see, the Zero Waste concept can work in many different arenas.

(The afore going materials were utilised in a workshop convened by IZWA, in partnership with the Development Bank of SA. It was held at Mama Jabu's in the Durban inner city on the 21st of November 2005, and catered for by local Black businesses. The workshop report follows)

Workshop Report

The workshop was a success. 33 people were formally present, including key City departments, researchers from tertiary education institutions, and a wide spread of civil society representatives, including NGO's, CBO's and faith-based groups. *(See register attached)*

The day began with an overview of the Institute for Zero Waste in Africa (IZWA), and provided a context for the day. This covered areas such as the main threats facing the world today from a sustainable development perspective; contextualising South Africa's position within this paradigm; unsustainable methods of production and consumption currently being the norm; some context as to the economic environment and the impacts of different development paths; the world context with regard to Zero Waste implementation, and challenges in this regard.

After tea, a series of presentations were made. The first was from **Nirmala Nair**, from the Zero Emissions Research Initiative, who developed the Zero Waste theme further. This was followed by **George Fred D'Almaine** from the Durban Institute of Technology (DIT), on Ocean Current energy generation, and a presentation on behalf of **Alan Hansen** (also DIT), on creating a Sustainable Development Hub, similar to one outlined in the booklet. **Iain Kerr** from the University of KwaZulu Natal (UKZN – Paper Manufacturers Association Research Fellow) presented his IZWA inspired research on manufacturing pulp paper products from waste. **Michael Brooks** from the Mangosotho Technikon presented his thoughts around Solar energy, and the work they have been doing. **Prof. Mike Smith** (Pollution Research Group - Biology Section – UKZN) then presented background on ecological sanitation, which was also well received, and raised some interesting moral, technical and social / cultural debate.

The session was closed with an IZWA presentation by National Co-ordinator, Muna Lakhani, utilising the pre-researched and prepared background document, and covering those potential projects that had not been covered by presenters thus far. This document is the first part of this booklet. This also included an indication of which resources could be re-entered into the in/formal economy. These covered, broadly, 'waste' that is currently being dumped; and the free resources for the generation of Renewable Energy. There was time for questions and answers after each presentation.

After lunch, the group was split into two, and were requested to discuss what had been presented, and to consider projects for possible implementation; possible locations; support required; a development of the way forward where possible, to identify lead people and to report back on same.

This was duly done, and outcomes were as follows:

- Aquaculture
- Biodiesel production – from algae
- Glass re-manufacturing
- Ocean Current energy
- Paper pulp manufacturing
- Products from Tyres
- Sanitation
- Solar Energy
- Sustainable development hub
- Urban Agriculture
- Woodwaste

(Plastic wood and grinding of plastic– these projects were de-selected, as people being exposed to harmful chemicals goes against the IZWA charter.)

The above was shared and discussed briefly in plenary, and the way forward was agreed upon, which included writing up the outcomes as short proposals, for kind attention DBSA (and later other funders for any that DBSA may choose not to engage with), and to be shared with all participants, and a wider audience, so that others not privileged to be at the workshop may also choose to pick up on some projects. Copyleft will apply on all such documentation.

Certain community leaders indicated their readiness to lead with some projects, and these are identified in the proposals below. IZWA has also decided to lead with some projects.

Projects.

Given that a specifically required outcome for the workshop was for actual projects, as opposed to being just another talk shop, the workshop clearly showed that the demand for such projects outstrips supply. All projects were generally well received, with all community groups wishing to be involved in at least one project. The range and spread of potential projects indicates that the approach was worthwhile.

General points.

It is accepted by IZWA that all projects will share the following in common:

i) The aim is to create sustainable livelihoods for people, particularly the unemployed and under-employed, of historically disadvantaged groups, resulting in an improved quality of life.

ii) In the case of Renewable Energy projects, the access to safe, clean and sustainable energy will also assist in the above mentioned aim, some directly (small wind turbines, mini-scale domestic water heaters from waste;) and other for the longer term energy security of the country (ocean current, solar thermal, etc.), while building skills and creating work in the process for South Africans.

iii) That all projects will contain an element of capacity building, as well as empowerment of PDI's, particularly around knowledge and skills, and financially.

iv) All projects will be documented, and will be made available upon request, initially through municipal and NGO networks, so that others may benefit from the work done.

v) All research projects will support the economic development direction of the City and/or country.

vi) All research information will be published, and then made freely available to all.

vii) All project participants will make themselves available to train others in the same field as and when necessary, given capacity, and non-disruption of their commercial activities, which will enhance the spread and success of similar initiatives. This is called "skillshare", an IZWA internal concept.

viii) The projects listed below are meant to be indicative – more detailed proposals can be developed and made available if required upon request. Please note that IZWA has not had the capacity to carry out market feasibilities formally, however, it appears that all projects suggested have the potential to be financially, socially and environmentally viable.

ix) Questions for information and clarity are more than welcomed.

x) All project budgets below are solid estimates. It I unlikely that the final proposal figures would vary greatly from those below, except where indicated as requiring further research, especially for markets for products. More details of any and all projects can be called for and made available if required.

xi) All projects will be carried out in partnership with other key stakeholders – the City, and/or academia and/or community structures, to ensure a spread of capacity and empowerment.

xii) As the intent is to produce products for mostly local and localised consumption, the viability of these projects grows according to both local resource availability, as well as local market development. This is further confirmed by the mostly skills required, many available within the ranks of the unemployed. Given the retrenchments in the traditional manufacturing fields in eThekwini, the availability of suitably skilled personnel appears not to be a problem. This applies to all projects.

Projects that IZWA would be interested in leading with:

Paper Pulp product manufacturing

The presenter from UKZN - a research fellow of the Papermaking Association of SA - confirmed IZWA's belief that it is indeed viable to develop small scale manufacturing enterprises based on adding value to waste paper. The technology for a small scale re-pulper and de-watering device has been confirmed, and the small scale press (that would use moulds) is being finalised at this time.

A range of packaging, promotional products (e.g. conference folders)toys, etc. are envisaged for this project.

To help innure the enterprise from potential market shocks, as well as to take advantage of the recent (and growing) increases in the price of plastic packaging, together with the increased demand for environmentally friendly packaging, it has been decided to support the application of "economies of scope", rather than simply economies of scale, as this will underpin the financial viability of the enterprises.

The intent is that one small project be established early in the new year, in partnership with UKZN, so that the pilot is supported by the relevant technical expertise, while at the same time, building the capacity of students. The process will be documented, piloted, and then "rubber stamped" across the City and country as and when funds and enthusiasm allow. It is not IZWA's intention to own any other than the first project, which will itself be handed over to a community.

Products that appear to have a sustainable local market include:
Packaging – Hamburger clamshell; Hot Dog clamshell; Egg cartons – 6's and 12's; Mushroom punnets
Toys - Building blocks (3 sizes)
Building materials: Roof tiles (reinforced); Ceiling boards, ceiling insulation; bricks; geyser blankets (to support bicycle trailer business)

The budget for Applied projects estimates include capital equipment, technical support, overheads and stipends for a 6 month period per business. The pilot, once accepted as successful, can then be duplicated widely.

Phase	**Timeline**	**Outcome**	**Budget Estimate**
Pilot project	First half 2006	Working machines proven, products manufactured and tested. UKZN/IZWA	130 000
Applied project	Second half 2006	Operations set up	242 000 per business
Wider Commercialisation	2007 onwards	Natural growth	none

This project will assist in bridging the gap between the 'two' economies, and will create at least 5 relatively well-paid and sustainable jobs per production plant. Total funding for pilot and 1 such enterprise: R372 000. Thereafter, each business will cost R242 000 inclusive of 6 months support.

Biodiesel from Algae:

Synopsis:

Research made available recently, show that there is great potential for the production of biodiesel in general, given the challenges of peak oil and increases and upward trends in the oil price; global climate chaos; and the reality that any sort of hydrogen economy will find it difficult to setup the infrastructure before the vehicles, and vice versa. It is important to note that energy is a key component of most Millenium Development Goal's. Regardless of the pressure on fossil resources, it is difficult to support further monoculture mode of production of the raw material for biodiesel (mostly food crops), that is based on a water wasteful, and oil and chemical intensive, process, yet is being mooted in some sectors, notably the genetically engineered crop supporters.

The most practical, decentralised and workable project would be the production of biodiesel using an oil-rich algae, which can be grown on currently unutilised resources, namely sewage. Initial calculations show that approximately 90 000 hectares of existing and proven technology sewage ponds will produce sufficient fuel to replace our current fossil fuel liquid requirements. As it is common cause that a variety of energy sources will be the only way to deliver a sustainable future, this is an exciting project. It is well within Zero Waste parameters when a problem (algae bloom in sewage processes) is found to be the solution – albeit a different algae!

Results obtained in the US Dept of Energy funded 18 year "Aquatic Species Program" at the National Renewable Energy Laboratory, demonstrate that it is possible to generate all of the US car vehicle fuel needs[4]

[4] http://www.energybulletin.net/2364.html - www.twig.org.za

with a less than 4 year payback period (not counting the cost of converting all petrol engines to diesel). It is therefore possible in theory to produce enough biodiesel to satisfy SA vehicle fuel demand on less than 90 000 hectares. As an indicator, that would be about the same size as about 18 golf courses! This produces biodiesel at a rate of 400 litres per day per hectare. Another advantage is that the process can be scaled to suit local resource availability. The Zero Waste balance also applies here – where there are more people, there is usually a greater need for energy – and where there are greater numbers of people, we have a larger volume of substrate for algae production.

The technology will have to be optimized for South African conditions. Suitable wastewater's will have to be identified e.g. algal ponds and space implications, growth rates of algae and extraction and purification procedures and human resource implications including technology transfer.

It is intended that limited studies be done in the laboratory in the first phase, so that the calculations and yields can be ascertained, before going into full scale field trials.

Phase	**Timeline**	**Parties**	**Budget Estimate**
Pilot project – desktop work and lab trials	2006	IZWA / Durban Institute of Technology/TWIG	R200 000
Applied research	2006/2007	As above plus ideally City sewerage plant	R200 000
Commercialisation	2007 onwards		R50 000

The following applications of this project are possible:

- Urban pilot decentralised community based processing of sewage and food waste processing: Utilising the ZERI based IFS system to close the loop on food and energy production and waste disposal. (see community projects below)

- Urban pilot at existing waste water treatment works: Many existing sewage treatments plants are plagued with micro algal blooms. This technology represents a useful method of turning a problem to the municipality's advantage. We have already had tacit approval from Michael Toll the operations manager at the Cape flats water treatment facility in Cape Town to experiment with microalgal production on some unused ponds at his sewage works. **Estimated Budget R300 000**
- Urban pilot at an existing algae based waste water treatment works: Existing sewage treatment works such as the plant at Eliot in the Eastern Cape make proactive use of microalgae to clean the water. At present microalgae is considered to be a waste even though analysis of the microalgae species in bloom at the plant show that there is the potential for oil extraction. **Estimated Budget R150 000**
- Rural pilot project using sanitation, food, animal and farm waste on an emerging farmer scale. This would require the installation of a small biogas digestor, algal and fish ponds on a pilot farm in the Eastern. **Estimated Budget including IFS training R200 000**
- Rural project using animal and farm waste from large commercial farm. This will include the installation of a large 80m2 digester: **Estimated Budget including wetland or IFS training: R350 000**

Internal capacity already exists around the production of biodiesel from the oils derived as per above. The question of scale is relatively easily addressed. Funders are urged to analyse the above for areas they wish to support, as it has the potential to solve a large portion of our future liquid fuel needs.

Mini wind turbine manufacturing

IZWA has been fortunate enough in learning of the work of ITDG, who have built such mini-wind turbines successfully in Sri Lanka and Peru. They have been kind enough to have placed the design and manufacturing process in the public domain.

The intent is that one turbine be built, and then, given the design characteristics, a business plan be developed around that product. While the immediate intent is to assist in the availability of safe energy for people not on the formal gird, through no-cost battery charging (in itself a business opportunity), this project is also of a strategic nature, as it will begin the process of developing wind turbine manufacturing skills locally. Currently, all large wind turbines are imported, and it is logical that South Africa develop such capacity sooner rather than later, given that the **accessible** wind generation capacity in the country is 30 GW, nearly a doubling of current generation capacity (45 GW). There also appears to be a mindset that the South is unable to produce such appliances, which have indeed been produced in India, Brazil and China.

Phase	**Timeline**	**Budget Estimate**
Pilot project – manufacture prototype	First quarter 2006	15 000
Pilot Project development	2nd quarter 2006	15 000
Training 4 teams + stipends	3rd quarter 2006	75 000
Setup costs for 4 turbine manufacturing businesses	4th quarter 2006	100 000 per business including technical support, limited marketing and 6 months overheads.

This project will need a level of community research, so that people trained in manufacturing turbines can grow their business – in the meantime, they can generate income from turbines built, by recharging batteries. Linkages will be developed with small scale users, such as yacht manufacturers, 4x4 community, etc. If the manufacturing of turbines is not found to be favourable by funders, then a backup would be to identify 10 persons in poor communities who would be assisted with setting up a battery charging business. This will change the budget lines (above) to R15 000 prototype manufacture and R10 000 per person – supply and erection of turbine and training. It must be noted here that, when it becomes standard practice for two way electricity meters to be installed, the market for this mini-turbine will rocket, as householders and businesses will be able to feed energy into the meter, which will reverse the consumption, thereby minimising their electricity payments every time the wind blows. This is currently NOT allowed by Eskom, but is the case in many forward looking countries. The long term intent is to build South African capacity for locally manufactured larger scale wind turbines in the 1 MW to 2 MW range. That is beyond the scope of this document. The technical support person is Cris Smith.

Solar appliances from waste

This is designed to be a non-commercial enterprise in the traditional sense, and will at best, simply be an exercise in cost-recovery with marginal profits, a survival industry, if you will. It will be located within the 2nd or informal economy, with the key benefit being an improved quality of life for the poorest of the poor. It is

indeed possible that some sort of ongoing income generating enterprises may come out of this, but that is not the main aim at present.

Given the small amount of funding required, it is the intent that some simple solar appliances be manufactured from waste, particularly water heaters and solar cookers, such that the poorest of the poor have some access to warm to hot water and hot food at least a few days per week. This is aimed at people who do not have luxuries such as hot water, including people living informally.

The test appliances will be manufactured at the lowest cost possible; people will be shown how to make these; and materials required for these appliances donated where possible. It is hoped that a few of these appliances will be sold for enough money to cover their costs and some income, enabling more to be made. After some time, an analysis will be made as to the potential and future viability of a business model around such appliances. It is the future intent of the IZWA to research the manufacture of other appliances, such as solar drying of fresh produce; cookers (to rather share skills, as many viable designs are widely available); solar water purification; space heating (heat storage with salts or water); all low cost, and possible medical sterilisation (syringes, etc) and future sterilisation of health care risk waste, currently a problematic waste stream outside of the urban conurbations.[5] However, the IZWA will have to seek separate funding for such activities, as it is believed that the DBSA does not fund such research.

Phase	**Timeline**	**Budget Estimate**
Pilot project – build prototypes	First quarter 2006	25 000
Applied	Second half 2006	50 000 mainly purchase of tools and training
Commercialisation	Second half 2006 onwards	None

20 people will be trained and equipped, 2 each from 10 different communities. Total investment required: R75 000.

Bicycle Trailer Businesses

The ability to move cheaply to and around districts with a small load opens up opportunities for many small businesses. We think that two particular opportunities are applicable as a start.

1) A small-scale water saving business requiring few tools, is a tap washer replacing and tap re-seating enterprise that has the opportunity to save many kilolitres of water for businesses and householders.
2) A second enterprise for the same person could be the installing of an Energy Saving Geyser Blanket, manufactured from waste materials. As hot water appliances like geysers generate a third of all domestic CO2 emissions, this would be both an energy and money saving investment for homeowners and residents. 350 homes draw about 1 MW, usually at peak demand, so this would also help Demand Side Management of energy in SA.

An effective Geyser blanket is made from ceiling insulation and a layer or more of foil faced material, one such material is kraft paper tea sacks, of which currently 700 are thrown away daily by one tea packer in Durban alone. There are potentially many sources of insulation as the heat is not great at the surface of the geyser and even coconut husks can replace the ceiling wool – the most practical and available material

[5] In Costa Rica, the National University won US$133,000 for a solar-powered oven that can produce temperatures of 180–200 degrees Celsius needed to sterilise biological waste in hospitals. The oven protects both environmental and human health because, unlike fuel-based ovens, it does not produce toxins. It is also cheap to maintain and durable — lasting approximately 30 years. The oven can be used on-site, enabling hospitals to make waste biologically inert for safe disposal. This also eliminates risks of transporting waste.

available at no cost is removed carpet underfelt. Over the current lifespan of a geyser is 10-15 years this will save a huge amount of energy and money.

Selected currently unemployed people will be chosen from various communities, especially those within cycling distance of wealthier suburbs; trained; equipped; and assisted with a low level marketing campaign.

Phase	**Timeline**	**Budget Estimate**
Training	First quarter 2006	20 000
Equipping and marketing	Second half 2006	75 000 purchase of bicycles, trailers, tools and marketing

10 people will be fully trained and equipped, and supported with marketing assistance.
Total investment: R95 000

Eco-sanitation awareness campaign in Westville

Given that overconsumption is the key environmental problem, it is logical to target the rich. A program to instil environmental consciousness in residents so that they practice "ZERO WASTE" principles in their homes and surroundings, by identifying areas where current practices are wasteful or could be managed in a more environmentally friendly way. To provide information to residents, in order to increase awareness, about the availability, distribution, and consumption patterns of natural resources both on global and especially local scale, as well as about IZWA and the principles of Zero Waste and its importance. This will encourage residents to apply principles learnt to their own daily practices and to provide suggestions about any measures that can be taken that have not been identified.

This will be through research (mostly existing IZWA information); creation of information media such as posters, flyers, and community radio announcements to invite residents to attend a presentations at community halls, the Civic Centre and schools.

Phase	**Timeline**	**Budget Estimate**
Research and materials production	First quarter 2006	25 000 (80% for materials production)
Public meeting presentations and awareness raising	Second and third quarter 2006	20 000 (10 presentations at R2000 each

A minimum of 10 presentations will be made, and information for ongoing education will remain available for future use, saving such costs in the future. It is anticipated that approximately 10 000 people will be reached at a minimum, with additional positive media coverage almost guranteed.
Alvira Singh is the contact person

Textbook

A textbook on alternative energy, sanitation and renewable technologies was also suggested to be written for use in schools. This would require a more detailed budget research phase, as such costs are relatively unknown by the team, yet is a very worthwhile project.

Projects that would best be housed with tertiary education institutions:

Ocean current electricity generation

This study will assess the preliminary feasibility of establishing electrical Power Generating Stations off the KwaZulu/Natal Coast and will identify their most suitable positions on the sea bed. The Agulhas Current has been targeted and will be mapped to determine its steadiness and accessibility.

If successful, this project could be implemented in the form of a practical generating station off the KZN coast. There should be no impediment to this being repeated along the Southern African coast or any other coast provided that suitable sites providing the necessary current flow exist. Off Southern Africa we have the Agulhas/Mozambique and Benguela currents and they should both be practicable.

Once the capital cost of a plant such as this has been recovered, the electric energy should be able to be generated extremely economically as there would be no fuel costs. Large industries situated near the coast at suitable locations could benefit from this project in that they would eventually be able to have their own source of standby power as a backup to the National Grid or even primary power.

The saving to the environment with generating plants such as this cannot be over emphasized. There would be no burning of fuel therefore there would be no emissions into the atmosphere. As we all know, the "Greenhouse Effect" is upon us and energy sources such as this could significantly reduce it. Furthermore, this source of energy does not carry the baggage that nuclear energy does and is considered "safe". The upside potential of this resource is immense.

A preliminary design of a generating station employing the "TESLA Bladeless Boundary Layer Turbine" will be undertaken. Models will be built and will be tank tested, leading to the possible later manufacture of a pilot plant. An Environmental Impact Assessment will be undertaken.

Phase	**Timeline**	**Budget Estimate**
EIA, literature, test bed	2006	R1 323 000
Sea bed measuring and scale model	2007	R1 200 000
Corrosion testing – site issues	2008	R930 000

Total for 1st 3 years of project R3 453 000

We expect more than one funder to come on board for this project.

Outputs: The goals of this project are to establish:

- Whether the Agulhas Current off the KwaZulu/Natal Coast has suitable sites for the establishment of a generating station
- A feasible method of generating this power
- A suitable method of transmitting this power to the shore.

This will lead to confirmation of the most suitable technology and economic viability of generating sustainable energy in the 8c to 16c range per kWh; parameters for a fully upscaled commercial underwater power station. Please note that the DME allows subsidies towards the costs of such generation capacity, and this project is in line with the eThekwini's municipality 5 year economic development strategy.

Sustainable Development Hub

The main objective is on-going practical education, training and research on the campus for extension to outside communities in urban and rural environments. This will focus on concepts such as Sustainable development and the integration of projects. The concept proposed is to develop a living experiment on campus in the form of a water-based system for environmental study generally but that also allows research into many other aspects of sustainable development such as renewable energy, waste management, health, engineering, economics, and development generally.

This will take place through activities such as Research; Education; Training; Invention; Application; Testing; Monitoring

The advantages of locating the hub on campus are numerous:

- Logistics of travel/transport are minimized for researchers and students
- it will provide a highly visible and close showcase for visitors and staff/students
- it will supply a living experiment for education
- visitors and outside scholars/students can access the facility in community learning exercises
- it can be closely managed and maintained
- it can be easily monitored

A initial budget of R 100 000-00 is estimated in order to prepare the detailed proposal including costing – over three years, it is likely to cost in the order of between R600 000 to R1 000 000.

Projects best housed with community groups:

Urban agriculture, Aquaculture, Manufacturing from shredded tyres

The Inanda Tea Estate was identified as a possible location for a tyre and agricultural project. The target community has a large number of unemployed people and the tyre shredding could offer a quick return by way of making shoes decorated with beadwork. Retaining wall systems were was possible. Together with this at the site, the possibility of demonstrating a small pilot agricultural project featuring an anaerobic digester, aquaculture and bio digesters. This would possibly create a tourism route, as there would be considerable interest generated in the model. This project could be used as an example and taken round the country as a sustainable model. It was suggested that the Sakhumnotho co operative lead with this project, with Mr. Alfred T. Dludla as the contact person.

Phase – Tyre shredding project	**Timeline**	**Budget Estimate**
Resource mapping, market research and equipment identification	First half 2006	125 000
Equipping, training and marketing, with adequate startup support	Second half 2006	850 000

Phase - polyculture	**Timeline**	**Budget Estimate**
Site research, land identification	First half 2006	55 000

and permission, and polyculture design – including aquaculture, digesters, etc.		
Training, equipment, and digester and aquaculture construction	Second half 2006 – first half 2007	350 000

ii) The Adams Mission area was a place where polyculture could be utilised. The integrated farming and waste management project was suggested. Mr Richard Pocock and Thabisile Java were identified as the contact persons

Phase - polyculture	**Timeline**	**Budget Estimate**
Site research, land identification and permission, and polyculture design – including aquaculture, digesters, etc.	First half 2006	25 000 (this can follow a similar design to the previous one, saving repetition)
Training, equipment, and digester and aquaculture construction	Second half 2006 – first half 2007	475 000

Glass aggregate

A glass recycling plant was identified for Umkomaas. Broken glass would be utilized in block mix. The municipality could assist by way of providing a location as well as transport. It was suggested that the Sinethemba Church Support Group run the project, with the contact person for this project being Mr. Zeblon Ngcamu.

Phase	**Timeline**	**Budget Estimate**
Research, costings,	First half 2006	R55 000
Training, equipment,	Second half 2006	Not researched adequately – absolute estimate R350 000

The machines come in a variety of sizes depending on the needs. Some systems will fit in a garage and can handle as few as 15 bottles. There are different models handling up to 20 to 60 tons per hour. Prices vary depending on the size of the systems. The smallest 15-bottle machine, often used by liquor stores and other small establishments costs about US$6,000 and American Pulverizers largest system is around $125,000.

Woodwaste

A supply of raw materials at the level of 130 tons per month has been identified for conversion into products as outlined in the workshop booklet. It was decided that this required further investigation, prior to being submitted as a project.

Grass cutting and river cleanup

It was suggested that Plain Trading cc, which has fund raised and purchased grass cutting and cleanup equipment, be assisted with such projects. This is noted. Mr Sakho Khanyile was the contact person.

Projects NOT presented, but submitted post-workshop by Mangosuthu Technikon.
(presented as supplied)

Optimisation of Wind Energy Systems For Energy Capture From Sparse Wind Regimes

Background to the project
A project that will be looking at the optimisation of wind energy systems for maximum energy capture, especially where the wind regime is sparse or where there is weak turbulence is proposed. There will be an investigation into a possible application of the Fermi-Pasta-Ulam (FPU) postulate to wind energy systems with a sparse wind regime or weak turbulence.

General aims
This project aims at establishing a system whereby useful energy can be captured from the wind field even at very low wind speeds

Initial Risks
Whilst work has been done on the application of the FPU postulate on energy systems, this work has been confined to small-scale systems at a molecular level. This project proposes to investigate the application of the FPU postulate to a large-scale system with significant uncertainties.

Expected Outcomes
Increased reliability of wind energy systems as a source of electrical energy;
Use of small wind turbines producing useful energy at a wider range of wind field conditions; and
Reduction in capital costs for wind energy projects.

Benefits of project
The significance of this investigation is that useable energy can be extracted from the wind field even at very low wind speeds, which would imply that a wind turbine would have increased reliability as a source of electrical energy. Needless to say, this could have far- reaching implications especially in rural communities as it would make it possible to reduce the size of wind turbines, and therefore the initial capital outlay in a wind energy system.

Initial estimates of cost and time
More time will be needed to arrive at somewhat accurate estimates here.

Cost: **R300 000** Time: 2 years

Electricity Generation from Poultry Litter

Background to the project
A closed-loop system is proposed whereby poultry litter, from an integrated poultry-farming unit, is used as a primary energy source to feed a gasifier/generator. The gasifier/generator will use gas from the gasification process to turn a gas turbine that will in turn generate electrical energy. The waste from the process will be a phosphate-rich by-product that can then be used as fertilizer. There is close to zero wastage of all resources and the system is environmentally friendly as the only form of pollution from it could be "odour pollution" which could be easily mitigated.

General aims
The aims of this project are:
To contribute in poverty-alleviation efforts;
To contribute in job-creation efforts;
To transfer technological skills to communities; and
To add to environmental-protection efforts through energy transformation by a carbon-neutral process.

Initial Risks

Whilst the technology underpinning the proposed project has been tested and proven in similar projects abroad, there is always a risk of an inadequate level of readiness from the relevant stakeholders to embrace "new ideas", and to believe in the possibil-ities a project of this nature would bring forth.

Expected Outcomes
Cost-effective electrical energy generation to ease the pressure on the national grid;
Raising of the living standards of the selected communities where this project will be developed;
Raising of the technological skills levels of the selected communities where this project will be developed.

Benefits of project
Easing off of the pressure on the national electricity grid;
Zero-wastage of all the resources employed;
Sustainable development of community-centred projects.

Initial estimates of cost and time
More time will be needed to arrive at somewhat accurate estimates here.

Cost: **R350 000**

Time: 2 years (for the development of project to implementation)

Conclusion:

IZWA is grateful to the DBSA for the co-sponsoring of the workshop. As is clear from the foregoing, the outcomes are probably beyond expectations; however, it is the norm for IZWA to deliver more than promised.

Acknowledgements:

The Institute for Zero Waste in Africa would like to thank the following for making this process possible, and of the high value it patently is. Apologies if we have forgotten anyone.

Ms. Saphira Surina Patel – Development Bank of South Africa
Community representatives in attendance
Research Team at Durban Institute of Technology
Research Team at Mangosuthu Technikon
Iain Kerr and Mike Smith – University of KwaZulu Natal
Nirmala Nair – ZERI
Richard Pocock – Solarworks
Ravi Moodley
Representatives from eThekwini Municipality

- INK Presidential lead project
- Business Support Unit
- Economic Development Unit
- Durban Solid Waste
- DEAT: INK node

Mama Jabu
Dipu
The IZWA team and board of Directors

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"Anyone who believed growth can go on forever in a finite world is either a madman or an economist."

Kenneth Boulding

Concluding Remarks:

A key to all projects is to ensure that a stable and valuable market is available for the manufactured products. The City can indeed be a key purchaser, but will probably not be able to take up 100% of production. It will therefore become necessary to ensure that projects implement economies of scope, not only of scale (i.e. manufacture more than one product, not just large numbers of one product), so that, as markets shift, the project is resilient enough to respond to market conditions, and remain financially viable.

A key problem is that we currently subsidise many of the products that compete with what we would wish to manufacture, so we must ensure that the market research takes this into account, when presenting the business case.

The Zero Waste philosophy works, creating more sustainable livelihoods for our people, with social and environmental benefits for all.

"We look neither East nor West. We face forward." Kwame nKrumah

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“You cannot solve a problem with the same mindset that created it “
Albert Einstein

What is the Institute for Zero Waste in Africa?

Our Mission Statement

Working towards a world without waste through public education and practical application of Zero Waste principles.

Charter Principles

1. Redesign products and methods of production to eliminate waste by mimicking natural processes and developing closed-loops
2. Convert waste to resources for the benefits of local production and the creation of a healthy and sustainable society.
3. Resist incineration and land filling in order to promote innovation in resource conservation and methods of production
4. Collaborate with others with common interests worldwide

Objectives

1. To advance the education of the public by all appropriate communication means and through supporting the elimination of waste and the associated health impacts.
2. To promote and fund appropriate research for the public benefit, including education
3. To promote the effectiveness of other Zero Waste initiatives
4. To promote the principles of waste avoidance and minimisation, re-use, repair, recycling and composting, through sustainable resource management in accordance with best environmental options.

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(Member of the Zero Waste International Alliance)

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