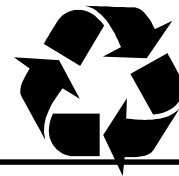


Green Technologies: Sustainable “STUFF”



Unit Overview

In this lesson students will learn about some innovations designed to make industry and consumption more sustainable. They will then be provided an opportunity to apply some of these ideas and principles in the creation of their own simple products. Finally, they will develop a case study relating to a firm producing sustainable products.

Using the Unit

There are three separate activities in this unit. Each can be done independently or all parts can work together as a whole. All activities draw upon the “Bright Ideas in the Quest for Sustainable Stuff” handout (SS1-4). In the first activity, students apply the “Bright Ideas” to make decisions about items cleaned out of an attic. The second activity gets students to creatively apply the principles to develop a product or service. The final activity presents a case study in which a company applies many of the “Bright Ideas” and has students then create their own short case studies putting these principles into practice.

Background for Teachers

What would sustainable production and consumption look like? There are those who argue that only by cutting down on the quantities of “stuff” that we consume will we ever achieve sustainability. However, even if

levels of consumption do decrease, it is unlikely that people will voluntarily do without many of the basic goods and services they have come to rely on in their daily lives. No matter how consumption patterns of the future change, humans will still desire and strive to acquire adequate food, clothing and shelter and will seek some level of comfort, beauty and convenience through the products they consume. The key, from the standpoint of sustainability, is to find ways of satisfying those needs and wants while doing minimal damage to the environment, providing adequate employment and income and preserving the earth’s renewable and non-renewable resources. Many scientists, businesses and academics have been focused on developing practical ways of achieving this goal.

One prominent suggestion is to begin making production processes “closed-loop” instead of linear. This means that materials we now consider waste and throw into the landfill or deposit in the air, soil or water, would instead become “food” for either new production processes or for the soil in the form of non-toxic compost, i.e. “cradle-to-cradle” design. To accomplish this goal, materials must be developed that are fully biodegradable and processes must be established to help in the product’s breakdown.

This promotes greater sustainability in two ways: It cuts down on the exploitation of raw material resources and it decreases the quantity of waste going to landfills as well as environmental pollution from the disposal of toxic substances.

Another idea, a soft-green approach, is that in the future we may stop buying “things”, and instead buy the “services” that those things provide. For example, instead of buying a couch we might purchase the *use* of that

Grade Level: Middle School (6-8)

SOL's: Earth Science 7; Life Science 12;
Computer/Technology 8, 8.4

Skills: problem solving, innovating, cooperative working

Key Terms/Concepts: cradle-to-cradle design, sustainable production and consumption, zero waste, reuse, recycle, renewable resources

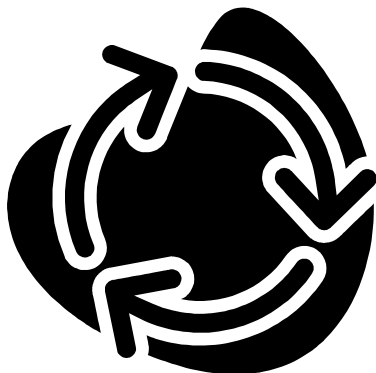
couch for five years, after which time we either buy another five years of use or return it to the producer who will resell the service or rework the couch. More examples of sustainable production and consumption practices will be given in the body of the lesson.

One of the challenges for the future will be in designing these processes so that they are efficient, effective and minimize harmful effects on the environment and society at large. Scientists, engineers, architects, managers, business people and government officials will be needed who can develop new ideas and put them into practice

Students of today can begin preparing themselves for this challenge by learning about current ideas for promoting greater sustainability in production and by developing their own simple products that put some of these principles into effect.

Unit Context

In the context of our Hard vs Soft Green framework (see chapter 2), Soft Green enthusiasts seek the elimination of the very notion of “waste” through cradle-to-cradle (not cradle-to-grave) design of consumer goods. They also advocate thinking outside the box about how industry and commerce function, not just tweaking the complacent system. Conversely, Hard Green enthusiasts see landfills as effective carbon sequestration sinks. They also distrust excessive government regulation on industry and mandates about how local firms and commercial establishments must conduct their business.



Learning Objectives

In this lesson students will:

- Apply sustainable production and consumption principles
- Research real life examples of application of sustainable production principles and develop a case study

Materials

- Copies of Bright Ideas in the Quest for Sustainable Stuff (SS 1-4)
- Copies of Spring Cleaning – Sustainably (SS 5)
- Boxes of raw materials for production of “sustainable stuff”. These may include – blocks of scrap wood, empty cans and bottles, string, wire, glue, egg cartons, scissors, markers, crayons, paper (fresh and used), sand, duct tape, beads, cardboard, etc.
- Copies of Design Tex Case Study (SS 6-7)
- Copies of Sustainable Businesses List (SS 8-9)

Procedure

1. If this topic is completely new to students, consider using portions of Lesson 2 in “The Life History of Stuff” Unit of the Elementary section of this guide. This lesson introduces students to some of the costs and benefits associated with current patterns of production and consumption.

2. Hand out copies of Bright Ideas in the Quest for Sustainable Stuff (SS 1-4). Explain that certain scientists, architects, engineers and business people have been thinking up ways for production and consumption to become more sustainable in the future. This handout represents some of these ideas. Have students read the handout aloud or to themselves.

3. **Class discussion.** Ask what students think of these ideas. Could they work? Can students come up with examples of where these ideas might or might not work? Can students come up with any of their own ideas for making more sustainable stuff?

Activity 1:

1. Tell students that they will now get the chance to apply some of these ideas. Hand out Spring cleaning – Sustainably! (SS 5) and have students work individually or in groups to make decisions about what to do with the products listed on the sheet.

2. When students have written down their ideas, allow them to share them with the class and discuss which choices best reflect the principles put forth in “Bright Ideas” handout.

Activity 2:

1. Now have your students apply one or more of the bright ideas to the creation of a simple product or service. They may work individually or in groups as “Product Design Teams.” Their goal is to come up with a product or “product service” that exhibits one or more of the sustainability characteristics introduced in the handout. This product can be something that they might like to consume or something that they see a need for in the larger society. Students should be encouraged to think creatively and should not be confined to coming up with ideas that strictly adhere to what is possible given today’s technologies. Remind students to incorporate as many sustainable production ideas as possible. They may use the raw materials from the boxes to develop a representation of their product or may simply choose to draw or diagram a representation. They should also create a one or two page description (complete with diagrams and pictures) that briefly explain the following:

- a. The name of your product and its use.
- b. The design of your product and how you produced it.
- c. The materials used in production and whether they are raw materials or recycled.
- d. Packaging.
- e. What happens to your product after the buyer is done using it?
- f. A list of the sustainable production and consumption ideas that were used in your product’s development.

2. When groups have finished developing their design and writing their report they should describe their products to the class in short presentations.



Activity 3:

1. Hand out copies of the [Design Tex Case Study \(SS 6-7\)](#). Have students read and discuss. Identify which bright ideas were put into effect by the Design Tex fabric producers.

2. Tell students that they will produce their own mini case studies of other sustainable products and the companies that produce them, highlighting the ways in which the bright ideas are incorporated in to the company's product or business approach. Hand out the Sustainable Businesses List (SS 8-9). Students may choose to do a case study on one of the industries listed here or may find one of their own. Information should be gathered via Internet, library research or by contacting the company by telephone or in writing to request any information or promotional materials that might be available.

3. Students should find the following information in their case studies:

- a. Name of Company
- b. Type of product profiled
- c. Specific examples of ways in which the product or company exhibit sustainable practices.
- d. Which of the bright ideas are put into practice by the company and how.

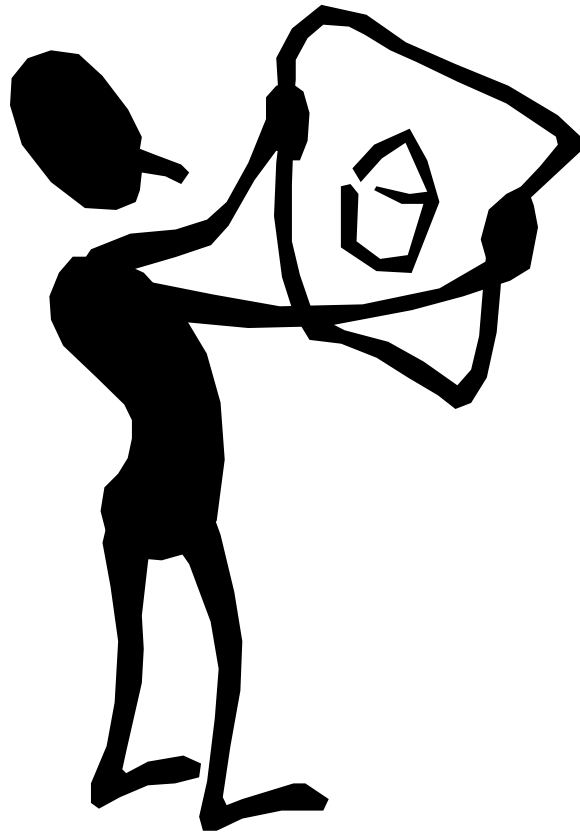
Enrichment

1. Have students develop posters, which display information about the subject of their case studies. Posters may display pictures, explanations of how the product is produced and the ways in which the product or process promotes sustainability.

2. Display posters in a mock "trade show" of sustainable products, services and technologies either on classroom walls or in the hallway. Parents and other classes can be invited to attend the "trade show" and students can stand by their posters to explain or "represent" the products in their case studies.

Resources

Hawken, P., A. Lovins and L.H. Lovins, *Natural Capitalism: Creating the Next Industrial Revolution* (Boston: Little, Brown & Co.), 1999.



REDESIGN IT!

1. RADICAL RESOURCE EFFICIENCY: Making More With Less

We can make natural resources and raw materials for production last longer and go further by redesigning products to use less material and changing production processes so they use less energy and create less waste and pollution. There are already many examples of this in products we see every day.

Aluminum cans weigh 40% less today than they did 10 years ago but do their job just as well. This was achieved by making the body ultra-thin and by making the top and bottom of the can smaller in diameter. Better steel and smarter building designs mean that we can now build offices with one-third the amount of steel that was required 30 years ago. Forty years ago a computer filled a whole room - now it can be as small as a notebook! New hybrid-electric cars have been developed to go three times as far on a gallon of gas as traditional automobiles. Industrial leaders Xerox and Dupont have set environmental goals for themselves of “zero waste” and “waste free products from waste-free facilities” which they are working to achieve over time.

These same ideas can be applied to thousands of other products and methods of production in a continuous process of making more with less.

2. REMANUFACTURING: Reincarnation of Stuff

What if all kinds of products were designed so that they could be sent back to the factory after use where they would be taken apart and remade into new things? In Germany this is already the law for many products. The manufacturer must take responsibility for what happens to the product after it leaves the factory. To keep costs down, manufacturers have redesigned those products for easy disassembly and reuse.

The second largest furniture maker in America has built a special factory to remanufacture furniture into like-new condition. Disposable camera makers like Fuji and Kodak save money by collecting the disposable cases from photo developers, re-loading them with film and selling them again. Xerox, the copy machine company, has designed a photocopier with every part reusable or recyclable. In the long run they expect this design will save them nearly one billion dollars.



In the Quest for Sustainable Stuff

WASTE EQUALS FOOD!

3. BIODEGRADABILITY: Feeding the Earth with our Stuff

Making more materials that break down safely in the environment instead of polluting soil, water and air can help us to cut down on toxic waste, decrease the need for high-tech landfills and potentially add to the fertility of the soil. These products would not be placed in landfills but put on the ground, restoring health and fertility to the soil. This could mean shampoo bottles made from beet extracts that biodegrade in your compost pile, or fabrics that break down in soil safely, without any toxic by-products, or furniture made of lignin, potato peels and certain enzymes. This furniture looks just like normal manufactured furniture except it can be shredded and safely returned to the earth at the end of its life.

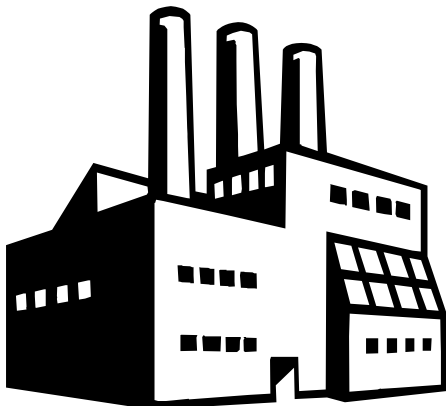
Some companies are already setting examples for how this can be done. DesignTex, a fabric manufacturer, is making a line of completely non-toxic biodegradable fabric. McDonalds is experimenting with replacing its Styrofoam containers with fully biodegradable ones made from starch and limestone. It just so happens that these new containers take less energy to produce and cost no more money to make than the old kind.

4. CLOSED LOOP PRODUCTION: One product's waste is another's raw material

If we can't make a product food for the earth, the next best option is for all by-products of production to become the raw materials for making another product and for the product itself to become "food" for another manufactured product when it reaches the end of its useful life.

In a small town in Denmark called Kalundborg, wastes are exchanged among several companies - a power plant, an oil refinery, a chemical company and a wallboard manufacturer. In each case the recipient uses waste from one of the other companies as a raw material. The refinery sends piped water, after it is used for cooling, to the power plant down the road that also uses it for cooling. The power plant heats the water using waste heat from coal burning to create steam, which is pumped back to the refinery and to a pharmaceutical company. Both use the steam to drive mechanisms in their factories. Another pipeline provides steam heat to homes in the town. The refinery also removes sulfur from waste gases that it sends to a company that produces sulfuric acid. The scrubber from the power plant produces tons of calcium sulfate waste, which is sent to the wallboard company to make gypsum wallboard.

In this way a kind of "industrial ecology" is created which acts something like the food web in the natural world. In nature waste from one part of the system becomes food for something else.



In the Quest for Sustainable Stuff

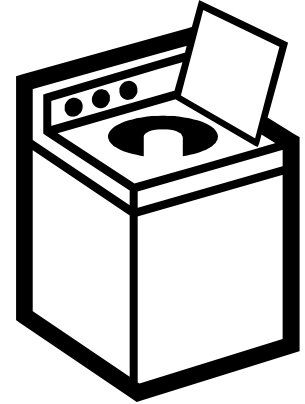
GIVE ME THE SERVICE WITHOUT THE STUFF!

5. SERVICE NOT STUFF: Borrowing the Use not the Object

It's easy to confuse the need for stuff with the need for the services that stuff can provide for us. For example, do we need to *own* a washing machine or do we need a cheap and convenient way to get our clothes clean? Do we need to own cars or do we need quick and easy transportation to places we like to go?

In the future it may make more sense for companies to sell us the services that stuff provides rather than the stuff itself. Companies may sell us the "services" of carpets, furniture, washing machines, televisions and hundreds of other things, for a specified period of time, after which we either renew the service or send the stuff back to the place where we bought it for reuse, remanufacture or recycling.

Some companies are doing this already. The Carrier Corporation sells cool air to its clients while keeping ownership of the equipment that makes the cool air. The Interface Corporation sells the beauty and comfort of its floor coverings rather than selling the carpets themselves. When the customer wants a different carpet, Interface exchanges it and turns the old carpet into raw materials for new ones.



THE R'S:

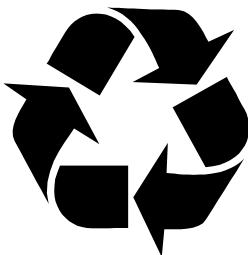
6. REUSE: Trade it Don't Toss It

When we reuse products, instead of throwing them away, we pass them on to new users or find a new use for an old product. Most of us have done this by giving our old clothes to the Goodwill or having a yard sale to allow others to buy the things we no longer want or need.

The Internet is becoming a valuable tool in matching waste materials with people who want to buy them. This is true for manufacturing waste and old building materials as well as stuff from the attic we no longer want.

7. RECYCLING: Raw Materials Can Keep Coming Back

When products cannot be redesigned, remanufactured, repaired or reused, the next best option is to recycle them. Some materials like aluminum cans, glass bottles and computer paper are easy to melt or break down so that they can be used as raw materials for similar new products.



Other materials like tires, plastics, newspapers and insulation are harder to recycle but as a last resort they can be down-cycled: ground down, melted or dissolved so their basic material can be made into products such as filler material, tent pegs and park benches.

In the Quest for Sustainable Stuff

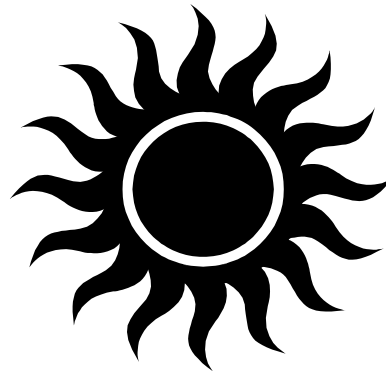
8. RENEWABLE ENERGY AND ENERGY EFFICIENCY: If a Tree Can Do It So Can We

A tree gets all of the energy it needs from a perpetual source – the sun. When a tree uses the sun's energy to grow and produce wood it does not create harmful by-products. Other sources of perpetual energy are wind, water and heat stored deep in the earth.

Industrial production uses huge amounts of energy to produce stuff for us to consume. That energy mostly comes from burning of fossil fuels like oil and coal. These sources of energy are non-renewable and they create pollution and contribute to global warming.

If we want to keep producing and consuming all kinds of stuff we have to find ways of increasing the amount of energy efficiency needed to manufacture and transport goods and also use more energy from perpetual sources. In this way we cut down drastically on the negative impacts of making all kinds of stuff.

For further information on these case studies and many more examples, see Hawken and Lovins, *Natural Capitalism*.



Spring Cleaning - Sustainably!

This year's spring-cleaning has left you with a pile of things you no longer want or need. Your job is to decide what to do with each of the following items. Be as specific as possible. (Try to use as many "Bright Ideas" as you can in making your decisions.)

1. 2 large garbage bags of clothing that no one in the family wants but all are in good condition
2. 1 bag of torn and stained t-shirts
3. 1 box of your grandfather's old baseball cards
4. 1 lamp with a frayed cord and broken plug
5. 1 chipped but beautiful pottery bowl
6. 1 wagon that is missing a wheel
7. 1 large stack of old magazines
8. 1 old wooden rocking chair with a torn seat cushion



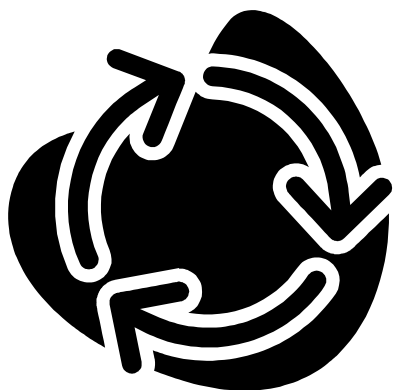
Case Study

Design Tex Fabrics: The William McDonough Collection

A set of upholstery fabrics for office furniture from DesignTex, Inc. of New York City may well set a new standard for sustainable products. DesignTex wanted to go beyond simply eliminating toxic dyes or using recycled fibers. They brought in architect and sustainability expert William McDonough to guide them in the development of a new line of environmentally friendly fabrics.

Many people like the idea of “green products” but are confused by conflicting reports on issues of recycling and pollution. McDonough explains that the essential first step in cleaning up our environment is redesign. “When you look carefully” he says, “you realize that recycling as currently practiced is not the answer. It’s a band-aid, not a cure. We should recycle, but it’s not the first thing we should do. It’s the last. Redesign first, then reduce, reuse and finally recycle, only if there is no alternative.

For the creation of DesignTex’s new line, McDonough’s plan was to redesign the entire manufacturing process, from the source of materials and chemicals used in the manufacture to the safe return of the fabric to the earth. This yields a completely healthy and environmentally sound product that could become non-toxic compost after use.



How Was the Product Created?

The Fibers:

The two fibers used in the fabric are wool and ramie, a plant similar to linen, which acts somewhat like polyester in fabrics. The resulting fabric transports moisture away from the skin, allowing the wearer to remain comfortable when seated on it for long periods of time. The wool comes from free-ranging New Zealand sheep. Working with the sheep farmers to reduce their adverse environmental impacts is an important element of the project, which is pursued by addressing issues such as low-impact grazing and alternatives to the toxic “flea-dips” that sheep typically get. The ramie for this fabric is grown organically in the Philippines.

The Dyes:

The goal was to find dyes that are completely free of any potentially harmful effects for either humans or the environment. The first step was to determine the composition of the dyes to be sure that no toxins were used. This was difficult because most chemical companies that produce dyes are unwilling to share information on the formulas for their products. Ciba Geigy was the only chemical company willing to take on the project. With their cooperation it was possible to select a set of dyes that could be proven to be completely free of toxins and environmentally safe.

Case Study

The Manufacture:

A tiny fabric mill in Switzerland was selected to produce the fabric. Every step of the manufacturing process was examined and improved. The most significant changes involved more efficient dyeing processes and reduction of wastewater. The few chemicals still used in production all had to pass the same rigorous tests as the dyes. The production process was designed so as to minimize energy use and harm to the quality of the water used. Government inspectors determined that the water used in making the fabric was as clean leaving the facility as when it entered.

All waste scrap and trimmings are used to create felt, which is then applied by Swiss strawberry farmers as ground cover for their crops. The felt controls weeds and insulates the soil, replacing the plastic usually used for this purpose. Gradually the felt decomposes and becomes food for worms and microorganisms.

The result of all of this work and redesign is the Climatex Lifecycle (TM) line of fabrics.

McDonough explains, “We are not going to solve [our environmental] problems by making slightly better engines every year, or by reducing the number of toxins in a product. The only way we are going to get there is to redesign our products. All of our products. Completely.”

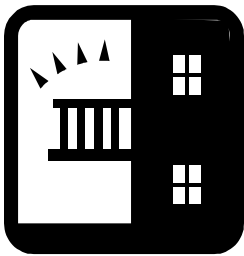


Fact Sheet:

Sustainable Business List

The following companies are making products using one or more of the Bright Ideas for Sustainable Stuff:

Trex Lumber: Decking made from reclaimed and recycled materials. The two main ingredients are waste wood fiber and reclaimed plastics, such as grocery sacks and stretch film.



For information:
Website: www.trex.com
Telephone: 1-800-742-1035 or 1-800-BUY-TREX
Search web for: "Trex Lumber"

Syndesis - Syndecrete: A lightweight cement based material which incorporates natural and recycled materials including metal shavings, plastic, recycled glass and scrap wood. The material can replace virgin wood, stone and petroleum based (plastic) products in the creation of floors, countertops, furniture, patio surfaces, tiles and other items.

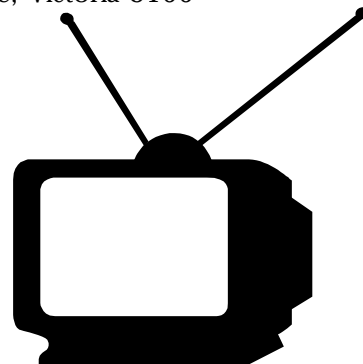
For information:
Website: www.syndesisinc.com
Telephone: 310-829-9932
Address: Syndesis Inc.
2908 Colorado Ave.
Santa Monica, CA 90403-3616

Interface - Solenium Floor covering: A new floor covering made from recycled-content components that come apart at the end of the carpets life for recycling. The company is dedicated to complete restructuring according to sustainable principles.

For information:
Website: www.interfaceinc.com
Telephone: 770-437-6800
Address: Interface, Inc.
Corporate Headquarters
2859 Paces Ferry Road
Suite 2000
Atlanta, GA 36339

Recopol - Furniture: Makes molded furniture which incorporates up to 75% recycled resins and plastics that come from used appliances such as computers, vacuum cleaners, telephones, televisions, washing machines and refrigerators which would otherwise go to the landfill. It creates 50% less green house gasses and uses 80% less energy in its production than similar products made from virgin resin and timber.

For information:
Website: www.wharington.com.au
Address: Wharington International Pty. Ltd.
48-50 Hargreaves Street
Huntingdale, Victoria 3166
Australia



Collins & Aikman: Is the first carpet maker to manufacture new carpet from old in a closed-loop production system. Powerbond is a 100% recyclable carpet that can be reclaimed and either recycled into new carpet or made into other products by the company.

For information:

Website: www.powerbond.com

Telephone: 800-241-4902

Mid-Atlantic address: C&A Floorcoverings, Inc.
Suite 102

301 Southlake Blvd

Richmond, Virginia 23236

Telephone (VA): 804-594-0500

Fuji Xerox- Copiers: Fuji-Xerox Australia has established a remanufacturing center where Xerox machine parts are taken apart, tested, then re-engineered so they are “as good as new.” The remanufacturing processes also use environmentally friendly cleaners such as baking soda and carbon dioxide.

For information:

Website: www.fujixerox.com.au

Address: Fuji Xerox Australia Pty:

101 Waterloo Rd.

North Ryde

NSW 2113

Australia

PrimeBoard: Prime board is a type of particleboard (commonly used in construction) that is made from a combination of agricultural wastes (wheat straw) and a non-toxic adhesive called MDI.

For information:

Website: www.primeboard.com

Telephone: 701-642-1152

Address: PrimeBoard, Inc.

2441 North 15th Street

Wahpeton, ND 58075

Automobiles - Hybrid electric cars

Toyota Prius: Toyota has developed a half gas, half electric powered car that maximizes fuel efficiency and minimizes emissions. The Prius averages 48 mpg and is a “Super Ultra Low Emission Vehicle.”

For information:

Website: www.toyota.com – select *Prius Model*

Telephone: 1-800-GO-TOYOTA

Honda Insight: Honda has also developed a half gas, half electric powered car. The battery is recharged not by “plugging it in” but rather through regenerative braking in which energy from forward momentum is captured during braking.

For information:

Website: www.honda.com – select *Honda Automobiles*, then *Models*, then *Insight*.



NOTES