

A vibrant sunrise scene with the sun low on the horizon, casting a warm glow across a body of water. The sky is filled with colorful clouds in shades of orange, yellow, and blue. In the foreground, the dark silhouette of a forest is visible.

SUN RISE

Your Complete Guide to Sustainable Living

By John Wilson

\$35.00 Canada
\$25.00 U.S

Sun Rise: Your Complete Guide to Sustainable Living

Sun Rise is your complete step-by-step guide to the sustainable living revolution. We are experiencing the end of the fossil fuel age and the return of the age of the sun, the source of sustainable power for all of nature. Sun Rise shows you how we've gotten to this stage, how we can all live a better life in harmony with the natural renewable energy provided by the sun, and how the Wilson family has achieved a natural sustainable lifestyle.

John Wilson is a National Post Design Exchange award-winning builder/owner /producer of the Wilson Natural Home and www.NaturalLifeNetwork.com web site.



**“When it comes to living green you can’t do
much better than the Wilson family.”
– Toronto Star**



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Natural Living: The Wilson Natural Home

A 25-minute documentary video, by the author of *Sun Rise*.

This down-to-earth documentary explains in simple terms, with hands-on demonstrations, how we all can start using solar energy, wind power, breathing walls, straw bale home construction techniques, passive solar design, smart windows, green roofs, and composting – today! You'll meet the experts as they explain how to make *Natural Living* work for you. You'll see it all in action: a wind turbine, solar panels, the hydro meter running backwards, grass on the roof, and a furnace the size of a bread box that doesn't burn fossil fuels.

Here is a documentary that breaks down many of the barriers to a sustainable lifestyle, and shows what is attainable today. I truly believe that, as in my own case, once people see what others have achieved, they will be inspired and emboldened to make the changes suggested in this documentary.



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Your Complete Guide to Sustainable Living

By John Wilson

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D e d i c a t i o n

For my children Claire and Ian Wilson with all my love.

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This book could not have been completed without the love and support of my partner in life Leigh Geraghty. Leigh has supported both this book *Sun Rise* and the lifestyle that we've come to call *Natural Living* adding immeasurably to the wonderful successes we've achieved. The love we share has been the light that shines when everything else seems like darkness.

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*Dazzling and tremendous how quick the sun-rise would kill me,
If I could not now and always send sun-rise out of me.
We also ascend dazzling and tremendous as the sun,
We found our own O my soul in the calm and cool of the day break.*
Walt Whitman, *Leaves of Gras, Song of Myself*

INTRODUCTION

The time has come for us all to reach within ourselves in order to transform our relationship with the natural world that sustains us. We all know there are problems. What is not always clear is what we can do about these problems.

The dawn of a new era is upon us. *Sun Rise* is about the life saving opportunity we have to rediscover a natural holistic approach to creating a sustainable world. We are at a point where most of us want to change. We can and must change our collective culture. We need to listen to what science is now telling us. The answers are in our nature.

Upheavals of war and terrorism rage continuously around the world. Nuclear weapons proliferation seems unstoppable. We are all complicit in our inability to stamp out the poverty and starvation that kills billions of people. Economic uncertainty for the majority grows. Teenage suicide rates are increasing. The gap between rich and poor is increasing. Horrific acts of terrorism and more violence occur every day. People everywhere are looking for meaning to their lives in the face of uncertainty, fear, desperation, uncaring, selfishness and tragedy. As if all this were not enough, and also as a result, we also must face perhaps the greatest challenge of



our times in the struggle to stop the destruction of the natural world upon which all life depends.

As horrifying upheavals transform our lives, and those of our brethren around the world, we have some choices to make. We can accept the insanity of war, nuclear/coal/oil based energy, the pollution of cars/trucks/planes, the unknown dangers of genetic modification of our foods (we even have the gall to think we can patent life for profit), the social degradation of reality television, pre-emptive military attacks, fear mongering and our obsession with money. Or we can choose a different path. Being sustainable is a choice that you make. If you are not prepared to accept the problems all around you or don't believe that sensible solutions exist then you are not prepared for sustainability. If and when you do accept that a better way of living is possible then this book can help you along the path of sustainability.

Nature is infinitely complex, varied, and yet balanced. It is nature that inspires awe, creates beauty, and provides connections to the rest of life. It is in nature that we find the answers to the most complex questions and problems. What is the purpose of life and it's creative powers? Extraordinary people recognize the connections between humanity and nature. Ultimately it seems to me that we must try to live each day, each moment, with this inspired understanding of the fact that "we are the environment". We are nature, but we have choices. By understanding this we will find the meaning of our lives, and provide that opportunity to our children.

We can generate the energy we need without using nuclear or fossil fuels. The food we eat can be healthier for us without costly genetic modification, damaging pesticides, herbicides and fossil fuel based fertilizers. Cities and towns do exist that provide easy walking access to all the needs of daily life. There are cars and trains powered by fuels that don't pollute the environment. There are jobs in a new sustainable economy that support the restoration rather than the destruction of nature. Emerging economic giants like China, Russia and India can take a different sustainable path. We all can and must find this wonderful path.

Sun Rise is about making choices that change everything. Take a look at nature all around you. With each moment of your life make the choices that nature shows you make the most sense. Take notice of everything in the natural world around you with a renewed interest. Become inspired by seeing through children's eyes again. Find people like yourself who know that things have to change. Make a plan. Then live each day with the purpose of making your life harmonize with nature.

The goal of this book is to provide you with a guide to creating a lifestyle that is fulfilling, in harmony with nature, sustainable and meaningful. The first section builds a foundation based on the need for a continuing quest for a deeper understanding of our current situation, the problems and solutions, so that we can make wise choices. Upon this foundation, in the second section, I relate a prescriptive framework for a step-by-step approach to a sustainable lifestyle that I call *Natural Living*. Finally, I will paint a picture of how my family and I have achieved a sustainable lifestyle that works today.

You can live more comfortably, be more financially secure for the long term, improve your health, get all your power requirements from the sun, transform waste into food for plants and appreciate life more than ever. If we can do it then so can you. Join us on this wonderful journey that starts each new day inspired and powered by the *Sun Rise*.

Change

Things happen for a reason
An unknown purpose hides within
Trapped by unjust social norms

Dare to live your dreams
The voice of inner peace and freedom
Against the tides of convention

The infinite potential resides in your heart
A creative force that paints a new dream
Powered by the endless connections at the
core of the sun

The one can change the whole
Be the dream, share the unknown
The spirit will live forever

Make love to the universe
The creative force will be liberated
For all to share equally

SECTION 1: WHERE ARE WE GOING?

*“Truth is by nature self-evident, as soon as you remove the
cobwebs of ignorance that surround it, it shines clear.” –
M.K. Gandhi*

Chapter 1

OUR CURRENT SITUATION

Major upheavals in my own life have helped me see where I am, where I am going and what I need to change. Without a major disturbance the insanity all around us can seem normal. Recent events as well as the general direction of our culture make clear that we need a new vision for the future. For many decades now we in affluent societies have chosen to largely ignore the billions of people slowly dying from starvation every year. When I was nine years old we moved to Haiti, even then referred to as one of the poorest countries on earth. This is the island that Columbus *discovered* as the *new* world. It *was* a beautiful island with lush green mountains, colorful art everywhere, and some of the most beautiful beaches in the world. The squatters in Petionville near where we lived were very poor. They lived precariously on the side of the hill, in makeshift housing. Despite the obvious uncertainty about their future these people were friendly, kind and appeared to me then to be happy.

On the other hand, the markets and streets of Port-au-Prince, the capital city, were sad and filthy. We once saw Jean Claude Duvalier, in his black Mercedes, dropping money out of the window as his car raced away. The poorest of the poor children raced in and fought to keep what little they could grab. Everywhere there were people in rags begging, mothers with babies, small children younger than I was then living in the streets, and horrifically ill people crawling to beg for help. Money for food, please! Things have only gotten much worse for our brothers and sisters in Haiti. The island is a social and environmental tragedy that could have been prevented.

We have been programmed to accept poverty, war, terrorism, selfishness and espionage as legitimate forms of international relations despite how clearly they are a form of mass murder. September 11th saw the horrific attack on the United States directed precisely at their symbols of economic and military domination, while thousands of innocent civilians were murdered. Afghanistan has been devastated by

a war of retribution against Osama Bin Ladin who still roams free. The recent war in Iraq was waged under the pretense of information regarding weapons of mass destruction. Does anybody believe that this was not primarily a war to secure the second largest oil reserves left in the world and to stimulate the weak US economy? Nobody knows how many innocent Iraqis have been murdered. In reality, a world addicted to oil, one controlled by multi-national corporations rationalized this illegal invasion despite the obvious fear mongering. A terrible precedent of terrorist attacks on civilians in the United States on September 11th resulted in pre-emptive attacks by the United States on Iraq in so-called preventative retaliation. Innocent civilians die in the name of an eye for an eye policies. Fear is the darkness that threatens to engulf us everywhere. Only a new *Sun Rise* at a grass roots level can shed light on the answers that are as old as time. The elites in power are blinded by greed, fear, arrogance, rationalizations, selfishness, disconnection, religion and ignorance.

On August 14th, 2003 most of eastern North America experienced a devastating Blackout caused by failures in a highly integrated electricity grid. That day brought the thriving modern city of Toronto where I work to a standstill. For almost an hour nobody knew what had happened. There was talk of terrorist attacks. Should we leave the building? The streets were jammed with traffic as signals had failed, everywhere! Slowly the word got out that all of eastern North America was out. The cause wasn't known. Nobody could predict how long things would be shut down. Generators nobody knew existed were roaring underground in the office towers near where I worked. How long would they last to keep businesses, all the banks, from completely shutting down?

It occurred to me that I had not filled up on gas when I had left my car at the commuter train parking lot that morning. More than likely, I thought to myself, the gas stations would not be able to pump gas without electricity. I began a long walk up the main street along with millions of others like me all over North America. People spontaneously started to make the best of things. People in suits directed traffic. Store and restaurant owners began offering people water for the long walk home, for free...out of the goodness of their hearts, as plainly the hot humid weather posed a grave danger for some. The city came together as though a small community. People began to talk to each other about what was going on...and if you know Toronto, you know this is very unusual. Parks had people sleeping under the stars in large numbers. Life went on, it seemed to me, better than it had with the power on. Even in the following days as power began to be restored office tower owners operated with 30% less energy in order to reduce the burden on systems

being restarted slowly. It turns out our natural instinct is to help each other and make the best of our situation, which in turn proved to me that we have the capacity for something much more inspiring and enduring, not to mention sustainable.

The spread of SARS world-wide overwhelmed even the most advanced health systems, killing thousands of people world-wide. Cod fisheries have been shut down for years and people are starting to wonder if they will ever be able to be reopened. Worldwide fishing stocks have been decimated. Billions of dollars each year are wasted in the subsidy of nuclear power programs that have resulted in costly failure. Complex nuclear plants sit idle, unable to be restarted despite billions of dollars being thrown at them. Corruption in business, especially the financial services and energy conglomerates such as Enron and their financial backers have destroyed the credibility of essentially all companies listed on stock markets, their accountants and their legal advisors. The country that could have the most impact on climate change, the United States, has broken its commitment made in Kyoto, just as more and more evidence makes clear that humanity is to blame for the recent warming trends that are expected to cause increasingly destructive problems globally. These are not just news headlines of events somewhere else. These tragedies occur every day to people like you and me.

When I was seven years old I attended a summer school program in a nearby school. That morning my younger brother Dan and I excitedly walked the dirt pathway to the school. Off in the distance we heard several gunshots, and then some more. We both agreed that, “they must be practicing”. Later that morning my father interrupted our class in the middle of a story. He said, “Boys, come with me, now!” As we left the front hall of the building a terrible fear rose up in my chest. Something was terribly wrong. My father said, “Keep your heads down!” He grabbed our hands tightly and we began a slow motion run across the dirt field that separated our home from the school. It seemed as though we would never reach our back fence. Off in the distance behind us was a massive cloud of black smoke. Machine gun fire echoed in the distance reverberating in the air around us. Just before we reached our fence a bullet hissed through the air toward my Dad’s head.

My family survived the war in Cyprus in 1972 but some families were blown apart. We hid in our home with several other families for weeks. American made Phantom F4 fighter jets ran bombing missions that saw them swoop out of the sky near our home. My six year old brother asked, “Which team is winning?” The Turkish military sent in thousands of paratroopers after the failed attempt to assassinate Archbishop Makarios (by those Cypriots looking to reunite with Greece). As these

men dropped out of the sky, with machine guns, descending slowly all around us my mother raced to the bathroom to vomit in fear. Later, my brother and I tried to pluck bullets out of the wall that had protected us from the strays, as a souvenir before being given orders to prepare to evacuate. The UN told us to leave everything except a single suitcase each. We left everything including the water treatment plant my father had been building. It ended up abandoned, as the two sides: Greek and Turkish could not agree on how to share it now that it sat on the line dividing the most beautiful island in the world, Cyprus.

A critical first step towards achieving a natural lifestyle is to become fully aware of the *need* to change. This need to change may be caused by a significant event such as the birth of your children, September 11th, the Blackout, SARS, war, crisis or the death of someone you love. Some of the powerful forces that can ignite your passion for change include the beauty of nature's creative powers, the sight of nature being destroyed, a horrific headline in the newspaper, the inspiring story of someone who has fought to save the environment, or a spiritual epiphany. Maybe the cost of gas or heating fuels starts to alarm you. Whatever the cause you must retain a clear and concise understanding of the reasons why you must change. Write it down. I am doing this for my kids, so that they will have as many opportunities as I've had, so that they may have cleaner air, so that they may travel the world without fear, knowing that they are one with all other people.

For me *the* event was the birth of my children. At that moment I literally felt my connection to the infinite, to nature and to time. The love I have for my children provides all of the inspiration and incentive I need. I knew I had to find a way to design a lifestyle that would nurture my children's creative potential while providing a model for living that, if adopted by a large enough portion of the world's population, would ensure a safe, healthy and sustainable world for their future. I think many of us have this deep-rooted desire to make the world a better place. Sadly, our cynicism, perhaps rooted in fear, fear of failure, fears placed in our minds to mollify us and help us accept things as they are, so that we become good consumers, make our natural instincts hard to access. The fact is we can and must change the world. We *can* make living sustainable.

Signs of Change

There is much to be optimistic about. All around we see, hear and read stories that show how creatively people everywhere are fighting the injustices of poverty, the

insanity of war and the terrible destruction of nature. Some farmers are converting to organic methods, that are sustainable and earning larger profits in the process. New and old farming practices are proving that increased harvests are possible without inorganic fertilizers, pesticides and herbicides. Young entrepreneurs are creating businesses that sustain nature by selling hemp or organic cotton clothing products. New books come out almost every day full of ideas for sustainable living. A few large organizations like the Rocky Mountain Institute are powerfully inspiring corporations and government towards sustainable policies and practices. Many governments are starting to support the Kyoto Protocol designed to reduce humanity's impact on climate change. We all can find inspiration in these and the following specific examples of change that I have observed:

- ⚙ Retailers like Gaiam Real Goods which have created complete large-scale show rooms like the Solar Living Center in Hopland California, full of inspiring working examples and products for living naturally and sustainably by the power of the sun (see www.realgoods.com);
- ⚙ Toyota Motor Corporation has created the *Motor Trend* magazine award-winning Prius hybrid that reduces pollution by 90% while doubling the fuel economy all in a comfortable, affordable, competitive and high quality product (we bought one this year and I can tell you from first hand experience that this is the future of all cars and trucks);
- ⚙ Commercial carpet makers like Milliken, Collins & Aikman, and Interface are creating products that are sold as a service, while the company retains ownership of the product, so that when the time comes to change the floor, when it wears out, the companies fully recycle the old products, reusing them in the new products. (*Sustainable Planet*);
- ⚙ BASF has created fiber that is able to be recycled into a higher quality product, a process called up-cycling, in addition to having none of the toxic materials in many current fibers (*Sustainable Planet*);
- ⚙ DesignTex has created upholstery that is biodegradable so that it can be put in a composting unit in order to return naturally to the cycles of life, with the unintended but perhaps not surprising, additional benefit of producing effluent composed primarily of clean water during the manufacture process (*Sustainable Planet*);

- ⚙ Herman Miller, a furniture manufacturer created a new 295,000 square foot factory designed to be restorative to the local environment, to the extent that they now call it “the greenhouse” and have seen increases in productivity approaching 25%, not to mention extremely high levels of employee loyalty (*Sustainable Planet*);
- ⚙ Ford Motor Company is planning on building one of the largest and most ambitious car manufacturing plants, on the site of one of their own contaminated sites, at a cost of more than \$2 billion over the next twenty years, the main building is to be covered by a living green roof that will be about 500,000 square feet; with this type of natural cooling, air filtering and water management systems overall costs will be reduced by up to \$35 million on storm water management systems alone. (*Sustainable Planet*) Some of the innovations Ford says will be used include:
 - The world's largest ecologically inspired living roof—about 500,000 square feet—that will dramatically affect the Rouge area watershed by holding several inches of rainfall
 - Phytoremediation—the use of natural plants throughout the grounds to rid soil of contaminants
 - Swales—shallow green ditches seeded with indigenous plants that will improve storm-water management
 - Porous paving that filters water through retention beds with two to three feet of compacted stones, helping manage storm-water runoff
 - Trellises for flowering vines and other plants to shade and help cool the Rouge Office building and the new assembly plant
 - Renewable energy sources such as solar cells and fuel cells
 - Planting of more than 1,500 trees and thousands of other types of foliage to attract songbirds and create habitats;
- ⚙ The award-winning Toronto Healthy House in downtown Toronto, Canada, built on an in-fill lot, complete with passive solar heating, high insulation values, renewable construction materials, biological sewage treatment systems, rain water collection, photo voltaic solar power, solar water heating and much more;

- ⚙ The first large wind turbine has been constructed in an urban area in North American in downtown Toronto's Exhibition Place right on lake Ontario, proving to be a beautiful and practical, sustainable addition to our skyline.
- ⚙ Documentary series like "The Sacred Balance" by David Suzuki and Amanda MacConnel, which inspire the needed connections to nature that we all must make;
- ⚙ The book *Earth From Above* by Arthus Bertrand that gives a new perspective on our wonderful world, both in photographs and profound words from some of the world's most respected experts on sustainability;
- ⚙ Canada signed the Kyoto Protocol;
- ⚙ Russia agrees to sign the Kyoto Protocol in 2004 guaranteeing this ten year effort will be implemented world-wide;
- ⚙ Pesticides and herbicides are being banned by municipal government in many urban and rural areas;

These "environmental" pioneers have shown me the possibilities and advantages of *Natural Living*. The incredible advances made on a global level by visionaries grow every year. The large-scale development of more sustainable communities has established a trend that, without exception, has proven advantageous. Many examples now exist, and the list grows larger each year:

- ⚙ Davis, California: In the early 70's a builder-designer built Village Homes, a 60 acre community of initially 240 passive solar homes with a community center and swimming pool, interlaced with walking paths among communal gardens and orchards. This development created what is now often referred to as the best community in the United States. (*Who Owns the Sun?*, pg. 39) The driving forces for this community were mixed housing types, narrow streets, greenbelts with fruit trees, agricultural zones, natural surface drainage, solar orientation, and abundant open space. The result has been a dearly loved neighborhood, a delightful ambience, lower utility and food costs, strong community spirit, and high resale values that significantly exceed those of conventional communities. Perhaps the vision of *Natural Living* is closer to being realized than we may have thought.

"This is one of the most astonishing places I've ever come across: it has a population of 40,000

(which they're keen to restrict to no more than 50,000), with 40,000 bicycles and just 900 cars. There are 70 kilometers of bike lanes. Energy saving is given the highest priority; strict building standards are enforced; thousands of trees have been planted to discourage people from installing air conditioning, and they even hang out their washing in their back yards, which for Americans is unheard of. They are aiming to derive half their energy sources from the sun by the end of the century." (*Where on Earth are we Going?*, pg. 107)

- ⚙ Cerro Gordo, Oregon: A community being built as a "prototype symbiotic community" for up to 2,500 people on 1,200 acres near Eugene Oregon. The community is designed to support the local residents without the need for cars for local transportation. The central village provides all of the necessities and local ecological businesses provide work.
- ⚙ Curitiba, in Brazil: The Mayor of Curitiba, Jaime Lerner led the city to become a world leader in recycling, public transit, ecological restoration, and green industry. The main elements of the plan included the frugal use of resources, new technologies, reuse of used materials, design that eliminates toxicity and works with nature. The scale of solutions matches that of the problems, and the continuous flow of value and service rewards everyone involved in ever-improving efficiency. As a result, 99% of the residents say they wouldn't want to live anywhere else.
- ⚙ Kerala, India: This community has proven what can be achieved through the efficient use of resources: high life expectancy of 72 years, high level of education at 93% high school enrolment, low levels of economic growth, high quality of life for more than 28 million people, with minimal impact on the earth.
- ⚙ Amersfoort-Nieuwland, Netherlands: The project consists of the installation of more than 12,000 m² of solar panels on 500 houses and a number of public utility buildings. It is expected that these panels will be capable of generating 1,000,000 kWh annually, which is equivalent to the average electricity consumption of more than 300 households. It is the world's largest solar power energy project in a residential area.

- ⚙ Kalundborg, Denmark: This area is a world - leading example of a highly integrated ecosystem of industrial production processing plants integrated into the local community. The closed loop flows incorporated in this community diverts what was historically waste heading for land fills into useful fuels or resources for other processes, incorporating an electric power plant, an oil refinery, a pharmaceutical plant, a wallboard factory, a sulfuric acid producer, cement manufacturers, local agriculture and aquaculture, and nearby houses.
- ⚙ Freiberg, Germany: The solar capital of Europe provides many examples of communities, houses and commercial buildings with extensive use of solar power and sustainable building practices.
- ⚙ EcoVillage at Ithaca, New York: The design of the houses incorporates triple glazed windows from a Manitoba, Canada company. The essential nature of the home design includes the incorporation of solar orientation and passive solar design. The heating system is a shared central gas fired boiler system, which is very efficient. Currently 58 people live in this co-operative community. The land and buildings are not owned individually. Instead each member of the community owns a percentage. Meals are regularly shared at the local community center. The second phase of development is now under construction.
- ⚙ Battery Park Village, New York: condominiums that include solar panels in the siding, water saving practices and other conservation measures.

At a societal level, we have made advances that have begun to address many of the, problems of pollution, waste, and deforestation, loss of biological diversity, population growth and even fossil fuel usage:

- ⚙ Large industrial cities like London England have improved their air quality over the last hundred years through vastly improved pollution controls.
- ⚙ Recycling programs for plastic, glass, paper and metals have become well established in North America, Europe and throughout the world.
- ⚙ Many water systems in North America and Europe are recovering from massive pollution levels that killed most life forms, as occurred in the Great Lakes area near where I live.
- ⚙ Forest companies do, for the most part plant trees after deforestation, and some old growth forest areas have been saved from destruction.

- ⚙ Some animal species have recovered from near extinction, although many have not and many more remain highly endangered.
- ⚙ Population growth rates have been significantly reduced in some parts of the world through improved education levels.
- ⚙ The use of fossil fuels for transportation and power generation has significantly improved in efficiency and the ability to clean exhaust of large amounts of pollution.

> *EcoVillage at Ithaca New York.*



- ⚙ Major European cities like Geneva and Bonn have implemented municipal cogeneration power systems that utilize the 70% of additional heat energy (from coal, oil, gas and nuclear power plants) that we in North America currently throw away as waste, and reuse it for district heating.

Progress towards a halt to the destruction of nature has been achieved by many long time fighters including Rachel Carson, Helen Caldicott, Ralph Nader, Al Gore, David Suzuki, Paul Hawken, Bob Hunter, Sierra Club, Green Peace, Rocky Mountain Institute, World Wildlife Fund, just to name a few. Unfortunately we are still very far from creating a sustainable world. Our non-renewable resources will be depleted, and our decisions today, or lack of them, will have serious impact on our children, and on future generations. I think you'll agree that these great strides in the right direction are an inspiration. However, we have much work to do since this is just the beginning. There is much more that can and must be done. The process of *Natural Living* is based on the inspiration of these great achievements.

These people and organizations have clearly seen the links between our actions and their results. Do you make these connections?

- ⚙ Nuclear and fossil fuel power plants provide vast amounts of energy at a very low cost through massive subsidies; in North America most power plants waste 70% of the energy transformed (largely as heat and transmission losses, not to mention pollution)
- ⚙ Cars, trucks, trains, and planes can rapidly transport us anywhere in the world; this contributes massively to increasing pollution levels everywhere that in turn kills people by the millions much like second hand smoke from cigarettes (not to mention all of the horrific deaths in accidents)
- ⚙ Scientific research continuously seeks to understand our universe resulting in life saving medical breakthroughs; viruses and bacterial infections now pose a great risk of annihilating humanity on a massive scale as SARS has warned us
- ⚙ Agricultural advances hold the hope of feeding a rapidly growing world population; genetically modified plants (with unknown consequences in nature where they have surprised their inventors by jumping to non-genetically modified fields) are patented to protect their ability to sustain greater inputs of pesticides that in turn poison nature...and all of us!
- ⚙ New forms of human interaction, innovation and entertainment through television, computers and the internet are deeply affecting culture; *reality*

television, advertising designed to brain wash us, and sexual exploitation have become the intoxicants designed to alleviate our fears, help us ignore problems, program us to become slaves to wanting more and ensure we remain disconnected from nature

- ⚙ A global system of commerce provides large quantities of capital for this transformation process; greed of the few with money is making things worse for the majority who live with fear, hunger and slave like labor conditions

What we have been programmed to think of as *advances*, have also resulted in a great deal of destruction, poverty, and premature deaths. You have to ask yourself are these the changes we really want or need? Do we have a choice? What will be the longer-term consequences?

Sustainability Revolution

In 1979 there was a “garage” sale at the school I attended. Everyone donated things that were of some value as a fundraiser for extra-curricular activities. On this occasion I found a small plastic device that had a touch -pad keyboard. It was called a Timex 1000 personal computer. I can’t remember how much it cost but I doubt I would have had more than about twenty dollars. To my amazement I was able to plug it in to our TV and create programs that displayed and calculated. Connecting a cassette recorder allowed me to save the programs I created. Within a few weeks I was able to create games and would one day develop a bowling simulation game for a school project.

By the time I reached University it was possible to buy a “modem” that allowed me to use a telephone line to access the school’s central computer system. There was even something called “e-mail”. Eventually, over the last ten years the network of University computers, called the Internet, has evolved into the world wide Internet we all take for granted. Amazingly, more and more, every bit of information we could ever require is available instantly, anywhere in the world. In just over twenty years the information revolution has changed the way the world works. My entire working life has been based on jobs that would not have existed without the personal computer revolution.

What is point of all this computer revolution stuff? Well, the opportunities exist now for a sustainability revolution composed of conservation first, then personal distributed renewable power systems, sophisticated hybrid transportation systems

that are computer controlled, smart building systems with integrated power management and generation capabilities and eventually eco-cities that are networks of all of our best ideas naturally, holistically and systematically integrated. Like the personal computer revolution the technology, price and size reductions, and proof-of-concepts systems have proven themselves. With mass production and mass distribution of these ideas, a wholesale change in the energy technology of society **is** possible. Change towards sustainability is as inevitable as the computer revolution. When something makes as much sense, provides so much value, while being so easily distributed it is able to overcome the centralized, primitive systems of the past. Sustainability appears to be inevitable on this basis. Let this be your manual to the sustainability revolution. The bigger issue is cultural. Can we put the values of sustainability first again?

Chapter 2

A BRIEF HISTORY OF SUSTAINABLE LIVING

Being sustainable is nothing new. It is built into our genetic code. According to the theories of Darwin, we are here precisely because by design, by luck, and by natural selection we are survivors. All of what we need to know to be sustainable already exists and has been proven workable if not currently then in the not so distant past. The tools and knowledge are out there although we should be aware that some are disappearing or being forgotten.

Around 20,000 years ago our ancestors began to use tools. Tools such as rocks formed for cutting, grinding and chopping, not to mention hunting and killing, enabled us as a species to become as dominant and adaptable as any species yet evolved. Our proportionally larger brains have allowed us to extend this ability into the realms of social interaction, organization for the purposes of building communities, and most recently to explore outer space. We've even co-operated to build a space station, housing designed for the inhospitable territory we call outer space. To be sure even here we've brought our technologies of sustainability, including that remarkable device called the solar panel.

The tools we need to live sustainably were discovered and refined long ago. Better integration, production scale and awareness are the primary remaining hurdles that drop daily. Sometimes our difficulty lies in rediscovering the brilliance of our ancient sustainable ways. Of course we've made as many mistakes, if not more, in the past. To a large degree that is part of the value. Time allows for the problem solving process on a vast scale. Trial and error are a natural proven technique for solving problems. Much of what we need to know has long ago been through this process.

On the other hand we can also use our failures of the past in order to fashion a better path for the future. Ancient cultures, it would appear, have come and gone in part due to unsustainable agricultural practices or environmental destruction.

Paintings of our early ancestors have been found in caves that served in some cases as shelter. The ancient Egyptians worshiped the sun and created great tombs including the pyramids, aligned with the heavens, to immortalize themselves. Anasazi, the ancient Navajos, designed and created communities that were sacred in design; that design took advantage of passive solar techniques, perhaps beyond our own current understanding of these concepts. Some Anasazi sites, for instance, demonstrate a deep understanding of changing natural solar phenomenon. Buildings and agriculture took advantage of the changing solar access through summer and winter. The buildings and community were designed in radial patterns around the movement of the sun and other objects in the sky as well as the seasons. The construction of limiting boundaries were key to the design of pueblo communities. Encompassing community requirements within limited and bounded structures reflects an understanding of limits within nature. Rooms to the north were often for storage as in the sustainable design of the Wilson home to be detailed later. Living areas were more often found on the south sides and upper levels. The southern orientation was well designed to take advantage of passive solar techniques combined with the thermal mass provided by adobe wall construction.

Solar History

Ancient civilizations were well aware of the changing position of the sun and discovered many ways to use it. Socrates talked of these concepts in ancient times. For thousands of years, African, Mediterranean, Asian, and other cultures used the sun to dry clothes and animal skins, preserve meat, dry crops, and evaporate seawater to produce salt. Where this knowledge came from is unknown. Presumably trial and error, experimentation, and many millennia of observation combined to provide communities and groups with an oral tradition full of these ideas. Cultures often build these into the myths, songs and stories they tell from generation to generation. Our own culture has given us one of my favorites...the story of the three little pigs, that impact our way of thinking in a very broad way.

Around 500 BC a shortage of local firewood led the ancient Greeks to use the changing angle of the Sun's rays to heat their homes. Famous Greek philosophers, such as Socrates and Aristotle, advised city planners to position buildings so that

sunlight entered them in winter, but not in summer. Heavy building materials stored the solar energy let in during the day. Window shutters were closed at night to retain the heat inside. Buildings were also clustered together to provide shelter from cold winds. Six hundred years later, the Romans added to the design of solar buildings. They faced transparent mica windows towards the Sun, and used heavy, dark-colored floors to absorb and store heat for release at night. The Romans were also the first civilization to use greenhouses to grow vegetables and other plants.

In the 18th century, the Swiss scientist, Horace Benedict de Saussure, built the first solar water heating collector. It was simply a wooden box with a glass top and a black base. By trapping solar energy, this collector reached a temperature of 88° Celsius.

In 1774, the French scientist Lavoisier focused sunlight through a series of high powered lenses to produce heat. Also in France, in 1878, a dish-shaped mirror was used to focus solar energy onto a steam boiler which powered a printing press. At about the same time, in Chile, a solar distilling operation produced over 20,000 liters of fresh water a day from salt water.

(Source: <http://www.earth.uni.edu/EECP/elem/mod3.html>, History of Solar Energy)

Timeline of Solar Power

- ⚙ The sun has existed for at least four billion years and is the oldest and most efficient form of renewable energy! For most of human history we have relied exclusively on this renewable and sustainable form of energy.
- ⚙ 400 BC: Socrates builds a solar house using passive solar design.
- ⚙ Ancient Native American tribes like the Anasazi build their homes within massive rock cliffs facing southwest in order to capture warmth and energy from the sun.
- ⚙ In 1767, Swiss scientist Horace de Saussure builds the first solar collector. John Herschel later uses this solar collector.
- ⚙ In the 1830s, John Herschel, a British astronomer, uses a solar collector box to cook food while exploring in Africa.
- ⚙ In 1839, a French physicist named Edmund Becquerel observes the photovoltaic effect in his laboratory. This effect will lead the use of solar photovoltaic panels for space exploration.

- ⚙ In 1891, Clarence Kemp, an inventor from Baltimore, Maryland, patents the first commercial solar water heater.
- ⚙ In 1908, William J. Bailey of the Carnegie Steel Company invents an insulated solar collector with copper coils. Bailey sold 4,000 units by the end of World War One.
- ⚙ Due to copper rationing during the Second World War, the solar water heating market plummets.
- ⚙ The photovoltaic, or PV cell, is discovered in 1954 by Bell telephone researchers. During the 1950s, photovoltaic cells are beginning to be used to power satellites for outer space.
- ⚙ During the 1970s and 1980s, due to the oil price increases, the OPEC oil embargo in 1973, and the Iranian hostage crisis in 1979, interest and research regarding solar energy rises.
- ⚙ During his term as President, Jimmy Carter adds solar heating panels to the White House. They have since been removed.

(Source: <http://www.personal.psu.edu/users/b/j/bjs286/egce/right.html>, Timeline of Solar Power)

Solar Power Today!

- ⚙ In 2000, the United States used 70 trillion Btu of solar energy.
- ⚙ Other countries around the globe have dramatically increased their research, development, and usage of solar energy.
- ⚙ 90% of Cyprus's homes and buildings have solar water heating panels.
- ⚙ More than 20,000 homes worldwide are powered by solar cells!
- ⚙ Japan leads the world in the production and use of photovoltaic solar panels.
- ⚙ Germany generates twenty percent of its electricity using the wind (wind is a form of solar power).

The History of Wind Energy

Wind energy was used as early as 5000 years ago, when it provided the power for mechanical tasks such as pumping water for irrigation, grinding grain, and sailing ships. The first wind machines had cloth sails, and were fixed in one position to face the prevailing wind. In the 1300's, a tailpole was attached to the machine so that the operator could turn the propeller to face winds coming from any direction. This was soon replaced by a fantail, which allowed the propeller to automatically face into the wind.

In the 1800's, wind generators were developed to generate electricity in remote areas. Installed across the Nullabor Plain in Australia, they provided power for radio communication between Eastern and Western states. Many rural homesteads were provided with electricity from wind generators also. By the mid 1900's, large wind generators were linked in with existing electricity supply networks to supplement conventional electricity supplies. Today, large wind machines are being experimented with in the USA. And in the USA and Europe, "wind farms", made up of hundreds of wind generators, feed electricity into existing electricity supply networks. Remote areas too, are turning away from expensive diesel-powered generators to wind power for their electricity.

The largest wind turbine in the world is located in Canada and is rated to produce 4 megawatts of electricity an hour...that is enough to provide power for 1,200 conventional homes. The wind farm has more seventy five wind turbines most rated at 750 kilowatt hours. Total generating capacity is estimated at 57 megawatts of electricity or approximately 17,000 homes. Canada now produces about 370 megawatts using wind power enough to provide power to more than approximately 110,000 conventional homes. Just imagine what the industry can do once the annual \$2 billion in subsidies to fossil/nuclear is redirected towards wind and solar. Each year we could be purchasing and installing about 1,000 wind turbines adding more than 1,000 megawatts every year. When combined with conservation measures that could easily reach at least 50% saving, and combined with solar systems the future could easily look quite clean and green. Finally, just imagine if the costs of pollution, clean-up, risk, construction/refurbishment, decommissioning and health were factored into fossil/nuclear. Clearly there is a better social and economic path.

(Source: <http://www.earth.uni.edu/EECP/clem/mod3.html>, History of Solar Energy)

Other Sustainable Systems

There are so many ancient ideas we can re-learn to make our lifestyles much more comfortable without using fossil fuels. Try finding out more about the following to see how much we really have achieved even in ancient times:

- ⚙ Cooling towers of the Sahara
- ⚙ Nebraska straw bale homes some of which are over a hundred years old and still being lived in
- ⚙ Agriculture of Mayan Indians
- ⚙ Machu Pichu agriculture, site design, and green houses
- ⚙ Adobe houses
- ⚙ The tipi
- ⚙ Igloos
- ⚙ Earthen houses of Africa
- ⚙ Houses on stilts in Malaysia
- ⚙ Wind mills of Holland
- ⚙ Chinese farming practices

This great heritage will become critical to our survival. Now it is time to take a good hard look at the biggest problems we need to solve. We've got the tools. Where do we start? What should be the highest priorities?

Chapter 3

CHANGE?

Change really can create a natural home, village, city, community, country and world. So how do we make these changes? First we need to understand the reasons we need to change. Our best scientists have been ringing the alarm bells louder and louder when it comes to global warming and climate change.

After the birth of my son in 1992 I discovered something that, inconceivably, the mass media had missed. The Union of Concerned scientists had issued a very clear “Warning to Humanity”. As a new father this warning concerned me deeply. This was not your average media hyped crackpot story. These were some of the best and brightest minds in the world.

What follows is a list of the most critical problems we face, according to the Union of Concerned Scientists, whose membership includes most of this century’s Nobel Prize winners for science. The “Warning to Humanity” was signed by one thousand eight hundred of the most prominent and respected scientists in the world in 1992. (See Appendix A for the complete text of the warning). We have been told clearly that the following problems are warning signs of the high impact our current activities are having on our environment. According to these scientists, these problems require that we take action as soon as possible in order to avert a disaster:

- ⊗ The Atmosphere – air pollution, acid rain, ozone depletion and health problems
- ⊗ Water Resources – ground water depletion and water pollution
- ⊗ Oceans – toxic pollution, fish stock depletion and soil erosion
- ⊗ Soil – productive soil loss, degraded vegetative areas and decreasing levels of food production

- ⚙ Forests – tropical rain forests will soon be gone, species that reside in rain forests will become extinct, forest cover available is decreasing, the lungs of the living earth are being destroyed
- ⚙ Living Species – loss of one third of all species by 2100, loss of genetic diversity, potential biological system collapse when combined with global warming
- ⚙ Population – one tenth of the worlds' 6 billion people are starving, one fifth live in terrible poverty; current economic systems cause environmental destruction with world population not expected to level off until 12-14 billion people

These are the symptoms signaling that we need to change. What specifically should be our top priorities when trying to address these problems? The following are the **most** harmful consumer activities, as understood by the Union of Concerned Scientists, and stated by them in the year 2000. We need to find ways to transform, reduce or eliminate these activities if we are to make a significant impact:

1. **Food:** Fruit, vegetable and grain consumption, meat and poultry consumption
2. **Fossil Fuels:** Car and light trucks, home heating, hot water and air conditioning usage, household appliances and lighting usage
3. **Home:** Home construction materials and methods, household water and sewage systems

These are at the heart of most of our lifestyles. We have to change the most common things we do every day. Daunting isn't it? It isn't really. The daunting feeling comes about because we aren't familiar with the answers. They are all out there. How do we find the answers?

We can do this by asking questions such as: What alternatives do I have to these essential parts of my life? The next time I think I need to buy a car or truck, can I eliminate that need? If not, can I minimize the need to use this type of vehicle, or purchase one that minimizes the pollution it will contribute during its lifetime? The potentially higher initial cost will be recuperated over the long term through reduced fuel efficiency and therefore, cost (The Toyota Prius we recently purchased is proving this theory to be true). This same kind of thinking can be applied to the food we eat, the heating and cooling systems in our houses, the appliances and lighting systems we select, the materials and methods used to construct our houses, and finally the way we collect, use and dispose of water. However, it is up to us as

consumers to ask the question, does this house, this car, this appliance, this cucumber and this light conform to the ideas and principles of a sustainable future? If the answer is no, then we need to remind ourselves to find a creative alternative. These alternatives save you money in the long term, are better for your health, and when combined holistically can transform our lifestyles to one that is sustainable and far more satisfying.

In my own life, the need to change seems more and more obvious to me as I open my eyes, ears and thoughts to the natural world and how it affects my children. In my own neighborhood, and in the city of Toronto, near where I live and work, I have found the following:

- ⚙ increasingly frequent “smog alerts” caused by cars and trucks, clogging the expanding road systems with less emphasis on public transit, and the increasing use of fossil fuel powered power plants (that also cause smog),
- ⚙ mass-produced and factory-farm produced meat and poultry products for fast food restaurants,
- ⚙ vast expanses of good farm land destroyed by pesticides, fertilizers, and genetically engineered fruits, vegetables and grains; or developed for housing, golf courses, and shopping centers,
- ⚙ urban sprawl development for housing and industry that requires artificial environments supplied with fossil fuel based heating, hot water and air conditioning,
- ⚙ home construction that uses minimal insulation of the lowest possible quality, toxic materials, non-renewable materials, and which does not take advantage of solar orientation or solar design principles,
- ⚙ horrible smells caused by overloaded sewage treatment plants,
- ⚙ tainted water caused by contamination of ground water from livestock waste, as we’ve seen in Walkerton.

Trees are dying by the sides of roads and highways. Grayish yellow smog in the sky drifts far from our cities. The odors are becoming noxious further and further from their source. Lake Ontario’s beaches are closed more frequently due to increased levels of bacteria from the increasing sewage loads and industrial pollution being pumped into this vast fresh water lake.



> *Lakeview Coal Generating Station, near Toronto.*

At a more subtle level, I find myself now aware of the strange desert wasteland that we have come to substitute for nature. Our parks, manicured lawns, and concrete-covered cityscapes, with their cold, clean, bug free, Kentucky blue grass, now seem to me to be like a wasteland. This contrast has become clear to me since I allowed the land around our new home in the country to naturalize, populate with many native trees, millions of bugs, and native plants of every kind. Even in the cities I've noticed a few brave creative souls have defied convention by creating front yards filled with wild flowers, perennials and native grasses. Given the slightest chance, nature creates a beauty, manages itself and feeds itself to perfection. It brings a terrible lump to my throat now as I wonder through the countryside, around suburban mega-developments, and even old downtown neighborhoods and parks. We have disconnected ourselves so far from nature that we now shun weeds, hate scrappy looking native trees, scream at the sight of ants, and hate the nuisance "pests" around us. And yet, now that I've spent just a few years back in nature I see incredible beauty in a field full of wild flowers, grasses, raspberries, thistles, daisies, bushes, and beautiful dandelions.

The Environment or You?

At the root of many manifestations of "environmental" problems, as identified by the scientific community, is a disconnection between humans with the natural world. Our global economy is driven by the idea of endless growth, economics of selling and a lack of any real connection to the natural world. This can't continue. Nature demonstrates that balance and symbiosis are the answers to sustainability. This takes a societal change that rejects the idea of growth, money and consumerism as the driving forces of the global community.

Our decision to accept the media, advertising and government mantra that economics must be our top priority has created a monster that fuels itself at the expense of everything in nature. By establishing economics as society's number one priority we have forgotten that the meaning of our life is not defined by how much money we have or how much profit our corporations generate. Rather life defines itself by its ability to continue over the long term. Life is about finding symbiotic relationships that benefit all of nature. Life uses its intelligence to support all natural processes. It is self-organizing and self-regulating, and values the whole over the individual because the individual is part of the whole.

Too Many Parking Lots

There are too many parking lots where forests should be,
We spend so much thought and energy on things that don't matter,
We've become neat and clean at the expense of real beauty,
We seem to think that if it can't be done with a machine, we can't do it,
We are all in a terrible rush but we don't know where we are going,
And we don't have time to stop and think,
Even though we know we always make mistakes,
We're afraid to try different things for fear of making new mistakes,
The whole world has gone crazy,
If you care, it is time to do something about it.

Going Wild

Wouldn't you love to see wild flowers by the side of the road,
Don't you think it would be amazing to pick apples and pears on University
Avenue,
Put all the asphalt underground where it belongs,
Return our parks to forests, meadows, streams, bogs, wetlands, and creeks,
Cover all the roof tops with wild gardens and solar panels,
Dig up big chunks of sidewalk and plant more trees,
Take all those concrete cul de sacs and return them to rambling streams,
What if we gave the fish a fighting chance,
That's what I call going wild.

We Are One

As you melt with me in the long grass
Our roots together begin to grow
The seeds of truth seep deep into your soul
A dream force circles above pointing the way to creation
Blinding sun above that warms the heart
The eagle soaring higher and higher, screeching
Merged and one with earth, body and soul
The twitter and buzz of all eternity drifts by
Like the ghostly white clouds of angels floating
We are all one together, the one is all
Stop. Take the time to just be at one
Everything will wrap around you in love.

Reconnecting with nature brings us closer to our children, family, friends, community, the earth, good food, fun, physical activity, free time, rest, relaxation, animals, plants, and the beauty of our natural surroundings. During times of difficulty, when there seems to be no hope, in the middle of our fast-paced, and at times mindless modern life, we sense that something is not right. As Ferenc Mate says in his book, *A Reasonable Life*,

“we will have to put humanity first again—each human’s physical needs and, just as important, the needs of the human spirit. We need to put them far ahead of the mythical importance of short-term profits, special interests, institutions, or economic systems whose preservation now dictates how we live.” (pg xii).

Our economic system has evolved in support of the few with the greatest amount of money. This system has been sold to the rest of us who can afford it. But this type of wealth does not bring us more happiness nor does it take care to look after nature that sustains us, nor does it take care of the poor starving masses who are our brothers and sisters, our global family. Economics is not life. We must put life, awareness of connection and nature first again.

We also need to change our institutions which are driven by our consumer-oriented society that drives the industrial commerce that does perhaps more damage than our individual lifestyles. These massive non-human systems will find it even harder to change their ways. Their simple mission is profit above all else. Although institutions, such as the multinational corporation, are major contributors to these problems, their ability to make the changes required is inhibited by their lack of consciousness. Our institutions must be transformed in support of life and nature, not profits. Only you and I can make that happen.

We must recognize car companies, power producers, forestry giants, multi-national food companies, military suppliers, pharmaceutical companies, sewage treatment utilities and many other large corporations for what they are. These companies are no different from present-day cigarette companies that have been convicted in United States Supreme Court. These companies were found guilty of knowingly hiding the deadly effects of their products, including the pernicious addictive properties, in the name of profits. Keep in mind that these are the same people who run the largest food companies as well and they will be found culpable again since

all of these are now known to produce goods and services that cause major environmental damage that in turn creates thousands of health-related deaths in each major city every year, (not to mention the long term health problems, that won't be known until sometime in the future). Their charters, their principles, their goals are to maximize profits for their highly paid executives and their major shareholders. This type of organization and its place in society must change.

Of course we are just as guilty, now that we know of the dangers. It is our duty, as citizens of the world, to act in defense of nature, in defense of our children's future. We must fight the perpetrators. To fail in this duty would be a crime in itself. To knowingly allow our children to be poisoned without defending them, without taking the time and energy to prosecute these crimes, we ourselves become guilty.

There will be those who take these companies and governments to court and they will be found guilty. This is an important task in the process of paying our debts to humanity, especially those not yet born, who will be the most affected. However, I also believe that we have even greater power than our ability to prosecute these companies and governments. We can change our lives despite the great power their marketing and propaganda machines may have over us. We can choose to live according to the principles set out in this book, which will force these companies to pay their debts to society, change their ways or cease to exist. The solutions described in this book allow us all to do this in a positive, affordable, realistic and life-affirming way that is fair for everyone.

History teaches us that in the search for the truth, the lies may be found in our "vanity" or ego. Nature will always be as perfect and full of answers as it has always been. It is ourselves we must overcome in the end.

We need to overcome ourselves first and foremost. Nature has all the answers. You and I, the rich and the poor, the CEO and the laborer, the solitary writer and the leader of groups, the teachers and the students, engineers and scientists, doctors and nurses, we must realize that we are here for a brief time. We are all made of the same stuff. We will return to the universe, all of us, the same way. Our simple connection with the universe is our continued existence in our children. Our children need a natural world full of the diverse creatures we have known. They need clean air and water, healthy food, and the opportunity to express their creativity. Your connection to nature leads you from vanity and into the arms of those you love. This is a call to fight the injustice of jeopardizing your children's future. This is your chance to act now, to save your children and their children, and

thereby save yourself. You...me, and our children, we are all the same nature all connected as one with the rest of nature. Vanity, individuality and your ego are an illusion. We are all connected equally through nature and too nature. We are the whole that is nature.

What Needs to Change?

In the media, issues are often simplified and stated in highly disconnected terms. As the very expression “environmental problem” suggests, we have tended to describe the problems as if they were the environment’s. In fact you and I are the problem and environmental degradation is the symptom. The symptoms of the problems can be seen in the media topics of:

- ⚙ Ozone depletion
- ⚙ Global warming
- ⚙ Energy: fossil fuels, nuclear and dams
- ⚙ Overpopulation
- ⚙ Top soil loss
- ⚙ Desertification
- ⚙ Water shortages
- ⚙ Chemicals, toxic materials
- ⚙ Arms spending
- ⚙ International debt
- ⚙ Acid rain
- ⚙ Contaminated water
- ⚙ Air pollution or smog
- ⚙ Rainforest destruction
- ⚙ Genetically modified foods
- ⚙ Wars for land and water

- ⚙ Drug use
- ⚙ Crime
- ⚙ Poverty
- ⚙ Terrorism

These symptoms are no longer debatable. I find it more useful however, to replace the media titles for the problems (in other words the symptoms) with what I believe are the real problems – the actual causes. Then we can apply the process of problem solving in our daily lives, and in the world community. We manifest these problems in the following ways:

- ⚙ Toxic chemical and fossil fuel usage for food production, transportation, and power generation.
- ⚙ Economics that don't count the value of nature now and in the future, in other words we don't pay the true long-term costs of what we consume today, nor is the system balanced, rather endless unnatural growth is assumed.
- ⚙ A lost connection with nature, and the meaning and purpose of life that results in fear.

We *can* we eliminate or balance these problems within the natural framework. Doing this in isolation, of course, is futile. Just because I may have solved some of these problems in my life doesn't mean that the problems have been solved at all. However, by writing this book, hoping that you will share this knowledge, I believe we can solve these problems together. Many others are doing the same sort of thing in different ways. If we all work together we can make the sustainable revolution a reality in time for nature to recover.

We need to find a process that makes these solutions universally applicable. That process isn't hard to find. It's a process that nature itself uses. It is one of finding perfect balance and flow, evolutionary change, sustained by solar energy. The infinite creative potential in the universe provides all of the answers. These answers will be realized through the spirit of our consciousness, through our new understanding of connection. This sense of our connection to the infinite through our children and their children to come binds us all together with nature. Our job must be to apply new values to this fundamental idea in our daily lives. We need to start making choices using the full power of our creativity. We must dig deeper in our understanding of our connection to nature.

We need to try to see through the masks covering the truth. We need to try to overcome our inability to admit that we have problems. Like any addiction, which our current lifestyle is quite literally, the first step is to admit we have these problems and understand what the true root causes are. The second step is to begin the process of solving them in order to bring back health to ourselves, those we love, and the natural world that sustains us. This next step is charged full of life, potential, creativity, and opportunity. The process of creating a natural lifestyle that sustains your family is full of adventure, fun, and discovery.

By being more aware of your impact, your potential...life becomes more engaged, more exciting and more fulfilled. We must work at this process every single day as though it were our last on this earth. Life is about *this moment now!* Plans for the future are important. Understanding the past is wise. Doing something **now** is the only real way things can and do change. We must continue the quest towards changing ourselves; relating our experiences with others and having them relate their experiences. This will lead towards a continuous process of improving on our solutions. We can live our lives joyfully, making choices in accord with our principles. This is the process of *Natural Living* that makes the changes such a wonderful experience.

The most important way to prepare for the critical changes necessary are an awareness of the root causes of the problems. Some essential things suggested in the book *Sacred Balance* that you can do to prepare include:

- ⚙ Think critically about the information that floods us. Consider the sources.
- ⚙ Trust your common sense, your ability to assess information. There is a difference between information published in a tabloid such as the National Enquirer and magazines such as Scientific American, the New Scientists or the Ecologist. Be aware of a publication's potential pro-business biases.
- ⚙ Confirm to your own satisfaction the depths of the global ecological crisis alluded to in the "World Scientists' Warning to Humanity." Ask your elders about how things have changed in the past sixty to eighty years.
- ⚙ Project your mind far ahead into the future and consider the problems that we are leaving as a legacy for our children and grandchildren.
- ⚙ Think deeply about some of the most widely held assumptions; many underlie the destructive path we're on. Are human beings special? Does science and technology provide us with the understanding and tools to manage nature? Isn't

the economic assumption of endless growth required to solve environmental problems really simply a suicidal notion for any species that lives in a finite world?

- ⚙ Think about your connections to the living web. How is this connection affected by the activities of your life?
- ⚙ Construct a hierarchy of your own basic needs, those things that are absolutely necessary for you to live, to be fulfilled and to be happy.
- ⚙ Reflect on how we can meet our fundamental needs while also making a living. To do so means that our economy has to be connected to the real world of the biosphere.
- ⚙ Protect the vigour and diversity of the local communities.
- ⚙ There are many small ways to modify your lifestyle that are good for your health, your pocketbook and the health of the planet. Acting on them reinforces our understanding that we can live in a way that makes Earth sense. Do I really need this? Could I take public transit? Why not bike or walk? Use both sides of a piece of paper.
- ⚙ Industries that are designing means of production can follow the example of nature in which one species' waste is another's opportunity.
- ⚙ Go out into nature. Nature is not our enemy, it is our home; in fact it sustains us and is in every one of us. All living things are our relatives and belong with us in the biosphere.
- ⚙ Don't feel guilty. Guilt is draining and oppressive—as the T-Shirt says. Nobody's Perfect.

(Suzuki and McConnel, *The Sacred Balance*, Pg 209-217)

The way we do things, the “worldly goods” we take so much for granted, this world of technology that seems to be able to solve so many problems – these are the illusions of our society. The difficulty is in being able to see through the thin veil of comfort, addiction, and our acceptance of the way things are. We need a far richer, deeper, more complex vision of living that does not accept our quick fix solutions of today. To try to get a sense for how messed up our modern systems are, take a look at our so called “modern technology” called sewage treatment systems:

“Mix one part exc reta with one hundred parts
clean water. Send the mixture through pipes to a

central station where billions are spent in futile attempts to separate the two. Then dump the effluent, now poisoned with chemicals but rich in nutrients, into the nearest body of water. The nutrients feed algae which soon use up all the oxygen in the water, eventually destroying all aquatic life that may have survived the chemical residues.

All this adds up to a strange balance sheet: the soil is starved for the natural benefits of human manure, garbage and organic materials that go down the toilet, the drain and to the dump. So agribusiness shoots it up with artificial fertilizers made largely from petroleum. These synthetics are not absorbed by the soil and leach out to pollute rivers and oceans. We each use eight to ten thousand gallons of fresh water to flush away material that could be returned to the earth to maintain its fertility. Our excreta—not wastes but misplaced resources—end up destroying food chains, food supply, and water quality in rivers and oceans.” (from the introduction to the *Toilet Papers*, by Sym Van der Ryn)

This is crap! This is insane. We need to view these systems through new eyes. Many of our “modern” conveniences create a false sterility that leads to an artificial system disconnected from natural systems. In fact, many modern systems are terribly destructive to life. Too often our “modern” way of life simply masks, or ships, or pipes, or disconnects, or trucks away the waste, which is in reality a resource, to a dump or lake or ocean. “Out of sight, out of mind.” An institutionalized system of waste management masks this insanity. This system ignores modern knowledge of ecological systems. And yet these stinking problems cry out for a creative, positive solution that is in their nature if we simply challenge ourselves to find them. Nature is able to process our waste as food for other plants and animals. All we need to do is combine that knowledge with creativity to come up with things like “Living Machines” and smart composting toilets to know that we could do much more with

much less. More than that, we could use this magic to transform waste into useful food energy for plants that in turn produce materials we can use again.

Nature is far more complex than our technology will ever be. So we can't continue in our current belief that technology will be able to solve the problems it creates. The technology already exists. The answers are built into the infinite creative ability of nature. Let this be our journey—to find this beauty in our daily lives. Let's find the right balance, the natural flow of resources, the complex, diverse, interrelated connections between everything that solve these problems.

Nature shows us how waste can be magically transformed into a food source, so that it becomes an asset rather than a liability. As Sim van der Ryn explains in *The Toilet Papers*, “When waste is used, a liability becomes an asset, and the very concept of waste disappears.” When we apply this to the balance sheet of our lives we find that we can transform almost every act from one of destruction to one of creation. This is one of the magical laws of nature.

In this book we will show this transformation in action as we build a home that returns excreta to the soil as food rather than creating waste. We'll learn how to maintain coolness rather than creating it. We'll see how we can transform and store solar heat and energy rather than pipe it in inefficiently from thousands of miles away (wasting 70% of the energy in the process). The potential, as nature shows us, is simply the most astonishingly beautiful balanced symbiotic existence imaginable. Nature is full of magic if we take the time to look deeper. We need to talk to her daily, learn more and love her more than ever, for she holds all the answers.

What problems?

Some of the most pressing problems, causing the most destruction to the earth and people every day, do not get reported. This includes tragedies such as “30,000 children” who died today for lack of clean drinking water (pg 82, *Superspecies*, Dressel & Suzuki), the glaciers that are retreating causing changes in weather patterns (okay recently there has been lots of press on this one), the daily loss of the world's best soil for farming, and vast areas of land being lost to unsustainable forest practices. These atrocities are occurring right now as you read these words. These are the unrelenting problems that are not reported each day as they occur.

The media are supposed to keep us informed of these important issues. This isn't happening. Why the lack of attention given the tragic impact? These major

multinational news corporations are driven by profits. Profits paid for by the companies inflicting the most damage to the earth. No wonder we don't get the complete story or the full reporting of the potential implications. The "Warning to Humanity" issued by the most distinguished scientists in the world did not get any major coverage in any major news source when it was issued in 1992! Sadly the headlines of the day were about sex, scandal, violence and celebrity, because these drive profits for the news corporations and their advertisers. They've found that currently this is what we appear to want to read and it sells. Do we really want this or are they manipulating us?

We need to be aware of this in the news we read, the opinions and attitudes of politicians, and even in ourselves. We are not immune to this constant barrage of perception management. To be blunt, we must take into consideration all of the brain washing that has been delivered to all levels of society since birth. We are all affected. No wonder attention to these critical problems has been lacking.

Media Crisis

The impact of sudden realizations, through major crisis, can change people at any level forever. The opportunity of creating a sustainable future for our children is such an issue. We are at a crisis stage. The effects we see, and especially those we don't, are telling us we must act now no matter who we are or where we live.

The media needs to provide a critical service to humanity. The business of reporting the problems we face, the analysis of competing views and research, and the expression of our shared knowledge has the great potential of in forming the basis for our existence. Unfortunately this seldom happens.

“ ‘As a society, we are moving away from talking about ideas. Now we talk in slogans. The media doesn't force us to think issues through in their full complexity. Thus, we are getting policies driven by slogan orientation.’ Complaints such as this reflect a dilemma regarding the business of information management. Precisely because it is a business, run for profit, the media tend to operate on a mandate that encourages public consumption preferences. (Downs 1972, 42: Herman and Chomsky 1988) It thus serves as an instrument

that reinforces scientific materialist values.” (*Fatal Consumption*, pg 112)

Media multi-nationals, which are driven by profit, simply can't provide the insightful life-supporting journalism we so desperately need. What little unbiased reporting that does exist is simply overwhelmed by the brain-washing media power-corporations who own the air-waves which dominate several hours of the average person's spare time each day. This lack of complete information is critical to your analysis of the problems each and every day, and to the analysis that leads to solutions. If you've wondered, if the current situation is such a big deal, why haven't you gotten that sense from the daily news reports, now you should realize that they are part of the problem. The current priorities of the world we live in don't support the kind of news reporting and journalism that would be required to properly inform the majority of people. Our economic priority must be transformed into a quality of life priority in order to have the kind of reporting we need.

Wealth

Rather than life, it is economics or money that is the driving force of societies today. Our economic systems are dominated by multinational corporations, working in a capitalist economic model that is fanatical about growth, profits and greed. This economic system is driven by a view of wealth defined by the endless accumulation of electronic goods, mind numbing entertainment, drugs, sterile homes, water-based sewage systems, unlimited inexpensive energy, fossil-fuel powered devices to make the world even more sterile and polluted. These same corporations, and the governments they manipulate, need more consumers in order to drive the growth-oriented economic system. This is not wealth, but addiction to growth. True wealth comes from a much richer context that requires none of the things we accumulate or use.

Instead, we need to adopt a vision of wealth that supports a more profound existence. A natural balance in our use of the earth's resources is required. We need to spend more time with those we love. We all need more fun and happiness in our lives. A much deeper connection with nature will help us appreciate our impact on each other and the future. If this is poverty by current definitions, then I guess we seek poverty. As many of the great spiritual leaders have taught, from Buddha to Jesus, the true path to their vision of a connection to the infinite is found through "poverty", simplicity, giving, peace, love and the renunciation of worldly goods. We

may not need to go as far as these words make you think. If dedicating the majority of my income to food and shelter that is sustainable is poverty, then I am happy to be poor. If simplicity and connection to nature means the elimination of commercial television programming, then I will rejoice in the newfound time with my family, friends and nature. And finally, with the minimization of “worldly goods” the few things I do have will be more special and important to me and those I love as they become critical to sustaining our existence.

Depending upon how we define it, wealth can be the source of a great many problems. For most of us the basic sources of wealth come from meeting some simple and basic needs:

- ⊗ Food
- ⊗ Shelter
- ⊗ Clothing
- ⊗ Family
- ⊗ Water, sunshine and clean air
- ⊗ Basic health care
- ⊗ Happiness

Unfortunately the modern global system doesn't try to meet these needs. Instead it makes it possible to accumulate the greatest amount of money, our modern representation of wealth, through the creation of nothing at all. The rich and powerful essentially use their “power” to leverage the wealth of the majority to “invest” it in order to create greater wealth. The poor majority supply the low cost labor, while also, in the end, becoming the consumers required to keep this cycle going. So the rich get richer and the poor get poorer.

True wealth must be understood well in order to transform this terrible systematic process of theft. True wealth can only be created through a process that is outside this institutionalized system. We must keep in mind that the current world system was invented and perpetuated by the small minority of rich, powerful, and paranoid. Once the meaning of wealth returns to that defined by nature, including sufficient food, shelter, clothing, time with family, water, warmth, health and happiness, then we will have achieved natural sustainability.

To bring down the whole house of cards, all we need to do is remove the lies, and shine a light on the full complex truth . We must change our lifestyles. We need to redefine wealth with the ideas of *Natural Living*. The principles of love, compassion, peace, sharing, creativity, health , equality, freedom, meeting basic needs, and caring for nature are the eternal truth.

Poverty of Wealth

Watching life drift by,
Living through the actors on TV,
Laughing or pitying the attention starved,
These are the signs of the poverty of wealth,

Not knowing why we do the things we do,
Feeling empty deep inside,
Filled with fast food, brand names and beer commercials,
These are the signs of the poverty of wealth,

The disease is spreading faster and faster,
The prosaic cure of our time is economy,
The creation of something for nothing,
These are the signs of the poverty of wealth,

The time has come to think of something different,
We must rediscover the creative in poverty,
The wealth of ideas in people must return,
These are the signs of the end of the poverty of wealth.



Big Picture

The vast scale and complexity of our current situation requires a deep understanding of some critical factors. The idea that we have an “environmental” problem for instance, is an indicator of the deceptive nature of the issues. In fact, we have a human problem of some kind that degrades the environment despite the environment’s best natural abilities to maintain balance and a healthy world. Some critical issues that must be dealt with, in terms of the “human” problem, are well-articulated in the book *Fatal Consumption: Rethinking Sustainable Development*. The question of why people haven’t acted already, given the obvious problems, must be understood if we are to have a chance of solving the problems. These “human” problems are outlined as follows in the book *Fatal Consumption* (pg 8-17):

Separation of Action and Consequence – Much of the destruction caused by our modern way of living is not immediately visible or detectable.

Temporally – Delay in the effects of human impacts on the environment.

Geographically – The massive scale of the global economy’s ability to move goods and dispose of them makes these connections invisible.

Socially – The modern evolution of products and services that serve social requirements like retirement living, daycares, employment, and housing are highly separated both socially and by distance, making a tight local integration nearly impossible.

Intellectually – The rationalized denial of the connections between the causes of problems and their adverse effects.

Ethically – The lack of ethics applied to intellectual development of technology and advertising, for instance.

Globalization – The system of economics that drives the global economy creates great wealth for some and terrible poverty for others. The supply of consumables for the wealthy from every corner of the earth, especially the third world, through a system of cash crops, near slave labor, abandonment of subsistence farming, unsustainable removal of resources, corruption, and poor working conditions. The conditions of civil war, terrorism, torture, famine, and abject poverty, under which a large majority of our inexpensive consumer goods are made, simply aren't listed in the ingredients. And even if they were, are we ready to do something in order to help these people in a positive, constructive and lasting manner, especially given our sad record of denial, abandonment, ignorance, and lack of caring for that which is somewhere else?

Finding the People Responsible – We are all to blame both individually, in our communities, through our cultural choices, and in our political systems. Much of this can be blamed on a short sightedness and a preference to focus on seemingly more immediate and important issues like the economy, ourselves, and other external problems. Our media, which is a reflection of ourselves, simply shows our lack of interest in these problems with a preference for sex, scandal, money, and style, for instance.

Find the Right Scale for Action – In order for the problems we outline here to be solved, we need to develop a clear understanding of the correct level and scale at which the solutions need to be applied. The program for action, the levels at which to enact them and forces required to perpetuate them, needs to be found in the failures of the past as well as the successes at all levels.

Paralysis by Analysis – The difficulties imposed by complexity, the lack of perfect understanding, and a method of dealing with these problems through denial, make finding solutions more difficult. The paralysis is also made worse by a system of progress based on the need for those that perceive the potential negative effects to provide sufficient evidence commiserate with the systems being questioned. In the case of the global economic system, this imposes a difficult problem, since the scales which perpetuate it are unimaginably large.

Disconnection from Nature – We currently focus primarily on the level of our own lives rather than that of seven generations or the continual evolution of nature. Our connection with nature and time needs to be re-established.

In practice we can see these difficulties. If we look back at cigarettes, CFC usage and lead in gasoline we find these principles at play. In each case the horrific delay in dealing with the deadly affects of these products can be attributed to some, if not all, of these difficulties. These products were not initially understood as their impact took some time to take effect. The massive scale of the economic system that depended on these products made their removal a costly prospect. Eventually as the connections to problems were made, denial set in. Driven by a need for continued profits questions of ethics are thrown out the window. Even as the deadly effects are proven and bans on the products take effect in the first world, the third world is still being sold these killers. The media was limited in effectiveness at

communicating the urgency with clarity. Even as the problems were recognized the complexity of taking action needlessly destroyed lives far into the future.

In the case of CFC destruction of our ozone, the deadly effects still are being imposed on future generation through sales in the third world. The effects will be with us for a hundred years after the last CFC is created.

Our continued use of nuclear, coal and fossil fuels suggests we still don't get it. Certainly the dependence on these products is broad and massive in scale. Much like cigarettes, CFCs and lead in gasoline, we are lead to believe that we don't have an alternative. Somehow we've rationalized the deadly long term effects of the pollution left by these sources of power, whether due to their distance from where we live, our lack of ability to make the connection to the pollution in our air, or our inability to imagine a terrorist dropping a commercial air plane into a nuclear power plant. Even once entering these into the realm of possibility you run up against the barrage of complexity, misinformation, lies, myths, and false advertising directed at maintaining the status quo. In reality we can live as comfortably as we do today without nuclear, coal or fossil fuels...my family and I are proving that, as are many others. You'll find it hard to cope with the contradictions of engineers, scientists, and politicians on all sides of the issue as they muddle things up, relate unrelated facts, use the popular method of magicians to distract you from the main issues, and in some cases simply lie or worse make false statements based on ignorance.

The way I've seen some of this manifest is, for instance, in our local community newspaper an article that discussed wind power, and even suggest that with 14,000 wind turbine s, the province of Ontario, where I live, could supply all of the required electricity we need. Well, then the experts leap into the fray with comments about how wind power is insufficiently regular, and all those wind turbines would blanket our landscape...ugh. The answer, we must have nuclear or coal or gas...because well we know that seems to work...never mind the pollution, cost overruns, or the facts about their deadly effects. We all, including myself, have the habit, natural I suppose, of color coating our own point of view, while simplifying, to the point of stupidity, that which we argue against.

My own experience has shown that nothing is easy and simple to achieve in isolation. In fact, one of the great revelations I've come across is that we succeed best by taking a holistic approach. In the case of my own home we also are taking an organic, step-by-step approach to achieving our goal of eliminating the use of fossil fuels. Of course we've insulated and used passive solar design to maximize the

direct use of heat from the sun in the winter. This by itself is not enough energy for our daily needs, although perhaps another design would improve the deficit. Since our heating system uses an in-line electric water heater to heat our floors on winter days when we don't get any sunlight we need to boost our renewable energy production. We started with ten photovoltaic solar panels on the roof. Unfortunately these don't produce much of their 400 watts of rated generation during our short winter days. Next we added a 1 kwh wind turbine. Now, as the wind blows exceptionally hard, especially in the winter, we've made a 25% dent in our use of electrical power provided by the grid (cold winter winds also have the benefit of being denser the warm winds thus producing...actually transforming more energy). We've still got about 75% of additional grid power to eliminate in order to be 100% renewable energy based. With the addition this coming fall of a solar water heating system, a doubling in the size of the solar photovoltaic system (to be combined as a shading system for the south side of the house), and perhaps a second wind turbine we will achieve our goals.

Now, when we apply this type of holistic evolutionary approach on a community, provincial or national basis we can do what the experts say is impossible. There is a way to eliminate the nuclear and fossil fuel power plants, but it might be a fair bit more interesting than erecting 14,000 wind turbines. By the way, I am not sure 14,000 wind turbines in reasonable locations around Ontario isn't possible either...which is another issue. We have a hard time understanding the scale and impact of these types of changes. Eco-cities like this have been envisioned. However, like so many brilliant ideas of the past, the initial reaction by the mainstream has been to mock them and use words like "impossible", ugly, dangerous, silly, unrealistic, too expensive and to dismiss them. Impossible has become a key word for me to suggest that this may very well be the precise place to look the hardest. It would be as simple as taking the \$2 billion in subsidies that currently goes to fossil/nuclear each year (in Canada), and building the 1,000 turbines with that money each year for the next fourteen years. That is just the subsidies given by the government to fossil fuel/nuclear providers. Imagine if some significant holistic investment was made to support individuals and corporations use of renewable energy systems:

1. Conservation
2. Passive solar heating/cooling
3. Solar hot water

4. Wind
5. Active solar
6. Other renewable systems

We need to make a critical transformation in our common understanding of our place in the world. Humans are a part of nature. We are constrained by its laws. We need to understand these laws as much as possible. Our health and our long-term viability depend on this understanding of nature and the complex ecosystems it sustains and that in turn sustain us. This understanding of nature is far more vital than our concern for the economy.

We “externalize” problems we find too complex or difficult to solve. Instead we find it easier to focus on the simpler ones like money and self-interest.

“If industry pollutes our favorite stream, poor logging practices destroy vital salmon habitat, or CFCs deplete the ozone layer, we say we have environmental problems. We ‘externalize’ the issue (to use the economists’ unconsciously revealing term). There is little real appreciation that the problem – and ultimately the solution – resides within us. Indeed, when we do act to improve matters, the frequent response is a technical fix aimed at enabling society to carry on pretty much as before. Stream contaminated? Build a swimming pool and chlorinate the drinking water (or import it in bottles from France).” (*Fatal Consumption*, pg 22).

The problem is not out there. It is in you and me. We have a choice to pollute or not to pollute, waste or not to waste. We can find alternatives. The difficulty turns out more often than not to be you and me. For every problem there are answers. We have a choice and a duty to find and implement them.

The reality of our own existence simply isn’t very sane. We focus on money. We try to make our lives as easy as possible. We are building strong economies that serve the wealthy minority:

“Driven by an uncritical worship of economic growth, it seems that consumption by humans threatens to overwhelm the ecosphere from within. This is clearly a pathological relationship. The continuous growth of any species in nature is an unnatural condition that can be purchased only at the expense of other species and the integrity of the ecosystem as a whole. Indeed, any relationship in which the vitality of one organism is sustained by sapping the vitality of another is, by definition, a parasitic one. The distinguishing feature of parasitism is ‘the subversion, co-option, or undermining of the self-regenerative or autopoietic capacity of the host.’ (Peacock 1995) ‘Looked at from the point of view of other organisms, humankind resembles an acute epidemic disease, whose occasional lapses into less virulent forms of behavior have never yet sufficed to permit any really stable chronic relationship to establish itself’ (McNeill 1979, cited in Peacock 1995). While it may seem extreme to interpret humans and their economy in such unsavory terms, it may also be wholly realistic. If we don’t understand the problem, we have little chance of finding workable solutions.” (*Fatal Consumption*, pg 24).

Clearly we must have the wisdom to accept our own involvement in this process. Without this deep understanding of ourselves and our society we will come up short with our solutions. In the end this deep, albeit horrible, understanding of ourselves is yet again another opportunity to take this knowledge and use our creativity to find the answers. Denial unfortunately leads to a worsening of the parasitic and addictive situation in which we live.

The Ecology of Economics

You have to ask yourself, what is the destructive force that drives the current economic system? If it’s so bad, why hasn’t someone done something about it

before? The answer seems to lie in the human tendency towards addiction and denial.

“Driven by an uncritical worship of economic growth, it seems that consumption by humans threatens to overwhelm the ecosphere from within. This is clearly a pathological relationship. The continuous growth of any species in nature is an unnatural condition that can be purchased only at the expense of other species and the integrity of the ecosystem as a whole.” (pg. 23, *Fatal Consumption*, Woollard & Ostry)

This is by definition a parasitic relationship. As such the current human condition and systems of economics can be seen as a disease.

The world can't be seen as an open system that can sustain unlimited growth. In nature, for instance, this can be seen as a cancer. Instead we need to turn to a closed-system based economy that matches the limits of nature. On our space-ship earth, we all must learn to coexist in balance.

“Many biophysically oriented scientists agree that the ‘full-world economics’ proposed by Herman Daly will be an economics based on principles of ecology and the second law of thermodynamics. While the second law is arguably the ultimate governor of all economic activity, it is totally ignored in conventional economic models.”

Conventional economics are based on the first law of thermodynamics. This law states that energy can be transformed but never created or destroyed and that the mass of the inputs will equal the mass of the outputs. This law has led economists to believe that we will never run out of anything as a simplified view of our world. Unfortunately there are changes in the forms of energy that do impose limits. The growing scale of economic production along with population growth now puts us in a position where we've exceeded natural limits. Our natural environment is being degraded. Non-renewable fossil fuels are being consumed at an increasing rate that will see some of them eliminated in our own lifetimes. We are increasing the speed at which we are exceeding these limits. We are on a crash course with one of the most fundamental laws of nature.

The fact is that our earth system will gradually become more disordered. In fact any organized system on earth will tend towards this disordered state. This applies to our economic systems, communities, countries and cities. Systems can only maintain the illusion of equilibrium through the constant input of highly organized energy, primarily solar energy, some of which was stored in fossil fuels over the millennia. Our current misconception lies in thinking that this perceived state of equilibrium is real. It is not. It can only be sustained by massive inputs of energy resulting in an increase in entropy, or lower quality energy, and more disorganization in the universe. The goal therefore should be the net balancing of entropy in our ecosystem. In the long run, this economic system can only work if it's based on the natural input of energy directly from the sun.

We need to start thinking of our current economic system as a system of consumption. Economics must take into account the second law of thermodynamics. "The second law [of thermodynamics] forces thus an uncomfortable reinterpretation of the nature of economic activity. In effect, it shows that what we usually think of as economic production is actually consumption—nature is the real producer." (*Fatal Consumption*, pg. 27).

The following quotes illustrate the effects of the second law of thermodynamics in the real world, not the theoretical one of current economic thinking:

"The populations of the so-called 'advanced' high-income countries are 75 percent or more urban, and estimates suggest that over 50 percent of the entire human population will be living in urban areas by the end of the century. If we accept the Bruntland Commission's estimate that the wealthy quarter of the world's population consumes over three-quarters of the world's resources (and therefore produces at least 75 percent of the waste), then the populations of the wealthy cities are responsible for about 60 percent of current levels of resource depletion and pollution. The global total contribution from cities is probably 70 percent or more.

In effect, cities have become entropic black holes drawing in energy and matter from all over the

ecosphere and returning all of it in degraded form back to the ecosphere. This relationship is an inevitable expression of the second law of thermodynamics (cities are prime examples of highly ordered dissipative structures). This means that in the aggregate, cities (and the human economy) can operate sustainably only within the thermodynamic load-bearing capacity of the ecosphere. Beyond a certain point, the cost of material economic growth will be measured by increasing entropy or disorder in the environment. The enormous drain imposed on the ecosphere by high-income societies has changed consumption by humans into a planetary disease.

We would expect this point—the point at which consumption by humans chronically exceeds available natural income—to be revealed through the continuous depletion of natural capital: reduced biodiversity; fisheries collapse; air, water, and land pollution; deforestation; ozone depletion; desertification; and so on. Such trends are the subjects of daily headlines. We seem to be witnessing the ‘destructuring’ and dissipation of the ecosphere, a continuous increase in global net entropy. By this criterion, society should acknowledge that the present global economy is unsustainably bankrupt. With prevailing technology, it can grow and maintain itself only by simultaneously consuming and polluting its host environment. As argued by the World Bank ecologist Robert Goodland, ‘...current throughput growth in the global economy cannot be sustained’ (Goodland, 1991). We have already reached the entropic limits to growth.” (Fatal Consumption, pg 37)

This analysis suggests that the global economic system is highly unstable. Only communities that are sustainable based on their own local resources will return the world to a more stable and equitable state. Examples, like the region of Kerala in India, show that it is possible to have a high quality of life with a low level of modern economic growth orientation. Thus the major hurdle we face,

“...the prospect of worldwide cooperation to forestall a disaster...seems far less likely where deeply entrenched economic and political interests are involved. Many contemporary values, attitudes, and institutions militate against international altruism. As widely interpreted today, human rights, economic interests, and national sovereignty would be factors in opposition. The cooperative task would require behavior that humans find most difficult: collective self-discipline in a common effort.” (*Fatal Consumption*, pg. 43)

However, given a clear picture of the injustices, people have been able to rise up and fight in the name of truth and justice. Our current situation requires such a response. Clarity regarding the problems and causes is necessary in order to support the right action.

Symptoms such as global warming, deforestation, fisheries collapse, pollution that kills people and soil loss all suggest we have reached the limits of our ecological systems. We have “...reached an historic turning-point, a point at which the world must shift from the assumptions of “empty-world” to those of “full-world” economics (Daly 1991).” (Wollard & Ostry, *Fatal Consumption*, pg 24). We need an economic system that is subservient to the requirements of nature. Economies don’t sustain us nor do they provide us with work. Only nature can do that. Economics needs to be limited by the laws of nature.

Laws of nature? What laws? Well, I found some and we’ll discover many others as we discover *Natural Living*.

Living systems have six key features:

- 1) interdependency
- 2) diversity
- 3) resilience
- 4) adaptability
- 5) unpredictability
- 6) limits

(Our Environment A Canadian Perspective, pg. 85)

The only sustainable economic system is one that maintains a sufficient level of natural capital for future generations, one that complies with the laws of nature. Any system that doesn't, and our current one doesn't, reduces this natural capital for future generations. If we don't do something now, our children will need to find a way of living that not only returns the balance in order to return natural capital to the levels we enjoy today but they also will need to live in a way that **increases** natural capital. This is a much more difficult task than balance. In effect, each step we take without balance means a larger deficit for our children. We need to act sooner rather than later.

“As to economic alternatives, the answer is quite familiar to all of us—indeed it is the answer which most of us already believe: democracy, market economics and an ethical culture. The self-organizing market is structured to respond in a highly democratic manner to human needs and values. We must concentrate on creating the conditions necessary to healthy market function. Since capitalism is the mortal enemy of democracy, markets and ethical culture, it should not be surprising that in most instances this means embracing policies exactly the opposite of those favored by capitalism.

Whereas capitalism prefers giant global corporate monopolies with the power to extract massive public subsidies and avoid public accountability, the efficient function of markets depends on rules that keep firms human-scale and require producers to internalize their costs. Whereas

capitalism institutionalizes a system of absentee ownership that keeps owners far removed from the consequences of their choices, a proper market economy favors ownership by real stakeholders—workers, owners, suppliers, customers, and communities—to bring human sensibilities to economic decision making. Whereas capitalism prefers the economic man or woman to the ethical man or woman, a proper market economy assumes an ethical culture that nurtures in its participants a mindfulness of the social and environmental consequences of their behavior. Whereas capitalism encourages and rewards the speculator, a proper market encourages and rewards those who contribute to wealth creation through their labor and productive investment. Whereas capitalism places the rights of money above the rights of people and seeks to free it from restriction by national borders, a proper market seeks to guarantee the rights of people over the rights of money and honors borders as essential to the maintenance of economic health.” (*Only Connect*, pg. 1996)

These dilemmas suggest we may not be asking the right questions. Does it make sense to be focused upon getting rich while others get poor? In their book, *The Sacred Balance*, Suzuki and McConnel, suggest asking more relevant questions such as

“What is an economy for?” and “How much is enough?” and “What are the things in life that provide joy and happiness, peace of mind and satisfaction? Does the plethora of goods that our high production economy delivers so effectively provide the route to happiness and satisfaction, or do the relationships between human and nonhuman beings still form the core of the important things in life? Is the uniformity of food and other products that we now encounter everywhere on the globe an adequate substitute for the different and the unexpected?”

In the daily grind of ordinary life, it's very difficult to keep these fundamental questions at the forefront. Instead, the typical routine—the institutionalized process of daily life consumes us, dulling our ability to think of the right questions. We appear to have been hypnotized into the rhythmic pace of modern economic life.

Playing it safe, I've been taught, means saving for the future. Since the government and pension plans no longer give us the security required for our later years, we've got to save for ourselves. People I work with have told me I'd be crazy not to be investing in retirement savings plans. Even worse, once that money is socked away, you would be nuts to touch it. I do understand that the money, the numbers might lead one to believe this. To some extent, however, this is a trap that ensures the continuity of the way things are now. If they were sustainable that might be fine. They aren't. So I have cashed in a portion of my retirement money to invest in solar panels and a wind turbine. You'd have to be nuts according to current financial advice. But, as we've seen, there is much more to life than money. Besides the stocks I bought weren't doing very well anyways. I think it is the economic system that is nuts.

Financing Change

Why aren't more people achieving a sustainable lifestyle? Once you make the decision to change, even though all of the technology, information and resources do exist, there are difficulties getting the credit or loans necessary to implement the solutions. Without this availability of capital it becomes difficult for any but the rich

to finance the types of projects that will provide payback for the substantial up-front investment. As the authors of *Who Owns the Suns?* say:

“...the real challenge for the solar movement is to enable the widespread adoption of energy-efficiency techniques and solar technologies by making available capital and credit to a much broader range of people. Without access to credit, few Americans will be able to afford the tools needed to generate electricity and heat with sunlight. Just imagine what would happen to new-car sales without automobile loans!”

Once again, under the current economic models that favor big business, this access to credit and the lack of true costs in electricity, for instance, make the costs seem prohibitive, and pay back times too long. We have to resolve these inequities so that the principles of natural systems, which underlie everything, are allowed to play their required role in a true market system. This will unleash the power of real natural capital in favor of solar energy and nature.

The Global Balance Sheet

Like any good accountant we must start by reviewing our current book of accounts. As in any enterprise our balance sheet may give us clue as to our financial health. The following startling numbers were reported in our local newspaper called “In The Hills”, Vol. 8, No. 3, 2001. Sadly, the mass media never seems to get things this simple. Just imagine your business being run on this type of fiscal regime.

- ⊗ Size of the earth’s surface: 51 billion hectares.
- ⊗ The size of productive land and sea on earth: 12.5 billion hectares
- ⊗ Current population of earth: 6 billion
- ⊗ The amount of productive land per person (assuming nothing is left for other species) : 2 hectares
- ⊗ The amount humans use on average globally: 2.8 hectares
- ⊗ The average for Canadians: 7.8 hectares.

⚙ DEFICIT -5.8 hectares

Plainly we need a new fiscal regime. In fact it would appear that our mission, our business, our way of life needs major adjustments. This type of global balance sheet simply is not sustainable. Just imagine when the current 6 billion people increase to 10 billion people on this earth. Just try to imagine if they all required 7.8 hectares of productive land each. Obviously we are heading for bankruptcy. These are the plans of the World Bank, UN and IMF. Why are we told it is more complicated than this? Simply speaking, our leadership, the large multi-national corporations, the mass-media, world governance, national governments and the rich few are in denial. We are living in a dream that is leading to nightmare not just for ourselves but for our children.

How dare we change? What must we overcome? Unfortunately the primitive forces of fear, power and selfishness run strong among us. These traits succeed best in the current global economic system that we have developed. What does this lead to?

The devastating effects of the most powerful among us litter the world. This institutionalized system of economic terrorism has left billions to starve to death. However, the institutionalized nature of the system allows the rich few to rationalize their treachery in the veiled name of development. This system must be made visible so that justice can be done. We have to confront the fear, power, hate and self-interest that sustains capitalism as currently practiced. Only truth and love have the power to overcome these institutionalized systems. That means a better, fairer, more inspired set of ideas. We must apply the principles of truth and love in support of nature. Only in nature can we find the laws that are universal. Only in the universal laws will we find the elimination of fear, power, hate and self-interest. There is no self in nature. We are one with everything else.

Propaganda

Something that we will find hard but necessary to accept is that we all have been manipulated. The constant billion dollar campaigns of advertising, PR, lobbying, think tanks, professional consultants, and sales people are all driven to create a culture in which the consumer, you and I, buy what we are told we need with false proofs, and under the terrible tactics of fear. Unless we can see this propaganda for what it is we have little hope of overcoming it. It is deeply engrained in society.

Much of it was formed before many of us were even born and we have accepted its foundations without question as the norm:

“It is interesting that since 1998 the Soviet government brainwashed its people by consistently lying to them, but its techniques were so clumsy that the people knew they were being brainwashed. By contrast, in the United States, corporations became expert manipulators, so most people have swallowed the corporate doctrine whole.” (*If You Love This Planet*, pg 161)

These are not easy concepts to accept or rationalize. They would suggest that we may not have full control over the development of our thoughts. In this knowledge we must be prepared to question even our own current thinking. This experience for me can best be described as coming to terms with a kind of insanity from which I suffer, one that was not of my own making, but that nevertheless has been perpetrated against my brain since the moment I was born. Accepting this, I am able to work through “my own” supposed assumptions, beliefs, principles, and thought patterns to try and measure whether they are true, or the simple remnants of past manipulation. Do I really like McDonalds? Is Esso my favorite gas station because they provide the best energy source? What is missing from my life when I watch more hours of television, and how does it affect me and my thoughts? We each must ask the hard questions and search for the real truth.

Progress

Our idea of progress has meant the never-ending innovation of tools, machines, medicine and systems designed to “make life easier”. We see progress in the technology of air travel, washing machines, cars, farm productivity, and a life of greater leisure than our ancestors. We’ve sent men to the moon and back, and lost the designs for how to do it. The incredible advances in science have enabled the transformation of atomic energy into electricity, provided drugs that prevent or cure some of the most horrendous diseases that have plagued humanity, all in the name of progress. Some of the greatest advances in technology have been achieved by the United States military, which isn’t that surprising considering they have received the largest share of tax dollars, in the name of “defense”, providing biological warfare, nuclear missiles, stealth capabilities and even “star wars”. The military build-up led

by the United States was also developed in the name of progress. Military progress is justified as a defense under the aptly named MAD (mutually assured destruction) banners which provide the much desired “security” we all supposedly want. Is this really progress, or have we been sold lies, brainwashed, and betrayed?

The truth is that much of what we’ve been sold as progress simply isn’t. We’ve created a world of have and have not, rich and poor. We have created lifestyles full of artificial barriers and eliminated a sense of connection with nature, each other, and to our own humanity. This artificial system has the rich few destroying the environment at the expense of the majority who live in terrible poverty. This system is of our own making. It is sustained partly by our own lack of empathy, which in part has been created by the brainwashing that surrounds us from the moment we are born.

The current economic system has been thrust upon us without our consent, creating a disconnection from each other and the natural living world that sustains us. The irony is that our highly sophisticated system of deductive research in science has finally come full circle. Where once, in the name of progress, science created the most destructive products of our modern world, now, finally, science is screaming, “Stop!”. This path we are on is killing us. We need to develop a much broader view of progress. We need a vision that integrates nature, partnership, complex systems of ecology, a rational view of “the good life”, and what life can be. We must fundamentally change our priorities, our beliefs, our views of this world, of ourselves, our place, and our relationship to each other.

It’s not enough to develop an understanding of the depths of the difficulties we need to overcome. We have to transform this new understanding into a lasting process for changing ourselves. We need to find ways of fighting the most powerful forces in the universe that are lined up against us. What can provide you with the strength of will to carry out the necessary changes? The answers are not easy. They are, however, as old, true and faithful as nature.

In his book, *Earth in the Balance*, Al Gore tells us what factors led to his extraordinary commitment to solving “environmental” issues. These factors, which he has shared openly, point towards the first step. He says in the introduction to his book “For many more months, our lives were completely consumed with the struggle to restore his body and spirit. And for me something changed in a fundamental way. I don’t think my son’s brush with death was solely responsible, although that was the catalyst.” This catalyst, along with others that came together in a very short period

of time, gave Al Gore a “new sense of urgency about those things I value the most.” What do we value the most...what should we...what does nature teach us to value?

For me, those catalysts were the birth of my children, that moment when they appeared in this world and I broke down and cried in joy. That memory of my deep love, my need to express my joy, their joy, my need to protect and nurture these perfect extensions of me, are the driving forces that enable me to work as hard as I can to see through the current veil surrounding the destruction of nature. Each day now I try to look for the most effective and creative solutions.

This kind of life change is enlightening. Our ability as humans allows us to tap into the emotion of consciousness, empathy, connectedness, compassion, love, and truth. These are the required tools for realizing a life change is required. The terrible specter of massive environmental destruction, the horrific disasters that may lie ahead, and the slow invisible changes that may be killing us need not be the only, or even the primary catalysts. Instead, as in my own case, I believe that the catalyst of truth, love, beauty and connection to my children, and to nature are the most powerful. These creative forces of truth are far more life affirming. Only the power of love within these catalysts is strong enough to weather the long-term work required to justify it.

The effectiveness of this kind of life change is extraordinary. This kind of change is fundamental. It is within. It is based on a truth that can sustain the short-term difficulties. Another story that suggests the seeds of the new way of thinking that we must all embrace,

“But I believe deeply that true change is possible only when it begins inside the person who is advocating it. Mahatma Gandhi said it well: ‘We must be the change we wish to see in the world.’ And a story about Gandhi – recounted by Craig Schindler and Gary Lapid—provides a good illustration of how hard it is to ‘be the change.’ Gandhi, we are told, was approached one day by a woman who was deeply concerned that her son ate too much sugar. ‘I am worried about his health,’ she said. ‘He respects you very much. Would you be willing to tell him about its harmful effects and suggest he stop eating it?’ After

reflecting on the request, Gandhi told the woman that he would do as she requested, but asked that she bring her son back in two weeks, no sooner. In two weeks, when the boy and his mother returned, Gandhi spoke with him and suggested that he stop eating sugar. When the boy complied with Gandhi's suggestion, his mother thanked Gandhi extravagantly—but asked him why he had insisted on the two-week interval. 'Because', he replied, 'I needed the two weeks to stop eating sugar myself.' ”

Can we stop eating the sugar? Can we find the will to live by our principles? Are we creative enough to figure out these complex problems and their solutions within the confines of our principles and nature's principles? Can we connect with each other so that our own transformations make a difference, by changing others?

Addiction

As if brainwashing, false visions of progress and self-interest were not enough we must also wrestle with addictions. Some of the legacy of our evolutionary origins has left us with traits that make us susceptible to addictions. Some of these may have served a natural purpose in our primitive past. However, under the powerful influence of the media these traits have led us to become addicted to a way of life. That way of life is not sustainable. Despite the knowledge that it may lead to our ultimate downfall and death, we find it hard to admit we have this addiction. In so many ways this addiction to consumer goods for instance seems like “progress”. How on earth could everything that we've come to associate with the “good life” — the information age, the technological age, and the age of automation, which we see as improving our lives, be an addiction? As Helen Caldicott says:

“We have become addicted to our way of life and to our way of thinking. We must drive our cars, use our clothes dryers, smoke our cigarettes, drink our alcohol, earn a profit, look good, behave in a socially acceptable fashion, and never speak out of turn or speak the truth, for fear of rejection...The problem with addicted people, communities,

corporations, or countries is that they tend to lie, cheat, or steal to get their fix. Corporations are addicted to profit and governments to power, and as Henry Kissinger once said, 'Power is the ultimate aphrodisiac.'...The only way to break addictive behavior is to love and cherish something more than the addiction...In the industrialized world, and indeed in most of the Third World now, governments are more and more run and organized by a few corporations. But the corporatization of government is not conducive to global survival, as we have seen. A corporate mentality encourages greed, selfishness, and consumerism, not compassion for people or for nature."

I have dedicated my life over the last several years to the creation of a lifestyle sustained by nature and solar energy. To a large degree our inability to admit we have a problem poses one of the greatest difficulties. As I have learned the hard way this difficult first step is necessary. Unfortunately for most of us this first step does not take place, without a major, often traumatic, difficult crisis. This crisis often leads to an emotional and mental break down. If we are lucky we remember what really matters: those we love and if we are lucky, they are still willing to support us despite our moments of insanity and denial. I believe that we are addicted to a way of life that is destroying nature. Our current global society is destroying the environment that sustains us. Thus we are destroying ourselves slowly but surely.

There are some obvious similarities to the destruction caused by alcoholism. I had to admit that I was an alcoholic several years ago. It was quite literally destroying my family and had jeopardized my job, right in the middle of my quest to achieve a sustainable lifestyle. At the point at which I thought I would lose everything I found the courage to admit I had this problem. To make sure I was tested (do you drink every day, do you binge and forget what happened...). Sure enough I was assessed as being an alcoholic. Although at first I did not want to go to an Alcoholics Anonymous (AA) meeting I finally did. They gave me their book that includes the twelve-step program.

The idea of admitting my problem with a group of people like myself, alcoholics, was difficult at first. And yet, as each person related their problems, ones so similar

to my own, it became easier for me to do the same. Acknowledging this problem and the problems it caused my family, was critical...how else, I discovered could they ever have been solved if I didn't acknowledge or admit they exist and that I was responsible for them. I also learned that it can help a great deal to make right my past wrongs. I forced myself to find the people I had wronged, try to apologize, and ultimately make right what I could. This effort took many years in some cases. Even at the point when I thought it had failed to make any difference I came to realize later that it had. Certainly my ideas for *Natural Living* have been influenced by these experiences. As I relate here and elsewhere our current lifestyle is to some extent an addiction. For some of us these types of steps can help a great deal in resolving these addictions, although, as they say, we must always be mindful, as we will always be recovering.

Collectively we need to look each other in the eyes and listen. When it is our turn we need to try to admit that we do cause some of the problems, explain which ones, and then, if we are ready, make a vow to try to change the addictive habit. I drive a car that pollutes the air and kills people. I have driven it when it wasn't all that necessary. I am a polluter.

I think I've found a program that can help us out of this nightmare. It is the story of *Natural Living* that follows in the next two sections of this book. We must not be afraid to look the problem in the eye as we have done in this section of the book. On the other hand dwelling here doesn't solve the problems either. First, you must accept that these problems exist, that **you** have a problem, and that **you** are responsible for changing your life and making right the wrongs. It is a wonderful journey but the key is taking the first step. Rather than shame, you should feel a great inner strength, a welling up of love that will drive you through the remainder of the steps that we must all take to rid ourselves of these addictions.



Natural Living

1. Awareness
2. Food
3. Plan
4. Home
5. Choice
6. Transportation
7. Creativity
8. Work

SECTION 2: NATURAL LIVING

“As human beings, our greatness lies not so much in being able to remake the world, as in being able to remake ourselves.” – M.K. Gandhi



Chapter 4

TAKE THE FIRST STEP

Start today, right now. Seem like a lot of new stuff to learn? Actually things seem pretty good in general. Maybe things will work out, they always have in the past. I am sure the people in power are looking out for us...hmm...well maybe not. No, if we don't do something, things will not change. It really is up to us, you and me, starting right now.

Where can we find the energy and inspiration to continue? Look for the light, that fire that burns in all of us, in all of nature. Find your inspiration in the constant rebirth of nature all around you. We must see again with new eyes. We must rebuild our thoughts on the foundation of truth. All the answers exist in nature, in our heritage, and in our technology. The answers are all out there. Everything we need to know has been figured out. All we need to do is take the first step.

Take the time to learn about your connection with nature by stopping to watch the sunrise or sunset. Be aware of the true causes of problems in the world. Be skeptical of anyone who says it is impossible. Even the best among us may be mired in cynicism, wrapped up in ego, or thinking too conventionally. Keep in mind that we may be misinformed. Don't be deceived by one-sided reporting on issues. Know that there is more to life than the money it costs to buy something. The things of daily life are wonderful things that we should take care to do with all our heart. You know what is right. Do what is right.

How do I know this? When I ask myself, "What is the purpose of my life?" The simple answer comes back, the life of my children. It is the same as it has always been and it always will be. It is the same as for bacteria, plants, insects, birds and all other forms of life. Our primary purpose is the creation, preservation, nurturing and propagation of life. The purpose of life is to live as well as we possibly can.

The first step, I propose, is to embark on a path that reduces the complexities to a level that we can understand. By focusing our attention on the essential purpose of

life, we will recover our awareness of nature . The essential elements of life, even our complex modern one, are still the food we eat, the home that shelters us, the type of transportation we choose, and finally our life's work. In all of these we must consider how we can best serve the needs of our lives so that we may create a nurturing environment for our children and their children. In our choice of food, the homes we build, the cars we drive, and the work that pays the bills, we must ask ourselves, does this truly support our purpose? And if it does not, then we must choose to change our ways, creatively.

Some of the best things in life can be found in sharing food with family and friends, finding happiness by exploring natural places, having fun by playing in water, creating, loving and even just being. These things are the basis of a fulfilling life based on the purposes of creation. Many creatures in nature demonstrate these same traits.

I've learned to have fun and even laugh at myself in relation to the many things that I've changed in quiet contradiction to the norms all around me. I remain humble in the face of nature and people who every day teach me something new. But yes, the issues of preserving life on this planet are very serious. Given the grave consequences of ignoring the warning signs and knowing that our purpose is creating and preserving life and nature, surely you will agree we must act now. To this task I propose, based on my direct experience, learning from many mistakes, the following step-by-step process. These steps offer a fun, simple, and effective system for living sustainably as you apply it in your own creative way. These steps help us address the highest priority problems that we each have direct control over. These changes may seem substantial at first. Some of them are. But they are all achievable and provide many benefits.

Stop everything!

Listen to silence. Find a quiet place and listen to the silence of nature , full of life, full of music. Take some time to think about who you are, what you are doing, and why. What is your purpose in life? What talent do you have that, when you do it, puts you into such deep focus and enjoyment, that you don't notice the passage of time?

Stop everything!

Plan to take next weekend off, completely off. Go for a walk in nature. Make it a long walk as deep into nature as you can. After walking into nature for several hours, away from other people, stop, listen, and look around. Don't think. Simply

be aware of nature, life, rocks, leaves, sun, wind, wild flowers, leaves, grass, birds chirping and your heart beating. What value and beauty do you feel? Can you sense your connection to this force in nature that creates life? You can notice it when you tap into the harmonics of nature.

So maybe that seems a bit over the top. It worked for me when there seemed to be no other answers. Alone in nature I was re-awakened to a primitive driving force within me to nurture and preserve life. By feeling nature's pulse I found the energy and understanding I needed for the battles ahead.

Another way I like to connect to nature, one that may be more accessible to you on a regular basis, is to start by walking down to the local coffee shop. Buy your own reusable mug with a lid if you don't have one already. Select one of the organic coffees. If you can, sit outside in a sunny spot. If it is too cold, then simply sit near the window. Sip your coffee and observe, without thinking, without judging. Let the caffeine infuse your arteries with that positive energy boost (take care not to become addicted). Then simply be. Dream. Love what you see around you. You are connected to all of nature, the little weed in a crack on the sidewalk, yes the people, the cars, trucks, buses and even the small puddle with birds playing in it.

Stop everything!

More than anything it is a reconnection with nature. You are a part of the living earth. Take notice of it when you swim, through the plants you eat, in the warmth of the sun on your face, and when you hold someone, mother to son, father to daughter, and lover to lover. We are all one. We are all connected through time, space and matter as one in nature. Science proves this. You can sense it by thinking of how you were created and how you came to be. The intelligence of life, the creativity of ever diversifying life forms is intimately connected to everything else in the universe. Something in this nature we share connects everything to everything. Our goal must be to find these connections. Our perception of individuality is not real. We are both metaphorically and scientifically one with the broader context of nature as a whole. Two implications are: First, that the harm and destruction we inflict on nature injures us all as a whole. Second, that our actions towards the healing process individually will heal the whole of nature.

Stop everything! You need not do anything!

The first step is awareness. This means being aware of nature and your connection to everybody and everything else. Be more thoughtful about your actions.

Connection to nature is easily felt by simply removing all thought and focusing on your breathing as your lungs make the connection with air which is connected to the infinite. Awareness provides you with the knowledge, intelligence, compassion, empathy and feelings needed to desire, through love, to protect your greater self, called nature.

This connection became clear to me during the birth of my children. This epiphany is the first step along the path of *Natural Living*. Without this first step the other steps may be too difficult since they are built on the foundation of awareness. Only with awareness of your connections, as you go about the process of living, can the rest of these steps continue to make sense.

Some essential features of all our daily lives include eating, sleeping in a home, getting to work, and the work we do to earn a living. These common activities are the most damaging to nature. This correlation makes sense. The activities that are common to all people create the largest stream of consumer activity. The main activities of our lives include providing a home for our families in which we share family meals. Eating food is essential for all life. These two natural activities are at the root of life, all life in one form or another. For humanity, however, two other major activities have been created by modern civilization. These modern activities include the need to work, to earn money, to pay for a home and food. Also, the majority of us must use some form of mechanical transportation, such as a car, motorcycle, truck, bus, train or plane now that there are so many of us living and working in different places.

Our so-called modern civilization, despite the many advances, has at its core the need to provide for the essentials of life. These are primarily the need for clean air, nutritious food, fresh water, solid shelter and some rest. As it turns out these ancient essential activities...given our vast billions in number...create the largest impact on nature. We can well do without popular consumer activities such as television, video games, and alcohol. However, we can never do without food to sustain us, a shelter of some kind, work to pay for it or transportation to get us from one to the other. That's why these activities are the most problematic activities. Since they are the root of the problem the greatest impact can be made by addressing them first. That doesn't mean doing without, but it does mean asking deep and hard questions about each and every aspect of these cornerstones of our lives.

That is why *Natural Living* revolves around these changes to the essential activities of daily life:

- **Food** – Switch to organically grown natural healthy local varieties.
- **Home** – Transform your home so that it uses energy efficiently, is created from natural renewable materials, and provides a healthy and inspiring place to live.
- **Transportation** – Take the necessary steps to better use public transit. Whenever possible avoid the use of a car. If a car is required make the switch to an ultra low emissions vehicle or better with your next purchase.
- **Work** – Do what you love to do. Ensure that this activity is life supportive. Make plans to change the work you do to be supportive of a sustainable society in the long run. Live near where your work.

In order to make these changes, it's necessary to change our mode of thinking. So much of what we do every day seems routine and common to everyone. Most of the systems that form the fabric of our societies support these common routines. These engrained systems aren't normally visible. We don't even consider them, since they seem so normal. Unfortunately many of the normal things of every day life have developed from the abnormal until they're perceived as normal. We need to break these linked systems in order to change the essential activities of our lives.

The glue that links together the essential activities of *Natural Living* includes four principle changes in the way we think. Actually, these aren't changes at all; they are more of a reawakening to the essentials of a life worth living. After all, it is a search for the good life, a life that creates and sustains life that is at the heart of *Natural Living*. In order to find the path, the life force that holds nature together for people, we must consciously adjust our way of thinking. Unlike most forms of life in nature, humanity has the responsibility of a brain as our niche survival trait. This brain has advanced so far that, combined with our large numbers, the machines we've created, and the new ways we transform nature, we have the power to destroy ourselves maybe even all of nature on earth. Of course that same brain, when applied creatively with a broad understanding of our connections to nature, has the power to be not only life-sustaining, but the greatest celebration of life through awareness of life itself.

That's why the four steps that bind together the activities of *Natural Living* revolve around the way we use our brains:

- **Awareness** – Use your reasoning powers in order to get beyond your self, to move beyond self-awareness, into a universal awareness of your connection to nature. This evening, my daughter explained it to me this way: “We breathe in oxygen from the air and breathe out carbon dioxide for the plants to breathe in our carbon dioxide and then they breathe out oxygen for us to breathe in again.” We as a species are symbiotic with the plants all around us. Think of it!
- **Plan** –The power resides in each of us to take the first steps. We must plan to make changes in these essential aspects of our lives through these first steps, and all the remaining steps of our lives. Planning is our connection to the element of time—so relevant to life's trans-formative powers. Time only exists in this moment so make a plan now and get changing things now.
- **Choice** – Make choices consciously in every moment, with a full awareness of your connection to nature. Making choices consciously breaks the binds of illusion built into the routines of daily life.
- **Creativity** – In making the choices of daily life, apply the full depth and power of your creativity, to find the broad array of your connections. We need the power of creativity to help us find new answers or rediscover old answers.

These are the steps of *Natural Living*. Before getting into the details of these steps the next chapter provides you with a quick start guide. If you are like me you'll want to get started right away. The next chapter provides first a short term step by step summary of actions you can take along with their associated benefits. Then a long term step by step summary of actions are provided that enable you to make the deeper changes we all must make in order to create a sustainable world. These one page guides are designed to give you a quick reference to the most essential information on the steps of *Natural Living* to make it easy for you to review each day.

The Path Ahead

The main reason current lifestyles are not sustainable are manifest in the broad use of limited supplies of fossil fuels for:

- Transportation (cars and trucks)
- Energy production (coal and oil powered generating stations)
- Agriculture (fertilizers and mechanization)
- Plastic (fossil fuel based products)

Fossil fuels pollute nature with the rapid release of millions of years of stored carbon and energy originally captured by plants from the sun. Fossil fuels are not renewable. In fact, many types may be depleted within the next fifty to sixty years. Additionally, the large scale “waste” and inefficient use of water, organic matter and non-renewable resources are destroying forests, filling up land fill sites and contaminating nature. We need to find alternatives. We need creative ways to economize, reduce, and recycle, as in natural sustainable processes. Thus, the goal is a return to balance, as inspired by nature. The solutions are found by eliminating, significantly reducing or transforming the processes involved with the essential activities of our lives. The goals of *Natural Living* are:

1. Use sustainable non-polluting energy sources (primarily the sun and wind).
2. Select local organic food or grow your own food organically.
3. Choose to live within walking or biking distance of where you work and use public transit.
4. Create or transform your home so that it is optimally oriented for solar heating and natural cooling ventilation, including natural renewable insulation materials to retain heating and cooling.
5. Where and whenever possible eliminate, or where required, change all appliances and lighting over time to be the most efficient, long lasting available while minimizing their use.
6. Construct your home and all products you choose in your home from natural renewable materials.
7. Recycle wastes and water back into nature using living machines, composting or other natural processes.
8. Reconnect to life energy, creativity, beauty and inspiration in nature.

Applying these goals to your daily life is a wonderful experience. The necessity of finding creative alternatives in order to reach these goals has enriched my own

family's lives by bringing us closer to nature. These goals are designed to provide the most impact for addressing the highest priority activities of our consumer oriented lives. We certainly haven't achieved all of them, all of the time, but by having these front and center as we make our daily decisions and plans for the future we are changing the world, and the world that will be left for our children. Now it is up to you to make an even bigger impact. Tell others. Try out these ideas. Be prepared for both success and failure. Both are part of the process. You will find a more joyful, natural way to live your life.

In order to express this new type of lifestyle we need new measures and frameworks for defining these terms. Many modern philosophers, scientists, designers, artists, musicians, doctors, and engineers are creating these new definitions. One such thinker is Deepak Chopra. Combining his knowledge as a medical doctor and of the ancient spiritual traditions, he has woven together a set of principles that redefine life with some of the deeper context that is at the heart of the new connection to nature that we need to make. The essentials of true wealth can be restated in terms of *Natural Living*, based on the principles expressed by Deepak Chopra, as the seven spiritual laws of success. We are fortunate to have many new creative options that are gaining in popularity as people begin to rethink their priorities in life:

1. Think about each action we take in our lives and ask what will be the effect on nature and our fellow human beings. If it is peaceful, loving, truthful and sustainable then it is the right action.
2. It is time we returned value to where it belonged. We must return to an understanding of value for the infinite creative potential of people and nature as the highest source of wealth. We must spend more time in nature, in quiet, and in openness to change.
3. Be prepared to share, give and receive a fair flow of essential life sustaining resources such as air, water and sunshine.
4. The infinite creativity in nature has provided all of the answers. We need only understand the intrinsic nature and value of anything. In nature things are as they should be. We must take responsibility for our place in nature. In nature time unfolds with least effort or maximum efficiency. We must learn to value this efficiency and intelligence and use it creatively and sustainably.

5. Make a concerted effort to focus your intentions on a sustainable and more fulfilling way of living, the *Natural Living* way, along with its principles. By maintaining a clean and healthy environment of air, water, earth, sunshine, family and community, and through a focus on this every day, in every moment, we can attain something natural and sustainable for all people.
6. Maintaining a detachment from the results allows us to be open to the creative solutions that exist in the process of trying to attain a natural lifestyle. The infinite potential of creativity means we must be open to change, open to the new and unusual answers that may appear along the path, even if those seem to contradict the conventional.
7. Finally, we each have a very important part to play. We each have a special purpose in life, a gift, something we love to do, that we must find and apply to this critical process of living naturally, living sustainably so that our children can enjoy the same infinite potential.

The wealth of the majority in this respect already outstrips that of the “rich” few. We are on the right path. As Mahatma Gandhi said, “...life is about the search for truth, ahimsa, the process of living truthfully, with non-violence, simplicity, and harmony, and love.” Modern society has lost its way through the worship of growth, profits, money and economics as wealth. The institutions of multi-national corporations and corporate sponsored government have lead to societies that are driven by profit and growth for the rich few at the terrible expense of all of us. And yet we can regain a meaningful life as simply as making a decision to do so. Create your own framework for living based on the laws of nature . Find the truth in the spiritual traditions, nature and science while searching for your own creative answers.

Chapter 5

TAKE ACTION

The following tables provide a quick summary of the *Natural Living* action plan. The first column is a reference to the most significant consumer activities or “Life Activities” that are currently unsustainable. The second column, “Take Action”, provides a simple list of priority first steps that will make a major impact. The third column, “Results and Benefits” summarizes some things you can expect to accomplish.

First Steps, are simple and easy things we can all do to start along the path of *Natural Living*. The second table, **Natural Living**, is a list of priority steps that provide goals which you can set your sights on achieving throughout your life. These represent the essential elements of *Natural Living* and will result in the vision outlined in the introduction. Ultimately *Natural Living* reverses the current trend towards the destruction of nature and moves us to a restoration of nature and our reestablishment of reverence for it.

All it takes is for a few million of us to do these things, and those few million to encourage a few billion to join us, and that changes everything. Considering the so called “six degrees of separation”, making this change happen globally isn’t that hard to imagine. Through many projects in my own life, I’ve often heard, (as I am sure you have) that “it can’t be done...it won’t work....it costs too much”. And yet, in most of these cases those precise thoughts have been proven wrong. It can and must be done. “Can’t”, “won’t” and “costs too much”, are indications that creative solutions exist waiting to be discovered. Change for most of us is difficult to deal with emotionally since it means confronting the unknown. The wonderful part is that once we confront this fear we are rewarded with the creative energy to continue.

Take action today by cutting out the **First Steps** table. Post it on the fridge at home or in your office, and try to make progress each day towards achieving some of

these changes. When you've achieved some success with the first steps, then begin to focus on the **Natural Living** steps in the second table. As you achieve these steps celebrate the many benefits you and nature will reap. It took me years to take a few of the First Steps. The bigger steps outlined in the **Natural Living** table took more than ten years to achieve.

Review these tables and keep them in mind each day. Then you can return to the following chapter to find specifics and details on ways you can achieve *Natural Living*. Or, after reviewing these tables you may want to skip to section three, which records the experiences of my family, and learn about our journey. It can be done. We all can do it.

What to Expect

If you are feeling overwhelmed by all of the changes that are necessary, consider taking some simple small steps to get started. As friends have told me, "you can't expect everyone to jump in like you've done." Some of our first steps, which helped ease us towards the steps of *Natural Living* included:

- ⚙ Beginning to purchase some organic foods from our local super market
- ⚙ Reviewing the local recycling program guides to be more accurate and thorough in our recycling practices
- ⚙ Packing kids lunches in re-usable containers
- ⚙ Purchasing a coffee mug at work to reduce the use of paper cups
- ⚙ Purchasing natural and biodegradable dish washing soap
- ⚙ Planning a new solar powered dream home (dreaming and planning is free)
- ⚙ Downsizing our home in order to save for a solar powered home
- ⚙ Beginning to select products based on efficiency and quality even if that meant paying more.

First Steps

Life Activity	Take Action	Results and Benefits
Transportation by Cars and Light Trucks	Use public transit or car pool once per week. Purchase an efficient vehicle that meets your needs. Avoid trucks and truck-like vehicles such as SUV's.	Lowers your transportation costs. Reduces pollution. Sends a message to two of the worlds largest and most destructive industries, car and oil companies.
Meat and Poultry Food Consumption	Eat vegetarian one day a week. This results in a 10% reduction in meat consumption.	Eating one less hamburger a week could potentially be saving over two-and-a-half thousand square feet of rainforest, while preventing an additional 26,000 pounds of carbon dioxide from entering the atmosphere. Also, the decrease in meat in your diet substantially reduces your consumption of pesticides, hormones, and animal antibiotics. Pesticides alone accumulate in meat at 9 times greater levels than in vegetables and grains. Less meat is better for your health. (<i>Your Heart Your Planet</i>)
Fruit, Vegetables and Grains Food Consumption	Purchase and eat organic carrots, tomatoes, lettuce, bananas, cereals and apple sauce. These are readily available at most large super markets.	Organic vegetables taste better. Eliminating most fertilizers, herbicides and pesticides will improve your family's health and that of the agricultural environment where these foods are grown. Organic farming practices ensure improved soil conditions rather than the loss of soil related to conventional farming.
Home Heating, Hot Water and Air Conditioning	Insulate and/or better ventilate your home in order to reduce your heating and cooling energy requirements.	Reduces the use of fossil fuels that generate carbon emissions at the heart of global warming. Done on a large scale, these changes significantly reduce the amount of polluting emissions created by these processes.
Household Appliances and Lighting	When purchasing new appliances, especially your refrigerator, select the most efficient model available. Check the "EnerGuide" ratings for energy usage and expected savings.	The reduced energy usage will save you some money. The reduced electricity demand will mean less pollution from the power plants and less wasted energy in the gigantic power grid. Your refrigerator is most important because it is running all the time.
Home Construction	Select natural renewable materials to furnish your home. Try using recycled furniture, improve insulation levels, and improve the use of passive solar design including better insulating windows if renovations are required.	The use of renewable materials or recycled materials dramatically reduces the need to extract these materials from the earth. Reduced pollution and less waste will be created. Insulation and passive solar features in a home will significantly reduce the energy requirements reducing the pollution and costs.
Household Water and Sewage	Install low flow shower heads and taps. Make sure that all toilets require no more than 6 liters of water for each flush. Transform your garden into a naturalized landscape that requires little or no watering.	Water waste will be reduced leaving this precious resource in a cleaner state. By naturalizing your garden, far less water will be wasted on plants that aren't native to your local area. Also, by eliminating the need to use pesticides, herbicides or fertilizer in the naturalized garden, less water will be contaminated by these substances.

Natural Living

Life Activity	Take Action	Results and Benefits
Transportation by Cars and Light Trucks	Use public transit to get to work. If possible eliminate the need for a car. If a car is required purchase a hybrid or better car that reduces pollution by 90% compared to conventional cars today. Get a non-polluting fuel cell or better car once available. Walk, roller blade, skateboard or ride a bicycle for local travel whenever possible.	Reduced pollution levels will be significant enough to potentially reduce the dangers of global warming. Reduced transportation costs will provide more alternatives for different lifestyle choices including more time with family, increased enjoyment of nature, or investment of savings in solar power generation that further reduces long term expenses and pollution.
Meat and Poultry Food Consumption	Go vegetarian one day per week, and gradually turn more days into vegetarian ones by trying more vegetarian recipes. Try to limit meat and poultry to special occasions.	Health improvements from reduced consumption of meat will reduce overall health costs. Increased efficiency of food production through the use of agricultural land for vegetable, fruit and grains for human consumption rather than for animals.
Fruit, Vegetables and Grains Food Consumption	Grow your own fruits and vegetables organically as much as possible. Purchase organic foods exclusively. Try to shop for local fruits, vegetables and grains whenever possible. Eat fresh raw vegetables and fruits daily.	The transformation of agricultural systems will occur in response to the demand, reducing prices, and reducing the destruction of soils and water with the elimination of pesticides, herbicides and fertilizers. The massive reduction in transportation pollution will also improve the local air quality while at the same time lowering the cost. Improved health is associated with the consumption of fruits, vegetables and grains. Improved health saves money in health care costs which can be used for preventative health care.
Home Heating, Hot Water and Air Conditioning	Install a solar hot water heater for water and home heating. Replace your air conditioner with a home renovation or new home that is entirely naturally cooled with natural ventilation, green roofing, trees, and shading. Insulate your home with straw bale or better natural insulating materials to retain heat in the winter and coolness in the summer.	Improved indoor air quality will provide a better, healthier living environment reducing health problems. Large scale reduction in the requirements of central fossil fuel power plants also means significantly reduced pollution. The move to solar and natural cooling systems will make it possible to invest in independent solar power systems sufficient for all power requirements.
Household Appliances and Lighting	Convert to solar, wind and non-polluting renewable energy sources. Select only the most essential appliances and ensure they are the most efficient available. Eliminate any appliances that are not needed or that are inefficient. Find all "phantom loads" and eliminate them since they are like a leaky water faucet.	The reduction in power requirements will allow nuclear and fossil fuel power plants to be decommissioned while lowering the cost of renewable energy sources. Currently fossil fuel power plants are major contributors to global warming. Nuclear power is expensive, complex, risky and has no known means of safely disposing of the waste produced.
Home Construction	Use natural renewable building products like straw bale, cob, hemp, rice bales, bamboo, and other renewable materials. Optimize the orientation of your home for passive solar heating, natural cooling, ventilation, and reuse of local materials.	The massive and rapid destruction of forests world-wide will be halted. Reduced energy requirements will allow renewable energy sources to be sufficient to supply the majority of energy requirements.
Household Water and Sewage	Collect rain water and use it exclusively. Process sewage in a composting toilet system or a living machine based waste treatment system.	Water quality and availability will be maintained. Local soil will be improved by compost material.

Natural Living Big Steps

After about ten years of developing our awareness and concern we started to eat more and more organic foods to the point where we make a conscious effort to, whenever possible, select them exclusively. We consciously make choices to select products that are the most efficient or locally made. After starting to use public transportation more frequently and saving for a hybrid car, we began to use our creative powers to imagine and develop alternatives to daily activities that were centered around nature – like spending more time working on projects designed to support a natural lifestyle, while getting involved with experts in order to plan our sun powered home. Finally, we took the giant step of building a home with straw bales. So far, achieving *Natural Living*, for us has meant:

- ⚙ Using public transit without exception other than in emergencies
- ⚙ Planning for our next car to be hybrid gas/electric (we got the Toyota Prius in 2004)
- ⚙ Replacing meat with vegetable based alternatives more and more and selecting primarily organic or free range meats from our local organic grocer
- ⚙ Planting an organic vegetable garden, fertilized with organic compost generated from our food and garden waste
- ⚙ Composting all of our food, reducing our waste
- ⚙ Allowing the landscape to naturalize, planting local wild flowers rather than grass around the house.

Now that we've taken a peek at things it is time to take a look under the covers. In the next chapters in this section we will review in detail the key concepts of *Natural Living*.

Chapter 6

NATURAL LIVING STEPS

The following are specific actions, decisions, products, and solutions to implement in order to create a lifestyle that is in harmony with nature. These steps are driven by the power of the sun. All life is powered by the energy of the sun. Pick a few steps to start with. I find writing them down and keeping them with me helps remind me. Make these the starting point for achieving your own personal goals for *Natural Living*.

Step 1: Awareness

Reminder: We are the environment.

- **Connection** – Know that you share nature with plants by the fact that you need the oxygen they produce while they need the carbon dioxide you supply in a symbiotic relationship. Remind yourself of this connection each time you see a plant or tree. Think of this as you take time to stop everything in order to simply become aware of your breathing. Change the way you view your relationship with nature from self in nature to self as a part of nature. The next time you are able to go swimming in a lake or the sea, take a deep breath, submerge yourself, and feel the water all around you.
- **Give Thanks** – Respect your connection to nature which means respecting and giving rights to other people, plants, animals, the soil, rocks, air and sand. Next time you feel the need to squash a bug in your house, stop, observe the little creature, get a tissue, gently pick it up, take an even closer look, and then let it go free outside. Have compassion for every aspect of nature since it provides you with everything you need. Take a moment at your next family gathering to thank the natural world for all that it has provided, for you and those you love. Give thanks silently for the next *Sun Rise*.

- **Love and Truth** – Do what you know is right. Start making changes consciously with your newfound awareness. Seek the truth. Search more deeply, more passionately, and with greater critical thinking into the most important issues affecting your life and those of your children. Remain tolerant and non-violent in your fight for freedom, justice and the truth. Fight injustice by making it visible with compassion. Always be prepared to forgive. Know that the only answer to the most difficult injustices against which we must fight is love. Love all of life no matter the circumstances. Remember that the way of peace, harmony and good always triumphs in nature. Conflict and war, ignorance, and self are temporary states of being, illusions, that will disappear in the mists of time. Find justice and harmony for nature. Where you see disturbances to the harmony, work to restore it.
- **Laugh** – Have a sense of humor. In the midst of all the chaos and seeming futility, remember that the storm will break, and on the destruction laid bare, the sun will shine again to bring a smile to your face.
- **Passion** – Do what you love doing. Keep the purpose of your life ever present in your mind and live by it. Look for your purpose, your natural gift, nurture it, and do it. Find your passion and live it. Find inspiration in the wild creatures and wilderness all around you. Let the power of the wild give you the energy to take the next step.
- **Humility** – Trust in nature. Go back into nature alone, listen, and reconnect in order to feel what always, without fail, nurtures and cares for you. Be humble given your place in nature. Through humility you will gain the respect of the larger whole.
- **Responsibility** – Take responsibility for your connections to nature. In everything that you do, think of how it will impact nature, which sustains you and connects you to all others.
- **Enlightenment** – True wealth in nature comes from awareness, not money. Nature is true wealth while money is an illusion.
- **This Moment** – Now, each moment is the only reality in which you can actually do something. Do something now that your awareness in this moment says will create a sustainable world. Seize the day!

Step 2: Food

Reminder: You are what you eat.

- **Appreciation** – Without food and water all life dies quickly. Without water, most life dies in days. Treat every drop of water as the most precious resource on earth.
- **Eat Organic ally**– Think very carefully about everything you eat: Where did it come from? How was it grown? Be conscious of the nutritional value, sources of nutrients, and methods used to grow it to ensure that it has been done organically. Take joy and thankfulness in every morsel of food that nature blesses you with. As you eat, take the time to think how precious each morsel is and how it will become a part of you. Keep in mind that “you are what you eat”, so eat good, healthy, fresh, sweet, varieties of naturally grown food. Buy local fresh foods as much as possible. Get to know where you can buy locally grown fruits and vegetables. Choose the freshest, organic, local varieties of fruits, vegetables, and grains. Try to buy only locally grown organic food.
- **Compost** –. Keep a composting bin in your kitchen in order to store your organic waste through the week and then empty it into your outdoor composting unit on the weekends. Compost all of the food waste that you can. Use compost as an organic fertilizer in your new vegetable garden. Think of the magical part you are playing in nature’s creative process.
- **Think Vegetables** – Try to have a “vegetarian” day once a week or more or, if you can, become a vegetarian. The move to a vegetarian diet can be challenging but the rewards in terms of health for you and the planet are well worth it.
- **Grow Your Own** – Start trying to grow your own food. Grow herbs in your kitchen. Try basil and dill. Growing your own food makes the connection to nature more real and produces better tasting food. Start your own, ten feet by ten feet, organic vegetable garden. Begin to grow your own food organically. Take your time. Enjoy the process of creatively cooking, eating, growing and cleaning up after meals. Involve your children, family and friends in the process of planting, tending, and harvesting the bounty of your garden,

preparing the freshly cut vegetables and herbs, and cooking these especially tasty meals from your own garden. The food of life is one of our sacred connections to nature. Be aware each day as you eat, and be thankful for this life energy that sustains you. Maintaining an appreciation for the miracle of life in the food we eat ensures that we are mindful of our place in nature.

Organic, fresh, locally grown foods represent the healthiest, tastiest, most natural way to eat. By starting to grow some of your own vegetables or herbs both indoors and outdoors you will get some wonderful food. You will also re-establish your connection to the miracle of nature. After water, which we must take care to use consciously and carefully, food is our most basic necessity. Food is one of the most basic connections we can make to nature and our survival.

In our family, eating has become something we try to make the special ritual it ought to be. Growing vegetables in our garden has deepened our awareness of what food really means. Each meal that we prepare reminds us that the tomatoes come from the seeds we planted last spring, the potatoes are the ones we nurtured through the hot dry summer.

If all of these steps seem too overwhelming, remember that for us, it all started with just a few organic vegetables from our local super market ten years ago. Try out the organic fruits and vegetables for your baby since they will have no chemical pesticides or herbicides to wash off. Put organically grown carrots in your kids' lunch. Let it grow from these simple first steps.

Step 3: Plan

Reminder: Failure to plan is planning to fail.

- **Start Small** – Review your current situation to see how you might be able to save money by applying the ideas for *Natural Living*. Start by recycling more than you do now or by selecting a few organic food products.
- **Principles** – Establish your principles for making changes to your lifestyle so that you have a reference that supports your choices based on a well thought out review of your values, purpose in life, and awareness. Planning is a powerful process for achieving your goals but remember that this is a process that must be constrained by nature's principles.
- **Establish Objectives** – Determine the specific objectives of your plans especially as they relate to the *Natural Living* steps,
 - Allow time for awareness, review and reflection;
 - Set goals and objectives for the move towards more vegetarianism days and organic food you share with family and when you can start to grow vegetables yourself;
 - Review life choices you have in terms of where you live, your work, the vacations you take and find ways to align them with your principles;
 - Make plans to avoid the use of your car wherever possible, and think about making your next transportation purchase a bicycle or hybrid vehicle;
 - Begin to apply your creative abilities in order to find ways of achieving *Natural Living*;
 - Think of ways you can transform your home,
 - Make your life's work the process of *Natural Living*.
- **Take Action** – Apply the principles of *Natural Living* to the process of setting your goals and to each step towards achieving your plans. Let these principles be a challenge to your powers of creativity.

- **How? Yes.** – Set goals that are measurable with specific deadlines. Celebrate achievement of these specific goals. It is better to have tried, through planning, and failed than to never have tried at all. Failure should be celebrated as a part of the process of creation. The process of establishing a plan sets in motion a set of potential events that would not necessarily occur without this plan. Remember that the answer to “how?” is YES (from the book by Peter Block). In other words it can be done. Have faith, a positive attitude, a set of natural principles, a reasonable map, and the universe will align to support you.
- **Trust Yourself** – Some people will encourage and support you, others will insist that you are crazy, that it can’t be done, that it is pointless, that you are stupid. Take the power of those that help you, listen for the reasonable in all that you are told, and always be ready to prove the skeptics and cynics wrong.

The best way to achieve *Natural Living* is to visualize what it means for you. That means taking the time to write down your purpose, your goals, and vision. This is the process of planning for *Natural Living*.

Through every step of the process of creating your new natural lifestyle it is very helpful to maintain and adhere to a set of principles. These principles should be referred to as you make the major decisions at each step of your plan. These principles can evolve depending on your specific projects. Create your own principles for building a new home, selecting your next job, selecting the foods you will eat, and buying a car. The following principles were developed and applied in the process of building our new lifestyle that now includes a solar/wind powered home, organic vegetable garden, and a business venture (Natural Life Network) that we can operate from our home. For more ideas for establishing principles try reading through *The Earth Charter* in Appendix B.

1. Obtain all energy requirements from solar sources. No fossil fuels may be used in the supply of energy.
2. Use only renewable, non-toxic, natural materials.
3. Compost all organic wastes.
4. As much as possible, use the resources in the local area efficiently.
5. Grow as much of our own food organically and select only organic foods from local food stores.

6. Use local renewable sources of water.
7. Invest in our home for the long term. Invest in the solar infrastructure rather than expensive finishing. Be prepared to realize the investment returns over a twenty year period. Keep in mind that it will pay for itself in this twenty year period in pure dollar terms, while at the same time providing the model for restoring nature once the majority of us do the same.
8. Observe our natural surroundings to find resources that can be used.

The benefit of adhering to a set of principles provides a new basis on which to evaluate the decisions you'll have to make along the way. Allowing the powerful forces of government, market economics, advertising, and convention dominate our decision making, without consciously applying our own criteria has gotten us a long way but at what cost?

The systems that surround us have come to dominate our "way of life". But do they provide us with a better quality of life, more happiness, or greater health? We purchase fossil fuel based energy despite the fact that this form of energy produces waste that poisons our air and water. We accept fossil fuel generated energy because it is subsidized to the point where we think it is less expensive than solar or wind generation but at what cost ultimately?

So, you need a set of principles that are built upon knowledge of the complete requirements for a healthy, loving, and harmonious life. These principles then provide justification for paying a little more for energy sources, products, food, and the fundamentals of life in the short term while providing an eternity of pay back. These principles fill the value gap that is missing in an economic system that does not include the true costs of production, clean-up, health effects, and wars.

The way to achieve a natural lifestyle is through a process designed to achieve these changes. This process requires that you write down the following information as it relates to you and your life:

1. Self Analysis
 - a. Personal inventory – determine what you love doing, what you really have, determine what problems you have the power to solve
 - b. Prioritization of problems – develop a list of the things that you can do; draw from the action plans provided in this book, and use some

of the key steps outlined to help you find your path; then list these in priority order

- c. Priority Action Plan – in this book, identify the first three things you are going to do; start consuming organic foods, work hard to eliminate waste, create an efficient home that uses the power of the sun

2 Life Plan

- a. Goals – should be measurable and specific, and include a specific date or time frame within which you plan to achieve them so that you can measure your progress; include short and long term goals
- b. Values – review your own values, develop your understanding of truth, and continue to apply these throughout the process
- c. Principles – achieving your goals may not be worth it if you don't do so within the constraints of your personal principles, develop your own, or take some of the key principles outlined for *Natural Living* and customize them to make them your own
- d. Process – start at a high level, identify some the key tasks and activities that will be required to achieve your goals; look at specific steps like writing down what you want, listing the principles that you plan to adhere to, figuring out your financing, looking for people and groups that can assist you, developing designs, detailing plans and timelines, getting approvals, enlisting the help of professionals, getting materials, reviewing reference material, talking to people with experience, and finally physically doing it
- e. Scope – keep an eye on the specific things you expect to achieve; write down the most important ones; set aside the rest for now; you want to maintain focus on the essential elements of your life plan, rather than be distracted or side-tracked by less important tasks
- f. Resources (people, money, nature) – research all of the necessary people, products, services, financing, regulations, support facilities and resources you have, along with their costs, benefits, advantages and disadvantages; read section three of this book to see how we

found the resources to achieve *Natural Living* and copy us or others like us

- g. Schedule – prepare a timeline with specific dates for each major task; identify the person responsible for each major task; try to group tasks into sets of physical deliverables; be prepared to update the schedule as required when things change, as they always do, so that you can see the impact on the other items in your schedule
 - h. Deliverables – know specifically what the end product will look like; specifically, create descriptions of the home, job, types of food, and kind of car that you’re going to achieve with your plans; check these against your principles before accepting them
3. Design – develop the designs for your new life by writing down your own personal essential steps, copy the essential elements of *Natural Living* in your own words:
- a. Awareness – connection to nature informs design
 - b. Food – life revolves around the necessity of energy
 - c. Plan – determine what it will do to achieve your goals
 - d. Home – create a new lifestyle by transforming your home
 - e. Choice – make the choices informed by nature
 - f. Transportation – integrate all aspects of your life to minimize transportation
 - g. Creativity – apply your own creative powers with a knowledge of place
 - h. Work – transform all that you do to be restorative and symbiotic with nature
4. Development – build the detailed collection of information, services and products you need to follow as you develop your life plan; Bear in mind that these development processes apply just as well to building a home, buying a car, selecting food, or finding your life’s work:
- a. Approval – Work with your family to develop and review your plans, principles, and designs. Get everyone’s approval, and prepare a

partnership agreement in order to proceed with the dramatic changes you are about to undertake.

- b. Foundation – Start with some of the essential elements of your life that you can change and build upon these.
 - c. Framework – Once some of the essential, simple elements of your life have begun to make the transition, start filling the gaps, constructing a fuller picture of the complete transformation you envision. Ideally, make these transformations within the design framework developed during the design phase. Use the eight steps of the *Natural Living* process as a starting point for developing your own life framework.
 - d. Interior – It is critical to make the changes first in yourself. You need to take the first step towards awareness of your connection to nature. Getting your mind to consider all of the critical choices you have in this relationship, being much more creative with your new-found love of nature, and taking concrete steps to reinforce your new connections, are ongoing processes that will show outwardly in time.
 - e. Exterior – Take some big steps to demonstrate your new connection to nature. By physically making the changes you will reinforce the inner changes you are making and provide the inspiration necessary to inspire the millions and billions of others to follow in your footsteps. Transform the food, home, work and transportation that form some of the essential exterior aspects of your life.
5. Review and Enhancement – Be prepared to review your accomplishments with a view to improving on the process and results as you tackle each new aspect of your plan. Know that there will be many difficult challenges to overcome—some failures, and a great many successes to celebrate. Enjoy the process, as it is the process of life.

Step 4: Home

Reminder: Home is where the heart is.

- **Increase Efficiency** – The most powerful weapon towards achieving efficiency is not needing the resource in the first place. Insulate your home and seal cracks to reduce home heating and cooling requirements. Minimizing waste is critical to the process of creating a natural shelter and home for your family. Select the most efficient appliances by their “EnerGuide” ratings, which will end up paying for the potentially higher purchase price over time. Take the opportunity to minimize or eliminate their use where possible. Transform your home with florescent or low voltage lighting which are more efficient, reduces your energy costs, provides superior lighting, and lasts longer, plus allows you to get creative with all the new bulbs and fixtures. Light is a precious magical resource the use of which requires respect, care and efficiency.
- **Natural Materials** – Use natural renewable materials that are locally available such as: sisal, birch, organically grown hemp, straw, straw board, organic cotton, bamboo and wool. These natural materials will not off-gas toxic chemical, provide closer connections to the natural world, and reduce the impact on nature from production processes. If you can renovate or build a new home with straw bale insulation throughout, this marvelous material can provide insulation values of between R40 and R60. It’s easy and safe to work with, requires little skill, has proven itself over hundreds of years, and is highly available and renewable in one form or another in almost every part of the world. Don’t let your preconceived ideas about alternative materials cloud your judgment of their value. Make use of natural renewable materials locally available in the construction or renovation of your home. Look at your yard and see if you can take advantage of any natural features to provide shading, increase light, supply wood, or a cooling pond for instance.
- **Location** – Choose a home that is close to work, food stores, and parks so that you can travel most often by walking, roller blade, skateboard, scooter or bike. You’ll save considerably over a long period of time in reduced fuel and transportation costs especially if you can get rid of your car altogether.

- **Renewable Energy** – Use the power of the sun for the energy requirements of your home, by adding high quality (double or triple pane with argon or krypton gas filled) windows to the south (or north if you are south of the equator), add a solar water heater, get some solar panels, and install a wind turbine (these devices can be installed and maintained easily by a local supplier). These changes to your home have a payback although this ranges from five to twenty five years and depends upon the price of electricity and fossil fuels over that time.
- **Garden Naturalization** – Naturalize your garden by allowing native plants to return as a replacement for your lawn and flower garden. Include a vegetable garden in which your family, friends and neighbors can share the chores that reconnect your home with nature. Try using bees' wax candles or vegetable candles, going without any electrical lights for a wonderful romantic dinner or "special" family dinner occasion. The flickering flame reminds us of our primitive instincts towards worship for the energy of the sun. Make your home a natural indoor garden by growing fresh herbs, tomatoes, and other vegetables. These fresh, organic supplements to your food creations will improve the taste and reconnect you to the source of your food.
- **Sustainable Community** – Look for communities that foster a natural flow of energy, travel, food production, education, and life supporting work. Select your community with care or transform it if you can. The current massive development of houses that are sterile, garage dominated, lifeless, polluted, low quality, wasteful, poorly oriented, disposable, and far from centers of work must be replaced by a solar powered, community oriented, healthy, well built, ecologically designed home that fits within the natural world.

Your home offers some of the most powerful choices you have to make your connection with nature—so necessary for your family's continued health. So much of what goes into making your home must be supplied by nature. Here is your chance to make a major impact towards creating a sustainable world. The following steps provide a guide for creating a new home, or transforming your existing home, so that it exists in greater harmony with nature. These steps may take many years to accomplish, if not an entire lifetime. The rewards are many and worthwhile. The improved health of your family can be dramatic. Reduced energy costs over the long term may significantly improve your financial situation. Finally, reduced requirement

for materials significantly minimizes the short and long term affects of providing shelter.

These major systems should be reviewed as you strive towards achieving a natural home:

- ⚙ Design
- ⚙ Heating & Cooling
- ⚙ Energy
- ⚙ Construction
- ⚙ Water
- ⚙ Sewage & Waste
- ⚙ Restoration
- ⚙ Work & Travel
- ⚙ Site
- ⚙ Landscaping

Step 5: Choice

Reminder: To be human is to have a choice.

- **Selective** – Now that you have awareness and a plan, now that you are connected to nature through the wonder of life sustaining food, you have choices to make every day of your life. Before you purchase anything think about whether you really need it and, if you do, what the consequences of this purchase will be on nature. Take the time, when making choices, to use your own creativity to find other choices. Many times we may select different products that reduce the impact on nature.
- **Decide for Yourself** – Don't accept the choices of others. Question everything, including the choices of others. Remember that you have been programmed since an early age by advertising that does not represent your own thinking. Force yourself to overcome any programming or conventions that don't conform to your principles.
- **Laugh** – Maintain a sense of humor and know that you will not always make choices that are perfect. Instead remember that the more important thing is to try to maintain the awareness of your ability to make choices in every moment.
- **Question** – Ask questions so that you understand the implications of your choices and all of the options. Many times, with a little research, you will find a wide variety of options that minimize the impact on nature.
- **Remember** – Think about your purpose in life and whether the choices you make each moment support that purpose. Returning to our purpose, goals, and principles as we make our choices ensures that we remind ourselves of the real natural constraints within which we live.
- **Vigilance** – Making choices means being informed of the constituents, contents, connections and issues related to the choices you make. The laws of nature require us to be aware of these connections so that we don't make choices in ignorance.

As human beings we have a choice. The most important element required in order to make the transformations required of *Natural Living* is to make the connection

with nature and people who are of nature. These people are the ones who make choices based on the awareness of connection to nature. Find opportunities to talk to other people who have achieved the vision of a natural lifestyle, whether precisely or in part. More than any other factor, it is people that have been the driving force between achieving or failing to achieve. Specifically, when I asked people in “EcoVillage” communities the common theme was that it is our relationship with each other that we must overcome, well above the financial, logistical, technical and creative barriers. People are at the heart of the partnership based models that are required. This is not the easier model but along with the extra effort and demands is a far more satisfying result.

Early on in my search for some of the fundamental answers to questions I faced I came upon the story of Mahatma Gandhi and his experiments with truth. Gandhi was a true leader of his people, a man of the people and for the people, despite the fact that he never held any elected position. Rather he led by his every action, by his every word, by his every choice and by his every thought. Gandhi found the most creative answers to the most difficult problems of his time in the face of the greatest possible adversity. For me, his living example of brilliantly shining the light of truth on injustice, poverty, peace and equality, were only equaled by his dedication to finding solutions to these critical problems.

The light Gandhi illuminated for me, and that this book is dedicated to, is the idea that once we know of the injustice, it is our duty to develop creative solutions, even at the risk of losing our own lives. Then, as Gandhi taught we must put these creative solutions to work in our own life, to be the change, to be the shining example for others, this is the only answer to those most difficult problems we all face.

Mahatma Gandhi

Perhaps more than any other, Mahatma Gandhi, best represents the true nature of what it means to be human for me. I found it illuminating and encouraging that Time magazine determined that Albert Einstein was the most important person of the century, if not the millennium. Mahatma Gandhi and Martin Luther King were close competitors for this title according to Time. It encouraged me to see that the mainstream media could not deny the incredible truth, and the impact of that truth, on the world, of a simple individual, Mahatma Gandhi.

For me, however, what was indicative of the current world view, was the choice of Albert Einstein as “the” person of the century because of his brilliant thinking that has changed our understanding of the universe. These brilliant discoveries can not be seen as anything but the most important discoveries of explanations for problems. What, for me, makes the discoveries of Gandhi so important was his responsibility for his ideas and his desire to practice and apply his ideas to real life, to have failed and tried again. As Albert Einstein is often quoted as saying, “Generations to come will scarce believe that such a one as this ever in flesh and blood walked upon this earth.” Gandhi realized that the search for truth leads to the need to live what you believe, to apply the infinite creativity of nature, to go beyond a mathematical or scientific understanding, beyond the engineering disciplines application of solutions, to have people be all of these. The terrible problems of poverty and inequality were of primary importance to Gandhi. To these he brought answers that the United Nations, multi-national corporations, and local governments have ignored only to find these problems get worse. The answers he left us with include:

- ⊗ Truth above all,
- ⊗ Non-violence,
- ⊗ Civil disobedience with non-violence in order to change institutionalized programs of injustice,
- ⊗ Ashram communities which feature diversity, self-sufficiency, harmony, vegetarianism, and sharing,
- ⊗ The natural right to life sustaining nutrients from salt, land for agriculture, and water,
- ⊗ The necessity, no matter the dangers, to fight for the truth, against even the most powerful and seemingly insurmountable, using nothing but non-violent direct action, inspiring communication, and leadership,
- ⊗ In every moment you must live according to the principles you believe and make every decision based on those principles, with a spirit of good will towards all, with honesty and directness, and a sense of humor reflecting the fun available no matter the circumstance in nature,
- ⊗ The need to search for the difficult solutions, applying knowledge with the deepest possible understanding. Where Albert Einstein may have made the brilliant creative leap into understanding energy, nature’s patterns, relativity and

quantum mechanics, Gandhi has applied these adding the complexity of a broader understanding of their interactions and there implications for humanity and our earth through time,

- ⚙ Forgive all the evil in the world, be prepared to suffer injustice and make right any wrongs,
- ⚙ Love your brothers, sisters and your enemies.

The greater task of Gandhi's search for truth, greater than the fight to overthrow British rule, was the vision of an India ruled by many thousands of independent villages. He called this movement Swadeshi, or home economy. He said that "The true India is to be found not in its few cities but in its 700,000 villages."

"Gandhi's vision of a free India was not a nation-state but a confederation of self-governing, self-reliant, self-employed people living in village communities, deriving their right livelihood from the products of their homesteads. Maximum economic and political power—including the power to decide what could be imported into or exported from the village—would remain in the hands of the village assemblies." (*Only Connect*, pg. 172)

The general principles of Swadeshi state that the products of the village should be used first and foremost in the village by the members of the community. Trading between villages should be undertaken as only a secondary option and in general should be minimized.

"Swadeshi avoids economic dependence on external market forces that could make the village community vulnerable. It also avoids unnecessary, unhealthy, wasteful, and therefore environmentally destructive, transportation. The village must build a strong economic base to satisfy most of its needs, and all members of the village community should give priority to local goods and services." (*Only Connect*, pg. 175)

These citizens of the village ought to keep busy at the work of creating for the needs of the village community. Gandhi said, "It is a tragedy of the first magnitude that millions of people have ceased to use their hands as hands. Nature has bestowed upon us this great gift which is our hands. If the craze for machinery methods continues, it is highly likely that a time will come when we shall be so incapacitated and weak that we shall begin to curse ourselves for having forgotten the use of the living machines given us by God. Millions cannot keep fit by games and athletics; and why should they exchange the useful, productive, hardy occupations for the useless, unproductive and expensive sports and games?" The local village based economy takes care of itself, the families look after each other, and land is cared for by present and future needs. The way we choose to live is ours to make in every moment.

*"Gandhi knew that, with the globalization of the economy, every nation would wish to export more and import less to keep the balance of payments in its favour. There would be perpetual economic crisis, perpetual unemployment, and perpetually discontented and disgruntled human beings."
(Only Connect, pg. 174)*

He was right...that is exactly what we have achieved. These problems are the ones that get worse with the passage of time and the further the current global economic consumer oriented society develops. As Gandhi said, "A certain degree of physical comfort is necessary but above a certain level it becomes a hindrance instead of a help; therefore, the ideal of creating an unlimited number of wants and satisfying them seems to be a delusion and a trap. The satisfaction of one's physical needs must come at a certain point to a dead stop before it degenerates into physical decadence. Europeans will have to remodel their outlook if they are not to perish under the weight of the comforts to which they are becoming slaves." Simply stated he said, "People have to live in village communities and simple homes rather than desire to live in palaces." We have a choice to create these types of communities. Unfortunately we have been brain washed into the "European" or western capitalist model. As Gandhi says we've become slaves to a system that was not of our making. It is time now to rise up and fight this injustice using the tools, practices, principles, and inspiration that Gandhi has left us

Beyond this point, once desire takes hold, once the idea of the palace for everyone becomes the dream, then greed sets in. The greed has set in motion our delusional attraction to the idea of endless growth and endless consumption. This system simply doesn't work because at a certain point enough is enough. From the book *Only*

Connect, in the article “All Hands to Work” by Satish Kumar we are left with the list of Gandhi’s Seven Social Sins which provides an excellent starting point for the daily reminders of how our solar villages, solar homes and solar powered lifestyles must be governed. We must make choices based on these principles. In other words, restated in terms of *Natural Living* principles to live by, we must practice the following:

1. Politics with principles
2. Wealth with work
3. Commerce with morality
4. Education with character
5. Pleasure with conscience
6. Science with nature and humanity
7. Worship with sacrifice

We have choices to make each and every moment of every day. We need to build a culture that has a set of principles that make choice an inherently sustainable practice. These are natural principles in harmony with nature’s laws. The city-state and corporation are tools created by the rich and powerful to maintain control and limit our choices. Independent village communities will naturally evolve as the essential glue that transforms culture in the long run. Communities, even within big cities, are those villages within that work because the people know each other and their natural surroundings intimately. Despite the façade of city-state and corporate control as this evolution towards independence occurs, the choices made to live in villages according to Gandhi’s social principles will lead to a sustainable world. As Gandhi would tell us a few corporate leaders and their puppet governments simply can’t control the billions of us if we choose not to let them. It *is* our choice.

Step 6: Transportation

Reminder: The greatest journeys are those within our own mind.

- **Learn from Nature** – Everything in nature is in constant motion in one form or another. We can learn from the modes of transportation used in nature to find ways that have less impact.
- **Food Power** – Life, with the energy provided by food, has the choice of where and how to transport itself. We need to make the choice to minimize our use of fossil fuel driven modes of transportation through the use of our ability to walk, rollerblade, or bicycle. The best mode of transportation whenever possible is walking, which requires only the steps of *Natural Living*. Walking through the natural world returns our connections to it, improves our health, and uplifts our spirit.
- **Magic** – Motion requires the transformation of energy from one form to another, which plainly is a magical gift of nature that should be used with due respect for its limits. You can't exceed the energy supplied by the sun, in the long term. We should all try to understand the magic of transportation. We need to use our awareness to remind ourselves that, food is our energy for transportation. Our power of choices about how we will travel comes through wisdom since that is the facility that nature has given us to manage this magic. Current transportation systems are not acceptable given their primitive and unnatural limitation of relying on limited reserves of fossil fuels that are polluting our environment as we use them.
- **Home and Work** – We should try to eliminate car travel through changes in workplace, proximity to public transit systems, or the use of highly efficient hybrid vehicles when car travel is required. If you must have a car for transportation make it the most efficient, least polluting one you can afford. Live near where you work, work where you live, love where you are. Every place on earth has natural potential that we need only find.
- **Mind Travel** – Stop, don't do anything, and try to remember that one choice that must always be considered is the option of not going anywhere. Much of what we look for "out there" can be found right here at home, without going anywhere. Remember that in all the world there is nothing new that you can't discover right where you are now. Consider the options of contemplating,

connecting, and building your relationships to family and nature right where you are at any given moment. Travelers of the mind have gone much further than any astronaut. Travel through space and time in your mind. Write down your journey, read the journey of others, and be thankful for the journeys you've already enjoyed.

- **Limit Use** – By limiting your transportation to the principle requirements of life, that energy will be directed usefully back to nature.
- **Restoration** – The natural need to travel where required to work, to support the activities of growing food, and the construction of healthy natural solar powered homes all make necessary a transportation system that is solar powered and non-polluting. The endless paved cities, towns and homes should, as much as possible, be returned to the trees, bushes, and natural grasses that once flourished in the natural soil.

We must try to do without cars by the selecting a location for our home, work and community that makes this possible. When a car is required it must be one of the few that provides “ultra” low emissions. Other alternatives, such as bicycles or walking will be the primary means of transportation. For longer trips transit systems are the only way to travel. Some ideas for changing transportation systems include:

- Car use eliminated through walkways, bicycle paths, locally available necessities.
- Own cars that get better than 60 mpg or are non-polluting. The minimum mileage will be increased each year based on the best available technology. Older cars must meet these minimums within 5 years or be recycled. At least a 90% reduction in pre-2000 pollution levels must be achieved.
- Local high speed network facilities provide ideal conditions for working from home or shared office facilities in your local community.
- For some purposes electric vehicles may provide convenient and efficient local neighborhood travel if bicycle or walking are not practical.
- Walk to the local corner store. If local food stores and cafes don't exist within walking distance work with neighbors to create them so that car and public transit travel is not required for these trips.

- Create local shared vegetable gardens that produce food for all to share within walking distances of your home.
- Work with neighbor to create a community center within walking distance if one does not exist.
- Transform busy roads by planting trees that force cars to slow down. Implement traffic calming techniques such as speed bumps. Create urban walkways as replacements for main streets in the city/town/village you call home by eliminating car traffic.
- Rather than flying off to the tropics, take a vacation by hiking your local trails to become more familiar with your own country.
- Support the development of mass transit systems that are wisely conceived to reduce car traffic.
- Use alternative transportation such as car pools and car sharing .

The effects of transportation systems on our neighborhoods, villages, towns and cities have been dramatically destructive in general. The requirements for vast amounts of fossil fuels to power the ever growing number of cars has created one of the largest sources of pollution. The terrible cost of the military force used to try and protect fossil fuel reserves is in the trillions of dollars...money that if applied directly to the problems of poverty, pollution, and environmental destruction would be vastly more constructive and profitable.

Your choice has large impacts. Make your travel choices carefully and creatively.

Step 7: Creativity

Reminder: If we can dream it we can achieve it.

- **Dream** – In all that you do consider the creative alternatives that you can think of or that are offered by others. It has all been done before. Sometimes all we have to do is look a little deeper into nature, a little further abroad, or a little further back in our history. All the answers are out there.
- **Take Time** – Take the time to dream. Create some new answers to the problems of the world.
- **Love Nature** – Whether in art or real life, create with a passionate love of nature. The process of creation has the potential to answer all of the questions and problems that surround us. We can find the answers. Creativity is inherent in the diversity of life. There are some things that we can never know, but through creation we may catch a glimpse of the answers. Always look for that opportunity when there seem to be no acceptable answers. No problem is insurmountable. Through creation there is always hope.
- **Children** – Children are the most inspirational connections to nature. They are the pure love that teaches the higher things of nature, they are the pure white light that shines bright; they are the continuing flash of brilliance that was the creation of the universe. Learn from them, be as creative as they are, and be creative in their name, for their sake. Remind yourself that creation is the purpose of life, create children, nurture them with all your powers of goodness and with as much knowledge of truth as you can find. In all that you do create for them a world that will sustain them and their children.
- **Knowledge** – Knowing the problems is half the battle. Be creative in analyzing the connections and interdependencies, and then be creative in pinpointing, through this process, new answers to the old problems.
- **Truth** – Create new life, create a new life style, create a community on the principles of natural living, create food to share, create the truth in all that you do and see. Create words, pictures, paintings, poems, drawings, and stories that express your love of life. Create new answers, combine things in a new way, bring a new perspective that demonstrates the truth in nature. Don't

accept that it is impossible since creation is the overcoming of the seemingly impossible.

If ever a human being embodied the creative spirit and a deep love and connection with nature and humanity, then it must be Vincent Van Gogh. Like so many of the inspiring people who have discovered the truth in nature, Vincent, time and time again, the deeper he looked, found that nature and that white light, are the eternal answers we all seek, and which do exist.

The following are my favorite quotes that have inspired me throughout this journey toward *Natural Living*. Take them and frame them next to some prints of his Sower, Reaper, Fields of Wheat, Straw Bales, trees, people's faces, and Sun Flowers that express true nature, creativity, and feeling inherent in nature itself. Whenever you feel melancholy, as Vincent did at times, remember that we all have had those days, but that there will be a beautiful sunrise to lift our spirits if we maintain our faith in nature. It does not matter whether we live a longer or shorter life. Instead, let us live a life worth living and, if we can, leave something worthwhile such as a canvas with a picture, paper with inspiring words, a loved child or a straw bale house each made with the creative passion that dwells within our hearts.

Think of the life Vincent lived so desperately, so passionately. He had but little and spent most of his time working at his passion for ten years, sometimes with no food. He traveled mainly on foot, spent day after day deeply observing nature and people, reading in search of the truth, writing letters to his brother whom he loved with all his heart about all that he was becoming aware of, and living his life as passionately as humanly possible. Vincent had a vision, created a plan, and lived by his principles, goals, and love for ten years. His life is an inspiration. Find inspiration, creativity and awareness, as I have, by reading his words of truth and find the essence of nature and people through his paintings that are the energy and life of nature.

Words of Truth by Vincent

"I will try to fight the good fight."

"Give peace to poor creatures."

"If only one can remember what one has seen one is never lonely."

"As molting time, when they change their feathers, is for birds, so adversity or misfortune is the difficult time for us human beings. One can stay in it, or one can also emerge renewed."

"Do our inner thoughts ever show outwardly? There may be a great fire in our soul yet no one ever comes to warm himself at it."

"Love many things."

"My life and my love are one."

"If I could only express what I feel."

"At present money is what the right of the strongest used to be."

"Which is worse, danger or the fear of danger, personally I prefer the danger itself."

"The laws of color are utterly beautiful just because they are not accidental. In the same way that people nowadays no longer believe in fantastic miracles, no longer believe in a god who capriciously and despotically flies from one thing to another, but begin to feel more respect and admiration for and faith in nature."

"This white light and that I seek it and only this do I consider simplicity."

"Every day I am more convinced that people who do not first wrestle with nature never succeed. I personally know no other way than to wrestle with nature long enough for her to tell me her secret. I have no other wish than to live deep, deep in the heart of the country and to paint rural life."

Step 8: Work

Reminder: Do what you love to do.

- **Close to Home** – If you can, work from home or at least within walking distance. Eliminate the need to drive to work in a car. Take public transit to get to work.
- **Live Your Dreams** – Select or plan to make a career change that supports a natural way of life. Work to live your dreams.
- **Compassion** – Fight injustice wherever you see it. Take care of your fellow workers and the beneficiaries of your work.
- **Work is Life** – Work means those activities that support our survival. Work is a life that is symbiotic with the natural world. Remind yourself that work ultimately must service nature and humanity, rather than profits for shareholders. Apply the principles of *Natural Living* to your work. Make choices to ensure that the work you do is life affirming. Creating shelter, putting food on the table, enabling required travel, and supporting the principles of the family and community must change. The purpose of work is the sustenance of life, which means the sustenance of nature.

The use of your house, a local office or local shared office space makes the most sense for solving many problems related to getting to work. The office space itself must be as healthy and natural as the house we described.

Office Space

- Local shared office space eliminates the need to commute in a car.
- Open concept design in the home and shared office allows for the modification of spaces as the business changes.
- Additional work space may be constructed near the house as, when and if required rather than over-sizing now.
- As a consultant it is quite reasonable to work from the house with standard communication equipment such as a phone system and internet connectivity.

- Get local businesses to provide other required services such as accounting, supplies and consulting.
- All office facilities should minimize heating, hot water, air conditioning, appliances, lighting, construction, sewage and water requirements by using the same construction techniques as used for the homes.
- By using the house for work we leverage the investment in these features.

Investing

- Investments represent a major opportunity for the expression of support for companies which support the principles, goals and solutions presented here. Be sure that the company you work for takes responsibility for the environment.
- Stock portfolio holdings should include companies that provide fundamental support for the concepts of natural living.
- Put your money into investments that support the lifestyle you are adopting.
- Pick stocks, mutual funds and other investments that support companies that put the environment first, that are leading the development of environmental products and services.
- Only pick fixed income investments such as municipal bonds, corporate bonds or the like if you believe these organizations are using the money you lend them to support a sustainable solar powered future.

Companies

- Do not work for environmentally irresponsible companies.
- If your company does not already enforce recycling then try to make sure that you do your best to change it.
- Working for oil companies that currently mask their environmental destructive mission would be like working for a cigarette company over the past twenty years.

Many of the principles that we apply to our lives must be applied to the work we do to pay for our lifestyles. Your job is something that you will spend a large portion of

your adult life doing. It can have a positive or negative impact on nature . Look to make a positive impact wherever and whenever possible.

In Summary

These are the eight steps in your life where you can make the largest beneficial impact. They also provide a natural, step-by-step process that you can review each day, in order to achieve a natural sustainable lifestyle . Rather than trying to find new technological solutions, let's consider a new combination of what we have in the natural world, and what we can use today to help us find new or improved solutions. Most of the conventional systems that support our modern way of life must now be recognized as too limited. They were established during a time of primitive technology development, often by small rich elites, and supported by a system of unlimited growth . All of these modern systems must be resolved within a new, richer, smarter, and broader context. Often this will mean using a more complex and creative symbiotic approach, where in the past a simple brute force technique neglected any deep understanding of flow.

Chapter 7

ORGANIC FOOD

Taking pleasure in the food we eat makes sense given the number of times we need to do it every day. The food we eat given our numbers has a massive impact on our shared environment. This includes the vast amount of land used for the purpose, the chemicals and energy used to grow it, jobs, transportation to markets, packaging, super markets, processing plants, waste processing and advertising. Despite the fact that we grow more food than we need to feed all people, many do not get enough to sustain life and die of starvation. Chemicals required to support farming practices in marginal growing areas are wreaking havoc with wildlife, water systems and human health.

It doesn't have to be this way. Growing food organically, minimizing our consumption of meat, and transforming consumption patterns towards localization is occurring because it makes so much sense. Organic foods have entered the mainstream in a big way in recent years. Profits for organic growers are proving better and more sustainable. Quality and standards have improved to the point where consistency and availability of organic foods has increased steadily. Here is a simple way to make one of the biggest impacts towards a sustainable future.

As we've seen, the Union of Concerned Scientists make clear that our consumption of fruits, vegetables and meats are on the top six list of consumer activities that we must transform in order to become sustainable. Fortunately, there are many benefits and reasons to move towards local organic foods.

Healthier Safer Choice

One of the most shocking realizations I've become aware of is the high level of toxic chemical accumulation that comes from eating conventionally grown fruits and vegetables. It had been my understanding that these toxins could concentrate in animal meats including fish, chicken, beef and other meats since these were at the

top of the food chain. What is even more disturbing is the potential for us humans to concentrate these toxins as we consume more and more chemicals in the fruits and vegetables we eat. Despite cleaning with prescribed levels of determination, the chemical residues or absorbed toxin are still present. Since we are at the top of the food chain, we accumulate these toxins in our bodies. Even trace amounts of some like lead can be deadly. Choosing to eat organics largely eliminates this danger. In terms of reduced health risk we would all be well advised to select organics where and whenever possible. These problems can be even more significant for our growing and developing children. For their sakes we need to provide them with the least toxic food as the potential dangers for growing and developing bodies can be even more severe.

Your baby is perhaps the most vulnerable of all. If you have a baby or are planning to have one, do what we did many years ago now, start buying organic vegetables and fruits, learn how to process them. This is a great way to get to know organic brands, local organic markets, and more about the different options. Even within organics you'll need to take responsibility for reading the labels to determine the level of organics used, quality and nutritional levels. Even if it costs a little more isn't your growing baby worth it?

Additional concerns are now arising from the use of genetic modification. Genetics are being used to produce varieties that would not occur naturally. These genetic modifications once made, however, have been found capable of being transferred to crops outside their own fields. The potential dangers are unknown. Tampering with nature has pretty much always proven a bad idea. We simply don't know enough to understand the potential problems. Our mistakes litter the planet. Perhaps the best known was our use of DDT and its continued use in developing countries. In our local area the release of Asian lady bugs (actually beetles) to control A-fids has resulted in their wide spread growth out of control since they don't appear to have any natural enemies.

Better Taste

Once you start to get used to eating organics you can't go back. You may be tempted by slightly lower prices of conventionally grown foods, but your taste buds will tell you the extra cost is worth it. That better, fresher, more natural, full flavor should tell you something is very right about organics. For cooking, locally grown, fresh organics make meals a delight.

More Nutritious

The variety and nutrients in organic are better for you as well. Chemically grown produce simply does not have the variety of nutrients common to naturally grown organic foods. The reduced levels of processing and chemical in organics will also be much better for you.

Organic Growth

There has been a great deal of growth in the organic foods sector. In our local supermarket the powerful “Presidents Choice” brand has made major moves with a new organics option. Our continued support and demand for these products will continue to broaden the options available. Supporting our local farmers is where it starts. Organic farmers deserve our support as their methods significantly reduce impact on land, reduce chemical buildup in our environments in the most direct way. Obviously supporting them will also help to build their industry, increase competition and increase public awareness of the benefits their local organic farm produce provides.

Both new organic specialty grocers and markets that have long offered organics exist. In our local area organics are available at several roadside locations. Many exist in the suburbs. Even downtown markets offer specialty organic vendors. In our local village center there is Harmony Whole Foods that offers organic and natural food products exclusively. At Zehrs, our ultra-large major grocery store, you’ll find the new organic brand products. We’ve learned to find the best values at each.

Grow Your Own

The best thing is to grow your own vegetables and herbs organically. By growing your own you’ll not only learn about the connections to nature and benefits and ease of organic growing, you’ll get the freshest and best tasting produce you could ever imagine. Producing your own vegetables and fruits from native varieties also helps to maintain the genetic variety that may be so key in the future for organic growers. With diversity and native varieties we will find ways to grow better tasting food without the dangers of monoculture, pesticides, herbicides, fossil fuel fertilizers and water contamination.

Clothing and Fabrics

Starting looking for organic clothes. At our local Mountain Equipment Coop, we can now find a complete set of organic clothes. More and more you'll find that organic sheets and towels are becoming available.

Chapter 8

PLACE

Looking at your place with new eyes. Whether you are looking for a new property on which to build or at renovating your existing place some of the easiest and long lasting opportunities exist for reducing your impact. See where natural resources come for free. The sun, rain, wind, woods, flowers, and garden. How can you mimic nature in order to satisfy your requirements for home, food, work and transportation? These are the fundamentals of *Natural Living*. Many of them derive from a very careful look at place, site, area, landscape, environment, climate and community.

Place is a something we may take for granted. And yet, as in nature, we see that every little nook and cranny offers different opportunities and challenges. Sometimes finding and seeing these takes a new way of thinking. How would a Beaver construct things if this area was suitable habitat for them? What do the plants do to survive? Can we learn and work with the natural elements to find the best way to blend with each space.

When we look to build for our home or dig the land to grow food there are many ways we can retain the local dynamics of the area. First of all we can try to minimize any impact at all by leaving as much as possible as is. When trees and land are transformed it may be possible to restore or reuse these material. Green roofing and passive solar provide opportunities for this type of restoration of the local landscape. Using the material for parts of the construction or returning them to their natural state can help significantly towards helping the site return to a state of health. When we build we must realize that we are wounding the space and may need to help return it to health.

Natural site features to look for:

- ⚙ Southern exposure

- ⊗ Trees, earth or other houses on north, east, west
- ⊗ Top of hill
- ⊗ Not prime farmland
- ⊗ Near community and essential services (hospitals, schools, organic food store, community parks)
- ⊗ Transit nearby

Depending on where you live different sustainable building systems may be more suitable.

- ⊗ Renovation
- ⊗ Straw bale
- ⊗ Earth ship
- ⊗ Earth-sheltered
- ⊗ Rammed earth
- ⊗ Cave
- ⊗ Hybrid
- ⊗ R2000

Chapter 9

EFFICIENCY

Not needing something can be the most efficient form of conservation. Higher levels of insulation, better windows, sealed cracks, and reduced levels of demand for energy are where renewable energy starts. This is also the cost effective way to be sustainable. It also may be one of the harder areas as the concept of less, invisible savings are hard for some people to grasp. In my own case the exciting concepts of solar panels and wind turbines actively producing renewable energy intrigues me. In reality, the power of efficiency is the key to holding the holistic concepts of sustainable living together. Without thinking efficiently as nature does we are doomed to fail.

It starts with the amount of space you need. Keep it as small as possible. Rethink every element and wherever possible try to work towards as small of a space for what you really need. The benefits of this type of thinking result in cost saving in every other aspect of your life. The flexibility and opportunities provided by minimizing your footprint at this basic level when applied over the long term are the most powerful. Like investing, the sooner you start, the more you put in at the beginning, the better the long term returns. With efficiency this is the formula. However, the difficulty is in that the investment is in reducing, optimizing and eliminating. This kind of thinking is something we find difficult in our culture of consumption and wanting forever more.

Something we will find very hard is to change our ways of thinking. Efficiency is a natural way built into the universe. It is something that we are only starting to grasp but that has long been a part of spiritual traditions and ancient cultures. It has been the recent revolutions in energy usage patterns, innovations in mechanics, and chemical innovation that has allowed us to go well beyond natural limits. This can't be sustained. The key is conserving wherever possible, insulating, reducing materials, using renewable materials, and organic products.

Using every means possible to reduce leaks, improve insulation levels, and retain heat naturally collected through passive solar means a direct reduction in what we need to produce to maintain comfort levels. Much of this type of efficiency is not sexy or all that visible but it provides far greater value over the long run.

Once we turn to the active systems like lighting, appliances and heating system these too should be the most efficient and properly sized for the job. Over the long term the more efficient systems will pay for any additional cost that may be involved. Reduced levels of maintenance will typically be an added bonus. Also, efficiency comes part and parcel with quality. Quality is something that people will feel and sense. That feeling of security and comfort will also provide peace of mind and security, such valuable, although difficult to quantify benefits.

Efficiency occurs in natural systems due to real competition. In Europe where energy prices have been higher for longer the use of in-line water heaters is nearly universal. Rather than maintain hot water in a large tank, these systems heat precisely the quantity of water required for specific purposes on demand. These systems are usually fueled by natural gas or propane, however, the efficiency ratings are dramatically better than other tank based systems. Electric in-line hot water heating systems also exist.

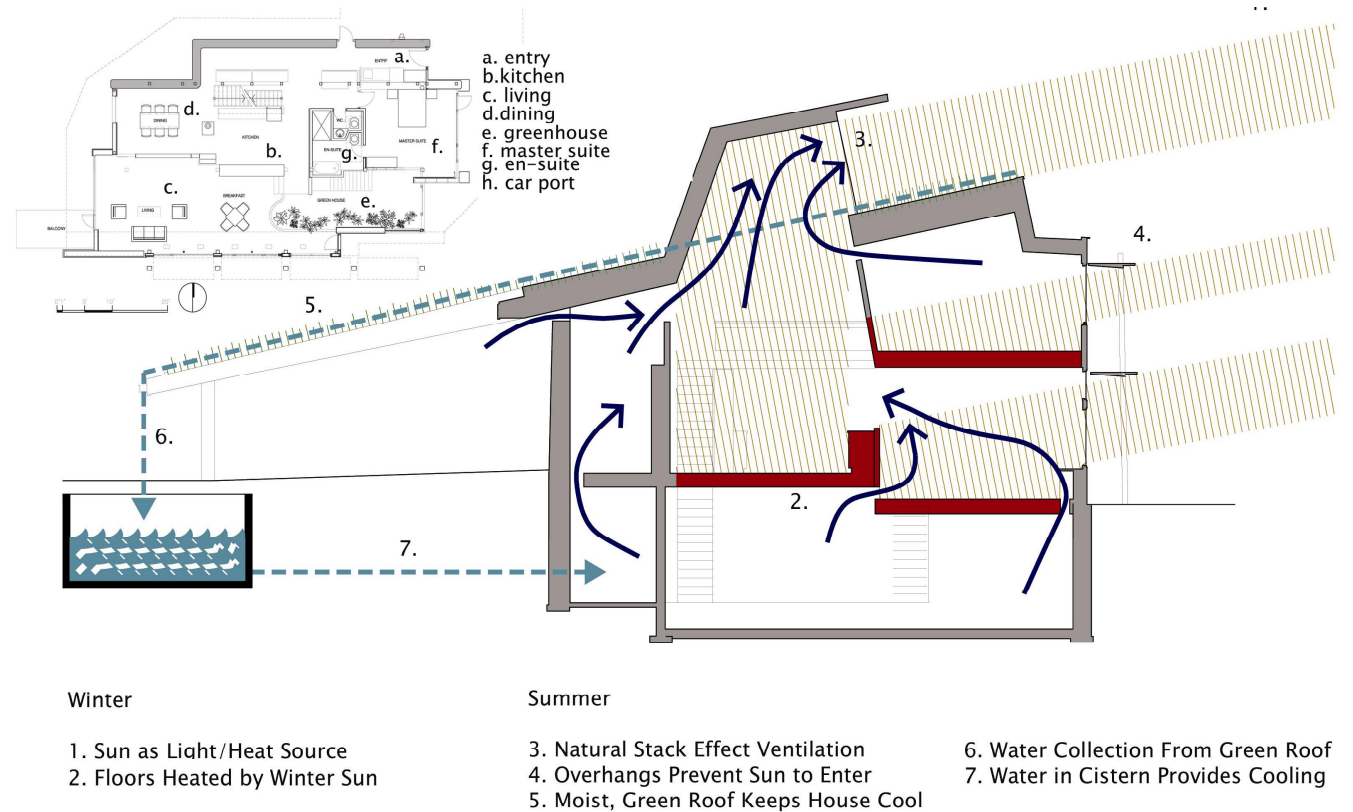
- **Start by changing all your light bulbs to compact fluorescents. They last ten times longer and can reduce energy consumption by up to 80% less energy. Imagine your savings when you change all the bulbs in your home!**

Chapter 10

PASSIVE SOLAR HEATING AND NATURAL COOLING

Perhaps the oldest, simplest, and most effective heating system, passive solar, directly converts sunlight into heat. The heat is most frequently stored in a thick floor or similarly effective storage medium. This is the most direct form of solar energy usage. Passive solar combines to also provide natural cooling so as not to overheat.

Creating a passive solar home starts by selecting the right site that should include access to plenty of sunlight to the south, a wind break to the north, and effective insulation for the home. The passive solar effect works naturally since the sun is much lower in the sky in the winter, and so high in the summer. This combines to increase heat storage in the winter when need and reduce heating in the summer. By combining passive solar with natural cooling techniques the home can achieve a natural balance that eliminates the need for a fossil fuel based furnace or air conditioner. This leads to substantial cost



saving especially when considered over the lifetime of the home. The reductions in carbon emissions and other pollutants related to the energy required for air conditioning are staggering. These two elements represent nearly fifty percent of the average home's annual energy usage. Using passive solar and natural cooling reduces pollution by as much as 90%. Of course all of these numbers are dependent on the area in which you live, level of effectiveness in the passive solar/natural cooling systems, and level of supplemental heating required in the form of a wood burning stove and/or hydronic in-floor heating/cooling system.

➡ **Energy savings can reach 90% with passive solar.**

Passive Solar

Layout Elements

(reverse in southern hemisphere)

- ⚙ Use site trees and berms to block winds to north
- ⚙ Face true south within 10°
- ⚙ More levels to south to capture more heat
- ⚙ Reduced levels to north
- ⚙ Living areas south
- ⚙ Sleeping, utility areas north
- ⚙ Green roof provides additional insulation in the winter

Key Features

- ⚙ Insulating windows south primarily (north in the southern hemisphere)
- ⚙ High insulation in foundation, walls (straw bale), and roof
- ⚙ Thermal mass to store heat or cold, typically concrete floors, approximately six inches thick, heat is released at night in the winter and coolness is released at night during the summer
- ⚙ Shading for summer cooling when sun is high in the sky

- ⚙ Hydronic heating to supplement storage and distribution of heated or cooled water
- ⚙ Natural cooling or passive cooling, through ventilation, shading, and stack effect that draws cool air from the basement and draws it out of the skylight in the roof
- ⚙ Provides extensive natural lighting throughout the home reducing the need for electrically powered lights
- ⚙ Potential heating and cooling energy saving can exceed 60%
- ⚙ Eliminates need for costly duct work of conventional heating system and prevents molds, mildews and dust produced and distributed by forced air heating and air conditioning systems

Natural Cooling

Layout Elements

- ⚙ Basement area in order to store and maintain cool air in the summer
- ⚙ High levels of insulation in order to keep heat out and maintain the coolness inside
- ⚙ Internal ventilation that allows cool air to be drawn up through the home when the skylights venting window is opened in the summer
- ⚙ Small windows low on the north side, in the basement primarily to allow outside air to be drawn from the cooler low-lying areas into the home.
- ⚙ A green roof provides significant additional benefits in terms of reducing heating by as much as 30-40% in the summer.
- ⚙ Windows that allow for cross ventilation in various directions

Key Features

- ⚙ Shading on the south to prevent sun from entering the home in the summer
- ⚙ Green roof to provide reduced heating in the summer
- ⚙ Large thermal mass in flooring and walls in order to store coolness

- ⚙ Sahara type venting skylight in order to draw cool air from lower areas displacing the warmer air that rises naturally
- ⚙ Hydronic tubing in the concrete mass to allow cool water to provide additional cooling
- ⚙ Trees and native plants that can provide shading in the summer while allowing solar heating in the winter

For a more in-depth review of passive solar principles see Appendix C.

Chapter 11

STRAW BALE CONSTRUCTION



Building with straw bale changes everything. This natural renewable insulation material is superior to conventional insulation. If you are thinking of building, renovating or doing an addition on your home then make sure you include some straw bale. If you are like me, it will sound strange at first, but once you read more, work with straw and begin to realize how much sense it makes, you will be forever transformed.

Before you begin any work read this entire article. Some of the tasks require substantial preparation. Other tasks should be practiced or experimented with in advance of the actual construction days. These instructions are best supplemented with hands on workshop experience or volunteering for a straw bale home building project, and books on the topic. For more information see the Products and Services section at the end of this article.

Concerns

First of all, you need to get comfortable with the idea of building with straw. I know when I first heard about the concept I was exceptionally skeptical despite a strong desire to build sustainably. My gut instinct told me that perhaps it would rot or catch on fire too easily. I have a family, and despite my strong desire to create a sustainable future for my children, it would not be worth taking additional risks. So I began to read every book I could find on the subject.

Surely the three little pigs taught us that straw was not the right material to use. It would just blow away, rot or burn...wouldn't it?

Is straw bale strong enough? Yes, in fact it's stronger than most other building techniques since it has some "give". Rather than crumbling in an earthquake, for instance, the system, like a tree, is able to



dampen the shock, bend, while not being rigid and crumbling. It won't blow away because the simple construction system sews the bales into place, weaving natural fibers together with steel wire fencing, and rock solid posts and beams. In fact these homes have proven capable of lasting almost a hundred years even in difficult climates like Nebraska. Even in the humid southern state of Alabama, a large straw bale mansion has withstood the test of time since the fifties.

Also keep in mind that straw bale and straw/mud homes are still built and used all over the world. They are a sensible design that has evolved over thousands of years of trial and error. Although we may be less familiar with the comfort, safety and longevity of these wonderful homes, people all over the world are building with straw bales, relearning ancient techniques and combining them with modern tools, materials and designs. As my wife Leigh says, keep an open mind.

So what is so great about straw bale? Where to start? There are so many things about building with straw bale that I've learned and that have convinced me that it is one of the most sensible, cost effective and sustainable systems ever to have evolved. The benefits also exist at all levels from design flexibility, ease of construction, health, safety and sustainability.

First of all, straw is in general an inexpensive, renewable building/insulation material available in pretty much all parts of the world in one form or another. Being a local and renewable building material that is inexpensive makes it worth a good hard look. There are different types of straw such as wheat-based or rice-based. Similar to straw is hemp, another potential renewable building/insulation material. Cob is another farm product that can be used to build in a similar way. The beauty of these materials is that they grow back each year so we aren't cutting down old growth forests or using up large amounts of fossil fuel based energy supplies to create conventional insulation materials like fiber glass or "Roxul" (volcanic rock with steel slag). Also, the cost of straw insulation is less than commercial insulation materials while the insulation values are better.

The other critical benefit of straw bale walls is their ability to "breathe". This ability, despite superior insulation levels, provides improved air quality. You've no doubt heard about "sick building" syndrome. You're probably aware of the molds, mildews and fungus growing in homes. Well, incorporating breathing walls can prevent all of this. Breathing walls also react to changes in climate much better than modern methods of sealing a home and then trying to mechanically ventilate it, not to mention the additional energy costs to do so.

- **Breathing walls improve indoor air quality. Conventionally sealed homes can lock in toxic chemical and cause molds and mildew buildup on vapor barriers (in the summer).**

Just imagine our modern homes, R2000, or conventional housing development homes built to Canadian “standards”. These homes are essentially sealed up in plastic and then a heat recovery ventilator (HRV) tries to mechanically refresh the air from the outdoors at a specific rate.

Unfortunately these systems don’t work that well. In most such sealed homes there is a very real and common problem of molds, mildews and fungus growing in your walls. This is most frequently caused by the condensation of water on the inside of the vapor barriers, mandated by R2000 or general building codes. So the sealed home works well in the winter by insulating and preventing air from blowing into the home. However, this design does not react well to warm humid summers. Instead, in the summer especially, these conventional homes will be susceptible to condensation. Combined with air conditioning and forced air type heating systems, these homes are like sealed bottles of toxic chemicals.

Problems?

Okay then, but doesn’t it cost more? Actually no. Straw bale construction probably costs about the same as conventional construction techniques, although it could cost a fair bit less if you did the work entirely yourself or with volunteers. Over the long run, however, the superior insulation levels provided by straw bale will save you money in reduced heating/cooling costs. Depending on the source of your straw, the cost may be significantly less than conventional insulation. As the cost of energy goes up, so will the cost of conventional insulation, which requires relatively large amounts of energy to produce.

Some of the other major concerns people have include:

- **Fire** – Tests have proven that the straw bales don’t burn; instead they may smolder a little but make actual flames unlikely, and certainly less likely to burn than convention 2x4 framed stud walls. The three layers of stucco, and the borax sprayed on the bales before the stucco is applied, all work to prevent even the possibility of fires. Also, the lack of spaces for air makes the spread of fire less likely. During construction is the only time that fire should be a major concern. Since the straw bales will be divided, trimmed, slice and diced, the loose straw that blows around the construction site becomes a fire hazard if not cleaned up regularly. Take special care to make sure people aren’t smoking or burning

➡ **Straw bale construction is an ancient technique. Some straw bale houses in Nebraska that are more than 100 years old are still being lived in.**

anywhere near the work site. Also, it is critical that you maintain a work site clear of loose straw to minimize this danger.

- **Pests** – Again the compressed nature of straw bales, lack of anything worth eating, and lack of moisture makes poor homes for pests. In general, the vast majority of experience with straw bale has proven it to be less susceptible to rodents, bugs or other pests, partly because of the three layers of stucco, tight sealing and again the compact nature of the straw bales.
- **Building Codes** – Most countries actually support straw bale construction in some form or another. The United States, and certain states in particular, have support including fire code testing. In Canada, the six thousand square foot straw bale home we worked on in the city of Mississauga (near Toronto), went to the building code committee for review. This review took about a year but has resulted in a very clear ruling in support of straw bales. The ruling required that the architects and engineers involved in the project back up claims that this natural fiber insulating material met the building codes principles for quality construction standards, including susceptibility to fire, strength and other building criteria. Keep in mind that you still may need to relate to your local building inspectors these cases and even some of the technical back ground of this system in order to get them on board.

The other thing you learn about straw bale is that two design types are possible. Actually there are perhaps hundreds of different ways or variations on these techniques, but in general, there are two popular techniques. First, you can build using post and beam construction techniques familiar to many builders and very common all over the world. In this configuration the straw bales are primarily for insulation although the walls themselves are substantially stronger than conventional walls. The second design technique is a “load bearing” straw bale design. This system does use the incredible strength of the straw, compressed, to actually bear the weight of the roof.

Most building codes now support post and beam based (non load bearing) straw bale construction. Some areas also support load bearing straw bale (for instance in Quebec, Canada). Always make sure to check with local building codes before getting too far down the path with straw bale.



You might be thinking, won't that straw just rot when it gets wet? Sure, if you leave it soaking in water it will eventually. However, a key part of straw bale design is allowing the straw to stay dry. A roof with extensive overhangs to prevent water from reaching the walls accomplishes this.

This chapter focuses on the basics of a post and beam technique for straw bale construction. For details on post and beam or load bearing straw bale construction consult one of the many excellent books on the subject, for example, *Straw Bale Building* by Chris Magwood and Peter Mack.

Straw Bale Advantages

- ⚙ R50-60 insulation
- ⚙ Renewable
- ⚙ Inexpensive
- ⚙ Breathing walls, healthier
- ⚙ Do it yourself, potentially lowers cost, broadens availability
- ⚙ Volunteers (lowers cost of labor)
- ⚙ Thousands built, proven building system
- ⚙ Lasts in some cases longer than eighty years
- ⚙ No pests, no fire concerns
- ⚙ Building code supported in many areas

Planning and Design

The general layout of your structure can essentially follow conventional rules for post and beam construction. For simple structures it is easy to draw up plans yourself. Drawings should include the site layout so that you can determine placement of windows, posts, bales, doors, stairs and other important features of your structure. Knowing in advance where everything is going and where you are going to place everything is critical. Without this you will no doubt build things that need to get reworked because you forgot to consider requirements of this feature. If you are planning a larger, more complex structure, home, workshop, community center or multi-story building you should work with an experienced architect. There



- ➞ **Learn how to build with straw bale by volunteering over a weekend or two to help others. That is all it takes to learn how to build with straw bales.**

are not many architects who are familiar with straw bale construction. One of the best in the world is Martin Liefhebber, who designed our home. For large, complex structures, it is essential to get an expert at eco-design. For a simple home, or once you've consulted with an architect, you may be able to manage the final design and construction yourself.

The basic design technique follows the principles of post and beam design. The straw bales essentially act as an insulation material and the stucco provides a flexible, strong, and "breathing" wall. Some key design elements to make sure you include for straw bale insulation include:

- **Plates (or curb on top of the foundation):** Approximately 18" (this is completely dependent upon the straw bales you get...so find out your source for these and make sure you know their average dimensions) top and bottom plates on which to place and secure the straw bale.
Bottom Plate (or curb): Use 2x4's nailed or glued to the floor. Fill in the area between each side of the 2x4 platform with about 2" thick insulating Styrofoam that matches the thickness of the 2x4. This ensures that the high insulation levels are maintained at the bottom of the bale walls. The 2x4's curb provides a base on which the bales can be placed and a surface for stapling the chicken wire to each side of the wall at the bottom.
Top Plate: Cut a .5" to .75" plywood to provide a top plate towards which the bales will be stacked. This top plate should butt up against the ceiling/roof structure. It should be the same width as the base plate.
- Keep in mind that the walls will vary in thickness and have typically rounded corners.
- Wall thickness can be varied by placing the bales on end, rather than flat, so that the thickness of the walls can be reduced by approximately 3" to 6". Of course the insulation levels will be reduced as well but for a shed or other structure that does not require as much insulation this may give you the additional inside floor space you want.
- The additional layers of chicken wire and two to three layers of stucco on both sides will add to the final thickness of the walls. Plan for an additional inch or two on each side. In other words about twenty inch wide walls rather than seven or eight for conventional walls. Keep in

mind that your walls will insulate at levels of R30-50 as compared to around R11 for conventionally insulated walls, so this extra thickness really pays off.

Ordering Materials

With designs completed you will need to get a building permit for anything larger than a shed. Check your local building code for permit requirements. Certainly on a larger structure like a barn, workshop, cottage, home or condo you'll need to ensure that your design is acceptable to the building department. In most places in the world, straw bale home construction has been approved, so this step should not be difficult. If concerns are raised there are many sources of information that you can provide to support your request to build with straw bales. In the case of a home in a suburb of Toronto, near where I live, the owners had to go to the building committee with engineers in order to get permission to build with straw bales. Their successful review puts their case in the building codebooks as a precedent. By referring to precedents like this – where engineers backed up claims that straw bale does provide a good building/insulation material, meets fire codes, provides proven levels of insulation, supports structure code requirements and will stand the test of time – you are treading on solid ground. It is possible that in your area you may need to be the ones to break down barriers. However, that process is becoming easier as more and more cases such as this are won.

Now that your building plans have been approved and you are comfortable with all the details having been determined, you are ready to place your orders for materials. With the dimensions of your floor space and walls determined, you will be able to calculate your required quantities of materials. Keep in mind that with straw bale you should order 10-20% more bales than you think are required to ensure that you don't run out during construction. You will likely want to order the foundation, framework and roofing materials first, and complete that work before taking delivery of the straw bales. Once you have completed this stage you can take delivery of the bales and store them in the covered structure or under a waterproof tarp. It is important to keep the bales as dry as possible throughout the construction process and until they are covered with stucco.

Materials List (Straw Bale Walls)

- Chicken wire fencing rolls

- Wire mesh for window/door corners
- Stucco paper for around windows/doors
- Portland cement bags
- Vapor barrier
- Tar paper (to isolate straw bales from foundation)
- Lime bags
- Wire of similar type and gauge as chicken wire
- Straw bales
- Staples
- Nails

Tools Required

- Stapler (ideally air powered)
- Hammers
- Large wooden mallet
- Trowels
- Buckets
- Wheelbarrows
- Cement mixer
- Sewing needles (straw bale)
- Wire cutters
- Power tools (drill, circular saw etc.)
- Chain saw (to trim the bails)



Before you organize a group of volunteers to do the straw bale walls make sure you complete the preparation of all plates around the perimeter of the structure, top and bottom. For both our home and shed we used 2x4's to frame the based, with 2" blue Styrofoam insulation cut to size between the 2x4's. This creates a perfect platform on which to stack the bales and tack the chicken wire to each side of the wall. The top plate can be cut from plywood to size and tacked securely to the upper beams supporting the roof or between the posts. This top plate needs to be secure as the forces to be placed on it by the wall and adjustments with a wooden mallet will be significant. As well, the long-term viability of the wall may be compromised if it is not well secured.

Construction

Once you have your materials, you need to complete all of the foundation, framing, posts and beams. In most cases it is best to also complete the roof so that you have a covered area to store the bales and so that the bales will be covered once the walls are completed. Keeping bales dry is important to ensuring their long-term viability. If they get wet without drying properly they will eventually begin to rot. Straw bales should have less than 20% humidity. Devices are available to measure levels of humidity within the bales. In general, as long as you and the farmer have kept the bales from getting soaked by rain the bale should be sufficiently dry for use in your project.



Each door and window should be framed with 2x6 or 2x8 lumber "bucks" for placement within the bale wall at the right levels. The doorframe can be secured before bale stacking begins. Once all of the framework, posts, beams and frames are ready, and all materials for construction of the bale walls ready, the construction of the walls can begin.

It may be easier to staple the chicken wire fencing (usual supplied in rolls) to the outside plates before starting the bale stacking (see photo right). Cut the chicken wire with wire cutters so that it can be attached to the top, then bottom plate. Staple the top and then the bottom of the chicken wire strips. Leave openings in the chicken wire for doors and



windows allowing sufficient wire to wrap around to the frames. As each strip of chicken wire is added, overlap with the previous section by about an inch. Then sew the two strips together with steel wire.

Corners and edges that are exposed to the outside side of the walls should be lined with a plastic membrane (vapor barrier). These should *never* be used throughout – *only* where the stucco will eventually make contact with the posts, beams, windows and doors. This will deter moisture from leaking through the walls and into the home at these edges. It is important that any moisture that does penetrate the wall eventually be able to evaporate and flow away from the wall. Make sure these small areas of vapour barrier do not have any cups that might trap water.

Laying the Straw Bale Wall

Now that you are ready to stack the bales it is important to have prepared some odd sized bales for corners and ends. Have a group of people prepare one third and two third bales by cutting the baling twine and re-tying the two parts. This turns whole bales into pairs of one-third and two-thirds bales. Make as many of these as you think may be required for the number of ends and corners in your structure (see pictures below).

Lay the straw bales one layer at a time. Complete the first layer, stuff any unusual gaps with loose straw against the chicken wire to ensure no gaps exist. This is critical to ensuring a consistent level of insulation throughout the entire wall. Any gaps or air pockets will severely affect the insulation capacity of the walls. Don't leave any gaps between the bales. Once each row is properly filled you can begin the next row. Offset the next row by half a bale, just as a bricklayer would offset the bricks with each row. This ensures a stronger wall. With each row, ensure no gaps or cracks exist. Fill these with loose straw before continuing to the next level.

As you stack bales around doors, windows and corner it may be necessary to insert one-third and two-thirds bales to ensure a good tight fit. Watch for bulges or bales stacked the wrong way as these will create areas of weakness, less insulation levels and unusual shapes. Keep in mind that it is possible to create and place artwork, shelves, tables and larger than normal window sills, stools, storage spaces and much more. Use your imagination with care though, as some ideas may not be what you want for the long term and changing things can be difficult.

While stacking the first layer, the electrical outlet boxes should be attached to a piece of 2x8 lumber and laid on the bales before stacking the next layer. All



electrical and plumbing work should have been planned well in advance and prepared so that it can go in, around or under the bales effectively.

Chicken Wire

Once all of the rows of bales are stacked, c racks filled and corners checked for gaps, it is time to staple the chicken wire fencing to the other side of the bales. Once again, cut the chicken wire fencing to fit the space from the top to the bottom of the wall. Cut to size with wire cutters, staple to the top plate, and then staple securely and tightly to the bottom plate. As each strip of chicken wire is added, overlap with the previous section by about an inch. Then sew the two strips together with steel wire. Special wire twists that can be used to secure the two pieces together quickly with a special hook tool are also available.

If there are any wire bulges, you may want to create some wire “staples”. Cut about twelve inches of wire and bend in the shape of a “U” or “V”. These can then be inserted into the bales to secure the chicken wire to the bales.

For windows ledges, sills, and doors, attach a finer steel mesh to create curved or sharp corners from the buck frame to the main wall. This additional steel mesh adds strength to these areas that will be impacted by people and objects as these areas are used frequently. Tar paper can also be inserted around and below the chicken wire/wire mesh in corners.

Sewing

While the corners are being finished the walls can be sewn together from each side. Baling twine spools and some straw bale sewing needles will be required. We made our own sewing needles using some steel rods about a quarter inch thick and two feet long, purchased from our local hardware store. On one end of each rod, we created a pointed end by sawing off the corners at a forty-five degree angle. Finally we drilled a hole big enough for the baling twine to fit through (about a quarter inch or half a centimeter). Be very careful with these tools around children, and make everyone aware of the danger of poking someone during the sewing or preparation process.



With tools prepared the sewing can begin. Sewing requires pairs of people to work on each side of the straw bale walls, after the bales have been stacked and the chicken wire secured on both sides as well as top and bottom. The sewing process starts by measuring about ten meters of twine and threading it through the nose of the sewing needle hole. The other end of the twine is then tied to the chicken wire at the bottom of the wall. The sewing needle is then pushed carefully through the bale so that the person on the other side can pull it through completely (being careful not to impale anyone!). The second person “zigs” over about eight to twelve inches and up two to four inches, and pushes the needle back through from the other side. After pushing the needle back through, pull the remaining twine through, ensuring that each stitch is pulled taught. This continues until the top of the wall is reached or until the twine runs out at which point it is tied off on the chicken wire.

Make sure that all of the chicken wire is pulled tight to the straw bales so that no gaps are left. The entire wall should stiffen up as more and more of the wall is stitched. Shifting over a foot or so, repeat the same process for the entire section of wall. Many pairs can work in parallel during this process in order to complete the job quickly – like a quilting bee! Make sure that holes and gaps are filled with straw around doors, windows and corners before sewing tight.

Preparing for Stucco

Use a large wooden mallet, like the hand-made model pictured below, to flatten and straighten the walls as desired. Make sure no gaps or weak spots exist. Trim all loose straw sticking out of the chicken wire with a “weed whacker”. Spray a borax/water solution on the bale walls as a fire retardant. Check to make sure that all corners are well prepared with additional stucco mesh formed to the desired shape. Remember that entranceways, windowsills, and corners need to be able to resist many impacts without cracking or breaking.

Depending upon the number of volunteers helping and the number and complexity of straw bale walls, this phase may take a full weekend to accomplish. In my own experience the two main phases, assuming a good number of volunteers (between ten and twenty people), the straw bale wall raising can be done through a single weekend. The stucco process usually then takes another weekend or two depending on weather and other factors.



Stucco Plastering

For larger jobs the major tasks in this phase of the construction should be specialized for different groups. One group should manage the plaster mixing while another does the stucco application to the walls. Each group needs to work in a coordinated manner so that as the stucco plaster is prepared it can be immediately applied to the walls. The first coat must dry to some extent before the next layer is applied. Also, the first rough coat may need substantially more stucco as this layer needs to fill all cracks and create an even surface. The first layer should also be scored with a rake before it dries. This scoring provides an important bonding surface for the next layer. Typically three layers are applied. The first layer should cover the entire surface of all walls and fill gaps. As it dries it should be scored with a rake. Any straw that sticks out should be clipped off at the first layer. Once the first layer dries a lighter layer should be applied to smooth out the entire surface. This may be used as the final surface. To make it a nice texture the second layer can be sponged with a wet sponge. This brings out the sand in the mixture creating a smooth texture and minimizes lines created by trowelling.

A final third layer may be applied in order to pigment the final wall. This allows color to be added.

In order to prepare large amounts of cement-based stucco, a cement mixer will be required. For the small shed that I built, I simply mixed the ingredients in my wheelbarrow. For larger homes, walls and buildings you will need a proper construction mixer. Building our home, we rented one for a weekend.

The plaster mix we used was one part Portland cement, one part lime and five parts sand. Mix in water until the consistency changes to a thick mud. You'll know it is right once you try to apply it to the straw bale walls. It should stick and spread, maintaining its position and shape. Don't add too much water too fast. If you do though, you can add the ingredients in the same proportion to thicken things up again.

Although other mixtures are possible, one part Portland cement, one part lime, and five parts sand provides a well-proven stucco mix. The parts can be mixed using a shovel or other tool as long as it is consistent in terms of the ratio of ingredients. If your particular ingredients don't produce the desired results, then experiment with adjustments to the ratios until you get one that produces the results you want.



Each layer should be applied completely before starting the next layer or breaking for the day, in order to ensure consistency. The stucco is typically applied using a stucco platter to hold the mix. Then the stucco can be spread evenly with smooth consistent strokes using a trowel. Corners can be rounded or forced to a square edge. You may need to spray some water on each layer of stucco as it dries, in order to prevent cracking. This spray should be very fine so that the water does not run down the stucco. After each layer has been applied, review the work to make sure it meets your requirements. Once the stucco dries it is quite difficult to correct any problems.

More Things We Learned

- More than fifty straw bale homes have been built in Ontario.
- The Ontario Building Code supports straw bale home construction that is non-load bearing.
- Quebec and other provinces have permitted load bearing straw bale homes.

Products and Services

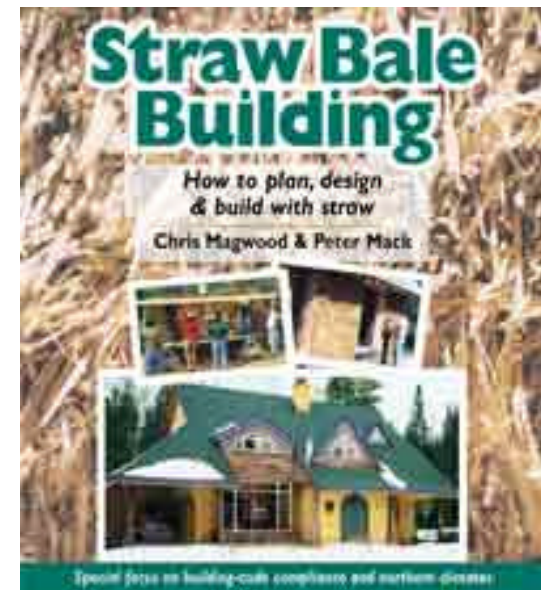
- **Straw bale construction company:** Camel's Back Construction, Chris Magwood, Peter Mack and Tina Therien, www.strawhomes.ca.
- **Post and beam home construction:** Colin Richards, Builder – e-mail gregory.richards@sympatico.ca.
- **Martin Liefhebber, Architect**, www.martinliefhebber.com.
- **Fresh, holistic approach to community design with straw bale**, Cheryl Bradbee, www.pov-design.com.
- **Hands-on straw bale workshops:** Everdale - www.everdale.org, Hockley Ecology Retreat Centre.

Straw Bale Books

Straw Bale Building: How to Plan, Design and Build with Straw

By Chris Magwood and Peter Mack

published by New Society Publishers, ISBN 0-86571-403-7



280pp, illustrated, 8x9, \$29.95 Can./\$24.95 US

Home Improvement & Construction / Ecological Design

Straw Bale Building speaks to a part of us that insists that we should be able to build our own homes with our own hands. We look at pictures of a bale wall being raised and immediately think: I could do that! Straw bale houses can be easy and affordable to build, super energy efficient, environmentally friendly, attractive, and can be designed to match the builder's personal space needs, aesthetics and budget. It's no wonder that straw bale houses are growing in popularity.

Now, with *Straw Bale Building*, this construction technique is explained in the fullest depth yet, enabling everyone who wants to build with bales to do so with confidence, safety and flair and to do so in compliance with local building codes.

Straw Bale Building guides the reader through every stage of the design and building process and is heavily illustrated with both architectural quality drawings and photographs of on-the-job action. With its extensive listing of further resources, it provides all you need to plan and then create the building of your dreams!

Straw Bale Details: A Manual for Designers and Builders

By Chris Magwood and Chris Walker

\$47.95 US

Straw Bale Details is the perfect companion for those who are serious about building with straw. It focuses entirely on the specific design theories and practices that result in well-built, long-lasting bale structures, and extends the range of books like *Straw Bale Building* through large, easy-to-read architectural drawings rendered for a wide variety of building options, including load-bearing and post-and-beam designs. A range of foundation, wall, door and window, and roof-plate scenarios are presented, along with explanatory notes and possible modifications. Also included is testing data from the most recent rounds of bale wall exploration, and interpretations of the data are given to help base designer and builder decisions on sound science.

For more information or to order:

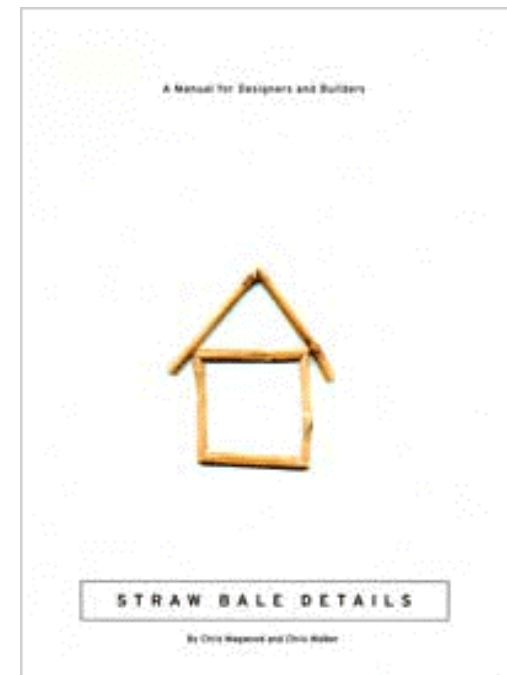
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Case Study: Straw Bale in the City



This home in the city of Mississauga features solar photo voltaic, solar hot water, in-floor hydronic heating, straw bale insulated walls, and a co-housing living arrangement. Three women have created this sustainable dream home in the conservative city-suburb of Mississauga, just twenty minutes from Toronto. Achieving this dream took a great deal of determination patience and will power .

The genesis of this remarkable co-housing idea came from the needs of three independent, smart and creative women, Cheryl, Grace and Beth. Cheryl had learned about the concepts of co-housing in 1994. Cheryl was in her 30's and was concerned about her long-term economic future as a single woman.

In 1997 She decided to talk to her friends Grace and Beth about the idea of working together to build a home that they could share . Grace had been looking for condos in Toronto. This would enable them to express their independence while supporting each other.

Renovating at the time seemed like the best means to try out co-housing. However, with Beth's sensitivity to chemicals the houses they looked at didn't work as she reacted to them badly. At that point they began looking for properties in Toronto and Mississauga. The two criteria for Cheryl were shopping within walking distance and easy access to transit. The property in the town of Clarkson, near lake Ontario, in the south end of Mississauga fit the bill.

They looked at five properties. The property cost \$250,000. They purchased it in December 1998. Some concerns existed with the property as a honky tonk bar had been trying to get permission to start a business on the corner. Several developers had looked at the property but had not done anything. Other properties simply didn't have things like easy solar access. One, for instance, was in a valley near a swamp. There was also a desire to have enough space to grow food. This was, as it turned out, the last undeveloped property in Toronto.

The day they closed on the property they met for a picnic lunch with Martin Liefhebber to start design on the site. It was critical that the design be done on the site, following the principles and ideas of Christopher Alexander, especially the book "A Pattern Language, Towns-Buildings Construction". Most architecture schools disdain him because he is "too people oriented". Decisions are then made on the basis of what people will live in the space, what God would do and based on the ideas of beauty. Beauty is, Alexander found, based on 15 things or patterns that were common to all people. Architects typically don't accept these ideas. Martin Liefhebber did however.

➡ **This 6,000 square foot straw bale home was built in the conservative large city of Mississauga, near Toronto. If you can build straw bale in Mississauga Ontario you can build with straw bale anywhere.**



ideas. This included the idea of thinking in terms of spaces instead of rooms. Also, the idea of always having windows on at least two sides of any space.

The design process also became very interactive as Grace would update Martin's drawings according to her views on Alexander and how she felt the space on the site would work. Light played a big part as is common in architecture. Lots of windows and light of course were the result. People, now, as it turns out, always mention how much light there is in the home.

The idea of using straw bale and solar had always been assumed. The primary goal was health, which very much included the health of the environment. So that both the materials and indoor air quality would be healthy. It is a natural fit to combine healthy materials with solar panels to ensure that the environment stays healthy.

After the plans had been submitted it took more than six months before they got any kind of response. A huge frustration was the city of Mississauga, which rather than getting behind this positive, innovative project, tried to stop it. Mississauga eventually issued a permit to build in the spring of 1999 without straw bale. So the second floor got enclosed without straw bale while the fight with the Ontario Building Code Commission began. The straw bale was critical to Beth so this was an important fight to win so that she could have a clean air environment. Unfortunately the Commissions building was so hard on Beth she could only attend meetings for less than an hour.

Mississauga realized that the house was a custom house in 1999. Martin had clearly documented the use of "cellulose" for insulation. At this meeting they finally asked what this meant. It meant straw bale.

It took until December 1999 for the Ontario Building Code Commission to rule in their favor. Then Mississauga delayed until March 2000 before they issued the permit to allow for straw bale. Straw bale construction took place in May 2000.

The cost of custom building this home, without the high-end finish would be comparable to conventional construction. The basic cost was approximately \$150/square foot. However, this is much more of a house. Essentially the 6000 square feet are like five very different complex homes in one. This diversity and customization added substantially to the cost but also to the uniqueness and artistry. Each unit was essentially a custom house. Each space that was not shared was done specific to each woman. Cheryl estimates that the city of Mississauga added \$200,000 to the cost of building the home. The home has no air conditioning.



None of the women like air conditioning. The yearly operating cost is estimated at about \$15,000 per year of which about \$10,000 is taxes and insurance. Geo thermal was originally what Cheryl had hoped to use. Martin was not comfortable with this so an ultra efficient natural gas water heater was used. Radiant floor heating was not what Mississauga wanted but they did agree in the end.

The city wanted several other standard things. They wanted the driveway to be asphalt instead of gravel (that allows the water to naturally drain through the soil).

The fight to build this home took a great deal of energy and effort but they knew it was worth it. Actually building it was quite easy compared to the fight with the city. Much of the difficulty was the city constantly delaying and asking for more changes.

They found Martin Liefhebber as an architect through Grace who knew him. Martin looked at some of the houses they were interested in renovating to get a sense of how they could transform it into a sustainable healthy home. Martin had won the CMHC Healthy Housing contest several years before.

As Grace said many times this could have been a great partnership and showcase for the city. Instead it was an adversarial relationship that prevented many innovations. A key innovation that was not implemented was grey water recycling for the toilets and plants. This is very common in Europe and especially Germany where most homes do this.

The in-floor heating system is powered primarily by a solar hot water heating system. The Solcan system (Phone 519-473-0501 or Web www.solcan.com) provides the majority of the water heating for the home. Solcan estimates that the system can reduce your hot water heating energy bill by 40%-60%. Considering hot water heating is one of the biggest energy hogs in any home this system may be considered in any home renovation or construction plans. The system is so reliable it can be expected to pay for itself several times over.

The Solcan solar water heater system connects to the existing hot water system and preheats domestic water. The solar collectors are mounted on a roof facing south. Two pipes are connected to the collectors; one carries hot fluid to the solar storage tank while the other carries the cool fluid back to the collectors to gain more energy. The solar storage tank feeds into the bottom of the existing tank.

Two main types of solar hot water heating system can be used. First, the closed loop system uses non-toxic antifreeze that circulates between the solar collectors and a heat exchanger which transfers the heat to the potable water in the solar tank, which



feeds the existing water tank. This system turns on automatically whenever there is solar energy to be gained. The second, passive-systems is a seasonal application in our Canadian climate. It includes a solar collector with a water storage tank mounted directly above it. There is no pump or any moving parts; the natural circulation is driven by the sun.

The gas boiler provides additional hot water heating when required during dull days in the middle of winter. The system is easy to install and relatively inexpensive

compared to active solar system like photo voltaics. The system cost approximately \$4,000.

From an architectural perspective building this home has taught Cheryl a great deal about how people perceive their environment. The opportunity to custom build your own home forces you to learn and think about how you live in spaces and what you will be doing in space and how the different features will affect you. In our modern world, we mold ourselves to fit our cookie cutter homes. Instead, when we use our natural abilities to build our own shelter it changes our relationship with the spaces. The connection to the space and site becomes much more intimate. The space actually expresses your values. It is an expression of who we are. So, what does that mean if we all live in a cookie cutter home built by an engineer or designer completely disconnected from us and who we are?

Building your own home puts you through a process that forces you to think deeply about how you live and what you do. Most architects and designers find it too difficult to accept this.



The home incorporates unisolar, flexible photo voltaic materials on the roof that convert sunlight into electricity. The system was designed and installed by Pers Drew who had been the renewable energy standards person for Ontario Hydro. The system is grid connected so that the electricity bills are reduced by the amount of energy generated by the solar photo voltaic system. The system also has a battery bank for emergency power.

The passive solar features are a primary heating system. This includes the placement of windows primarily on the south face, the concrete mass floors for storing the heat from the sun that comes through the windows, and high quality fiberglass windows that insulate the heat that is captured. The feeling in the house is one of lots of light, fresh air, and simply beautiful comfort.

Materials used throughout were non-toxic and non-off-gassing as Beth has severe reactions to chemicals. This meant using plaster on the walls rather than the drywall (the drywall compound has chemicals that Beth is sensitive to).

Cheryl now works out of the house in her new landscape architecture business in which she applies her recent degree in the subject along with her experience building this sustainable healthy home. The home's landscape is a deep reflection of her



desire to learn from nature. The plants are largely native plants that require little or no special remediation. Most are quite draught resistant. Even the garage roof is planted with native grasses that further increase the comfortable healthy feeling throughout the landscape. The water from the roof is collected and stored in the well that already existed on the property for using in the garden and landscape. All the plants are perennials and the combination is constantly growing, evolving and changing both naturally and as Cheryl becomes more familiar with the site, as she decides.

More Things We Learned

- ⚙ more than fifty straw bale homes have been built in Ontario
- ⚙ the Ontario Building Code supports straw bale home construction that is non-load bearing
- ⚙ Quebec and other provinces have permitted load bearing straw bale homes

Some books on vegetable gardening and landscape that Cheryl and Beth suggest:

- 1) *The Ruth Stuart No-Work Garden Book* by Ruth Stuart and Richard Clemence
- 2) *Four Season Harvest* by Eliot Clement

Products and Services

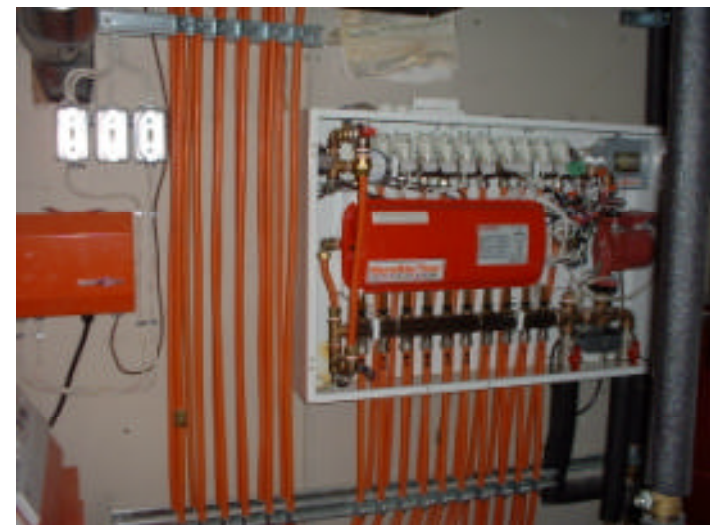
- ⚙ **Solar Hot Water Heating System:** Solcan Ltd., 126 Wychwood Park, London, ON N6G 1R7, Canada, Phone: 519-473-0501, Fax: (519) 474-1539, email: solarheating@rogers.com, web: www.solcan.com .
- ⚙ Lyle Jory, hydronic in-floor heating system.
- ⚙ Martin Liefhebber, Architect, www.martinliefhebber.com .
- ⚙ Per Drew, solar energy systems.
- ⚙ Fresh, holistic approach to community design, Cheryl Bradbee, www.pov-design.com .



Design	DESCRIPTION
Site	<ul style="list-style-type: none"> • In-fill lot within walking distance of local transit including buses, commuter trains, and walking/biking trails. • Within walking distance of village style commercial area. • The 'L' shaped layout provides a 6000 square foot living space with some shared and some private areas for three people. • Deciduous trees provide extensive shading in the summer for cooling while allowing passive solar heating in the winter when leaves are shed.
Construction	<ul style="list-style-type: none"> • Post and beam using paralam engineered wood product and site tree trunks • Non-load bearing straw bale walls finished with a sand, Portland cement, lime stucco mixture.
Efficiency	<ul style="list-style-type: none"> • Hydronic heating system. • Appliances are high efficiency in general including Miele clothes washer and dryer. • The gas boiler is about 95% efficiency.
Passive Solar	<ul style="list-style-type: none"> • Windows are Inline fiberglass windows with krypton gas filling to increase insulation levels. Fiberglass also reduces gaps between the glass and frame due to expansion and contraction differences that are common when metals are used. • Concrete floors are engineered to store the sun's heat.
Solar Hot Water System	<ul style="list-style-type: none"> • Dual panel Solcan system is the primary domestic and in -floor heating system



^ The copper tubing in the middle (covered with foam insulation) is the feed from the solar hot water panels on the roof. These supply heated liquid to the storage tank.



^ The hydronic in -floor heating system is heated primarily by a Solcan solar hot water heater. A ultra-efficient gas fired boiler heats the water when the solar hot water is insufficient to heat the home during the winter when there are cloudy days.

Active Solar	<ul style="list-style-type: none"> • Uni-solar strips are laminated to the roof to provide up to one third of the electrical energy in the house. This is supported by 60 batteries .Grid connected.
Wood stove	<ul style="list-style-type: none"> • Woodstock Woodstoves • EPA rated to reduce emissions
Food	<ul style="list-style-type: none"> • Vegetable garden



Chapter 12

GREENROOF

Our cities, suburbs, and towns create local “heat islands”. The level our impact on the local environment is so great that average temperatures in most places where people live have become several degrees warmer than would occur naturally in these locations. You can’t pour concrete or lay asphalt and expect this not to happen. The only answer is to return the land to a more natural state such that the cooling effects of plants can do what is necessary to maintain a hospitable and healthy environment. That means putting the soil back and growing things on every possible inch of the land that we’ve currently covered.

Of course corridors for roads and railway tracks will be with us, and need to be. A green roof can eliminate the need for an air conditioner while also providing additional insulation in the winter. On top of these money savers green roofs return local average temperatures in the community to natural levels. These roofing systems also last longer and don’t need to be replaced as often as conventional shingle systems.

➡ More than 20% of homes in Germany have a green roof.

Benefits

- ⚙ Reduces heating in summer by up to 40%
- ⚙ Additional insulation in winter
- ⚙ Reduces rain run-off

Design

- ⚙ Typically a green roof needs to be engineered to hold the extra loads imposed by soil, snow, and water.
- ⚙ The roof needs to have a slope for water drainage. Keep in mind that too much slope may cause problems with erosion.
- ⚙ An EPDM (synthetic rubber) membrane on plywood provides the base surface of the roof. The EPDM system is typically used for flat roofs and industrial buildings.
- ⚙ The edges of the roof need a layer of gravel and drainage pipe, much like the treatment around the foundation of the house. The gravel should cover the drainage pipe around the edges where drainage occurs.
- ⚙ On top of the EPDM, gravel and drainage pipe, a Delta (or similar) water membrane should be laid down and secured with soil (the next layer). This membrane has dimples for trapping water for the plants roots. This layer should be laid starting at the bottom, with each layer moving up the roof laid on top, overlapping by about a foot. This layering is the same process as shingling.
- ⚙ A drainage cloth (the type used for landscaping), should be laid on top of the Delta water membrane. This prevents soil from filling the cups in the Delta water membrane.
- ⚙ On top of the EPDM put a six inch layer of soil.
- ⚙ A layer of straw mats or other material may be required to reduce the effects of erosion where greater slopes exists.



- ⚙ Grow wild native grasses, berries, or alpine plants.

Chapter 13

RENEWABLE ENERGY SYSTEMS

Now that we've looked at the essentials of organic food, place, efficiency, and the natural insulation of straw bales, we are ready to look at some of the more "active" renewable energy systems. These are covered in the following order because this is in general their typical effectiveness relative to cost. For this reason we start with solar hot water which has been in use for centuries. In countries like Cyprus over 90% of the homes have solar hot water heaters. This direct means of thermal heat transformation is one of the most direct and thus efficient. Photovoltaic solar panels transform sunlight into electricity. Wind turbines convert the mechanical power of wind into electricity using a turbine. Other renewable energy systems include water turbines, wave power, heat pumps, and geothermal.

Solar Hot Water

One of the most prevalent and proven renewable energy systems for homes is the solar hot water heating system. Many proven models exist. Most of these systems have seen extensive use for many years in places like Cyprus, the Middle East, and other areas with similar climates like the Caribbean. These systems can be added to conventional hot water systems fairly easily.

Typically solar hot water heating systems are composed of several major components. First are the solar panels that transform sunlight into heat. These panels come in a variety of configurations. Most are based on the idea of circulating glycol (to prevent freezing in colder climates and reduce problems related to minerals in water even in warmer climates) through tubes in the panels to transfer

➔ **90% of homes in Cyprus have a solar hot water heating system.**

the heat from the panel into a storage tank where water can be heated. The storage tank provides an insulated area to maintain the heated water and a heat exchanger to heat the water required for domestic and home heating. Most systems are simple enough for people with some basic skills to set up the system themselves. However, qualified installers are available to ensure these systems are properly configured. (SolCan solar panel example)

When it comes to the actual solar panels a variety of systems exist. There are thermosiphon based systems that drain the water from the panels in the event of cold that might freeze the water in the panel. Other systems that may be more effective in colder climates are based on vacuum tube based collectors in the panels. Since a vacuum provides an excellent insulation property these systems may prove more efficient and effective in colder climates where the temperatures outside may reduce the heating effects as the heat is transferred from the panel to the indoor storage tanks. (Schott solar panel examples)

Electricity Generation from Solar Power

The system plants use to convert sunlight into energy / food for growth is one of the great miracles of nature. Although we have not yet become as sophisticated as plants at this process, we've made some progress in the form of Photovoltaic solar panels, wind turbines, wave turbines, geo thermal systems, heat pumps, and wind mills. Converting energy supplied by the sun which in turn drives the weather patterns on earth that create wind and waves, for instance, seems as natural as it comes. In fact we have been trying to mimic nature for thousands of years. When it comes to tapping into the mechanical energy embodied in wind and river water movement, innovations continue. The invention of turbines provided the more recent capability of transforming wind and running water into electricity. Turbines are the result of our recent understanding of the properties of electricity. We've learned to capture the energy in the wind and water by imposing a propeller into these environments that spinning wires tightly wrapped around metal posts, and magnets. Recently, in part due to the space program, there have been innovations in the form of silicon chips that allow sunlight to directly induce an electrical current.

Photo Voltaic (PV) Solar Panels

Generating electricity from sunlight is a fairly recent innovation that came out of the US space program. These systems use a property of silicon configured in a special

way to convert sunlight into electricity. These solar panels are able to then transfer this electricity in direct current (DC) form (the type of electricity typical of batteries) for use by DC devices or to batteries for storage. In order to use the electricity with conventional alternating current (AC) appliances and devices an **inverter** is required. An inverter is an electronic device that is cable of converting DC current being generated or provided by solar photovoltaic panels, wind turbines or other DC generators into AC electricity in real time, on demand. In situations where part of the goal is to supply excess electricity back into the electricity grid, the inverter provides the capability of matching the quality of AC power required. In addition, the inverter is a critical component in ensuring that power is not sent to the grid, in grid-tied environments, when the grid system fails. This protects the line workers that may be repairing the system from the dangers of potential electrocution. Inverters specifically certified for this grid-tied purpose are required. Other fail safe options exist with grid tied connects for manual disconnection from the grid.

Wind Turbine Components

- ⚙ Wind turbine
- ⚙ Tower of typically 40-60 feet
- ⚙ Wiring to electrical system
- ⚙ Inverter to convert DC to AC (some wind turbines generate AC at the tower)
- ⚙ Optional: Batteries for backup power

PV Panel Components

- ⚙ Solar photovoltaic panels
- ⚙ Wiring to electrical system
- ⚙ Inverter to convert DC to AC
- ⚙ Optional: Batteries for backup power

Other Renewable Energy Systems

- ⚙ Water turbine

- ⚙ Heat pump
- ⚙ Geo Thermal
- ⚙ Hybrid systems that combine any number of different renewable energy technologies

Off-the-Grid

Two types of system are available. Of course hybrids of these two may also be configured as well. The first and perhaps older system is that designed for “off-the-grid” uses. During the back to the land movement, in remote areas, and for those independently minded, off-the grid means no reliance or dependence on the electrical utility companies. Where utility grid access is unavailable or would be costly to connect, the off-the-grid options can be cost effective. Rural properties and some developing countries may benefit from this approach as installing grid infrastructure can range from ten to hundreds of thousands, if not millions, of dollars. Without the grid a large bank of eight to thirty two batteries may be required to store excess energy for use when large demand is required.

Grid Connected

Grid connected systems use the utility grid to provide access to additional power when required, rather than using batteries. In addition, grid connected systems can be configured to provide excess power generated into the grid, reducing utility bills. In some cases where more renewable energy is generated than is needed on-site, it may be possible to get paid for excess power provided to the grid. This option exists in some places in Europe and then United States.



Case Study: Freedom Off-The-Grid

Gaining your freedom off-the-grid takes a new kind of thinking. Leonard Allen lives and breathes that kind of thinking every day. Off-the-grid means generating your own electricity, storing it for usage during peak demand, and eliminating your electricity bills. Leonard is one of the few “solar” power people who “walks the talk.” His company, Phantom Electron Corporation, is one of the most innovative renewable energy systems providers in Canada.

Living off-the-grid does not require any radical lifestyle adjustments. The Allen family including Leonard, his wife Jolanda, their three year old son Weston, and dog Duke, live very comfortably in their large modern home. Like most families they enjoy the modern conveniences of a dishwasher, and clothes washer and dryer. Their computers access the Internet through a high-speed satellite link. Their large screen television, stereo and electric guitar (Leonard plays in a band), all make everything appear quite remarkably the same as those living on -the-grid.

Take a closer look, however, and there are some underlying differences that create the magic of freedom from utility bills. Out behind the house, mounted on a thirty plus foot steel pole are an array of photovoltaic solar panels that generate electricity. This solar array is actually mounted on an automatic “tracking” system that directs the panels as close to directly at the sun as possible all day. In the morning the panels point east, by mid-day they are pointed almost straight up into the sky, and finally by evening they end up facing west, constantly optimizing their transformation of sunlight into electricity.

Beyond these solar panels you would never know that this family lives off-the-grid. There are no other unusual features of the actual home, garden, or windows that would indicate that this home works a little differently. To be sure the house is wonderfully bright with light because of the many windows. If you look closely the fridge, elegantly designed into the beautiful kitchen, is a SunFrost (reportedly the most efficient fridge in the world). If you look a little closer you’ll also notice that the lights are all compact florescent of a wide variety of shapes, sizes and types.

Leonard bought the property in 1987 before having a family. He made a decision not to get electricity from the grid during initial construction. He was able to run many small power tools for construction using an initial set of four solar photovoltaic panels, an inverter to convert the DC current to AC, and a small set of batteries to store excess power. The SunFrost refrigerator was ordered early on as the only means of significantly reducing the load typically required by a fridge. It was touted to be the most efficient in the world at the time. Since Leonard was the only one living in the house he was able to limit his use to 400 watts of solar power generation. Everything worked well. The garage was added and since it faced south he put an additional 300 watts of solar panels on the roof. The security systems business Leonard ran moved towards more and more solar powered systems and in fact has turned into primarily a renewable energy systems provider today. The original system was fine for about five years. The battery storage system has been expanded several times in order to allow the home to operate for longer periods of time without as much sunlight. This is especially important during the winter.

The original 900 watt solar system, including the original battery system was then sold. That old system is still operating well for the people that Leonard sold the system to. He had no trouble selling the system as demand for solar is high. The battery system was expanded to three times the original size and is now able to store 50-60 Kilowatt-hours of electricity. This is enough to supply the home for the darker



periods in the winter. There is a backup generator in case this is not enough.

With the larger solar array and battery system a larger inverter was required. The new solar panels were put on a tower and tracker system, and mounted on a pole. The tracker automatically adjusts for variations in the sun's position during summer and winter, as well as throughout each day. The steep angle of the panels in the winter ensures that the snow does not accumulate on the panels (a problem when the panels were fix mounted on the garage). The current battery system is about ten years old. It should last another three years. The array is now up to 1500 watts and is on a higher pole than in the early days. The shading from trees required that they get it up even higher. They have more power than they need in the summer and the charger shuts down sometimes. There is still a deficiency in the winter. November in southern Ontario has many fewer daylight hours and may have no direct sun for days on end. The solar array could be bigger to make up the difference in the winter. In fact, engine-driven generators have been the biggest problem. They have been unreliable in general. They are strictly for backup power and aren't designed for longterm usage.

The generator runs about 150 hours a year. The cost for gas on this is about \$150. This is a stop gap for now, says Leonard. Eventually he is hoping to store the summer excess power for later usage in the winter. Eventually he hopes to run on a fuel cell energy storage system when these units come down in price. This should be in two to three years. Leonard expects to be one of the first off-the-grid users of fuel cells in the country. The fuel cell unit would then be sized to store the annual requirement for kilowatts needed. The array would probably need to be about 20% greater than expected requirement, and then the fuel cells could be used to store excess for use during the winter.



The home has lots of natural daylight so that electric lights don't need to be turned on during the day. During the recent renovations the changes to the overhangs on windows have significantly improved cooling in the summer. The home was originally a forced air gas furnace. During the most recent renovation an in-floor hydronic heating system was put in on the 1200 sq.ft ground floor. Now no blowers, which were gobbling up lots of power with the old system, are required. The in-floor heating system is supplied with hot water by a propane in-line water heater. This same unit supplies all of the in-floor and domestic hot water required. By turning up the hot water temperature while the dish washer runs Leonard is able to ensure that the electric water heater in the dish washer doesn't turn on, significantly reducing the load on the electrical energy systems. The dishwasher needs to see at least 140 °C to not need the energy boost. Before, the dishwasher was using about 1000 watts of power.

Propane is used for water heating, cooking and the clothes dryer. They get a 1000 liter propane tank filled three times a year. They spend about \$1,200 per year on propane. To some extent the extensive windows require this high level of heating. The wood stove also is used to supply an additional 20% of heating and only when it is especially cold outside. The cost of wood is about \$300 per year. Triple glazed windows are something Leonard would do next time. Another idea Leonard has is using the wood stove for heating water used in the in-floor system.

Being off-the-grid you must be cognizant of your energy usage. You may undergo an adjustment period initially. People are, in general, unconscious of their energy usage. When it is finite, in off-the-grid homes, it may take a few months, if not a year or two, to become familiar with how efficient and careful you can be with this resource.

Despite this, there is zero maintenance on the system now that everything has been optimized and tuned. There are some monitors for viewing the percentage of power available on the batteries. This becomes useful for unusual events more than day-to-day operations. For something like parties where additional power will be required it is possible to generate supplemental power with the generator. Basically, after the first year you understand what each system will provide. Each year will be about the same once the system has been tuned.

For Leonard the system has been working well as is for a few years now. Each solar panel is 85 watts and costs about \$600. He has 18 panels on the tracker. The skylights also provide lots of good day lighting. The garage has skylights for

additional light. The solar array is about 75 feet from the house with an underground cable in PVC pipe. There are six pairs of conductors. The six pairs of wires come into a 60 amp circuit breaker and then into a charge regulator. The charge regulator is able to take the increased voltage that solar panels generate in the winter and improve charging current by 25%-30%. The charge regulator also displays a great deal of useful information about the amount of energy being generated. The power flows into a 250 amp breaker that is connected to the battery bank. The warmer the batteries are kept the better their capacity. So maintaining them in a warmer environment is better. The second breaker protects the DC systems from the AC inverter. There is a meter that monitors the level of charge in the batteries. The sine wave inverter converts the DC current generated by the solar panels to clean sine-wave AC for conventional appliances. The inverter is sized to convert 120 V AC sufficient for having all of the loads including all lights being turned on – 40 amps AC - 5,000-6,000 watts. It takes a few days of sunny weather to charge the batteries to capacity again. However, with a properly designed system, the batteries should never get to the point of being totally depleted. It takes about a day and a half of sunny weather to charge the batteries to capacity again. For 240 volt appliances an additional inverter can be included. The Allen's 240 volt inverter unit is no longer used. Amazingly, since the recent renovations and system expansions, the generator hasn't been used since March and won't go on again until November.

The water system starts with a 13 year old 1/3 horsepower pump. It is sized to be just enough for what they need. An ultra-violet sterilizer cleans the water and is DC based using less power than other units. The SunFrost fridge and water cleaner run on DC (12-48 volts) rather than AC. The preheat tank will eventually be fed by a solar thermal heating array (panels). Currently the Rinnai Model 2532 Continuum in-line water heater provides all the hot water required for both in-floor and domestic needs. The unit is efficient at adjusting the flame to optimize for high and low BTU usage. Small pumps push warmed water through the floors for heating. The four small pumps are 12 volt DC circulation pumps each drawing just 3.1 watts as compared to 40-60 watt AC pumps used normally. Again, the off-the-grid aspect dictates ultra-efficiency wherever possible. The whole system only uses as much as a 60 watt light bulb, which is uncommonly low. The old forced air furnace was a major electricity load that drained the batteries. The in-floor or radiator based systems are the "only way to go" according to Leonard when compared to big fans blowing hot air around.

The appliances, washer and dryer are very efficient. The dryer is propane to reduce l. The washing machine has a high capacity for double loads. The theme of maximum efficiency, wherever possible, is the key. Other appliances are standard. The stove is propane.

Leonard gave us a Kill A Watt™ device that lets you measure the electricity usage characteristics. This device showed Leonard that his satellite Internet connection and television system combined were constantly draining 60 watts even while turned off. By adding a power bar to these systems Leonard has been able to shut off this constant drain on his system. Killing all the phantom loads is essential when you live off-the-grid.

Leonard Allen is the President of Phantom Electron Corporation, a major supplier of solar and renewable energy systems in Ontario. For more information about renewable energy systems products, installation and operation see www.phantomelectron.com.

Off-The-Grid Reading

Home Power

For anyone who wants to get into the details of living with renewable energy this is the magazine for you. Each month this hands-on journal has off-the-grid and on-the-grid home owners tell their story in an easy to understand format. If you are into all of the technical details and comparing systems then this is the ultimate source of information. You can download a free copy off their web site each month in PDF format.

Web Site: www.homepower.com

Natural Life

This simple magazine covers a wide range of sustainable living topics. For ideas that we can all start using today this is the place to start. Each issue reaches far and wide for interesting stories with lots of ideas for living a more natural life style.

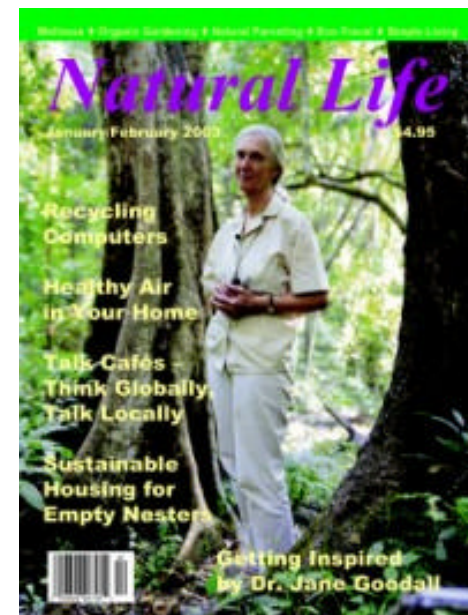
Web Site: <http://www.naturallifemagazine.com/>

Private Power

As the cost of electricity goes up this new magazine has been of great interest to the people in rural areas of Ontario. Capitalizing on the recent high profile initiatives announced by the government this magazine shows many different ways that Canadians can start to generate their own clean green renewable energy today.

If you can get your hands on back issues look for the wonderful article by Peter Forint on our SunFest 2003. In it Peter describes the event in some detail for those who want to know what it is all about.

This magazine has provided plenty of food for thought for those living in rural areas. The need for energy on farms can be quite high. With recent increases in the cost of this resource, farms have been looking for a publication like this which explains in simple terms how they can start to reduce their demand and even generate their own "Private Power" today. Beyond the magazine the people behind Private Power have offered conferences on topics such as Wind and Solar Power. Their recent trade show and conference attracted more than 3000 people. The



complete set of videos from the conference teaching sessions is available from *Private Power*. In addition, the Canadian RE Handbook, by Bill Kemp is also being offered with special pricing on combination orders.

Web Site: www.privatepower.ca

Chapter 14

TRANSPORTATION

As it turns out this may be the next big area where it is easy to make changes in your lifestyle. By getting out, doing some more walking, taking transit and if you need a car, looking at the new hybrids, you can make a big difference pretty quickly.

Walking

Obviously this means we need to be walking as much as we can. This failure to use our natural means of locomotion has led to the growing problem health problems related to being overweight. When you combine larger portions of fat infested food, watching more than several hours of television a day, and work that typically requires little more than sitting at a computer terminal all day, it is no wonder we are getting out of shape. Simply speaking we need to get up on our god given feet and walk. I believe far more in the need for us to exercise this simple and useful capability than any kind of dietary changes. When we can walk we should...and we need to regain a joy in doing so.

In the long run this will mean changing our communities...we need more walking paths, side walks, and connections between facilities that require us to walk. Combined with biking trails, shelters for walkers and bikers, we all need to make it a whole lot more appealing to get out and get there on our own two feet.

Transit

If, like me, you must commute to work then learn more about your local transit system. If you are lucky, the system will be as good as the one that services the area where I live. Of course the system could be a lot better. Make the break from driving your car. For the first year after living in our new home I was driving for more than an hour into downtown Toronto where I worked. This was partly

- **Transit can eliminate an hours worth of highway commuters.**

because at the time Leigh, my wife, also worked downtown. So we would take turns going in early and coming home early or going in later and coming home late, so that one of us could pick up the kids. Fortunately Leigh ended up with a job in a suburb much closer to us. At this point I made a decision to take a commuter train. At first I feared that losing the flexibility of the car might be too much of a sacrifice. I have found the opposite. Knowing how the system works well I've lost no flexibility, while eliminating the worst part of my commute, out of the downtown core. Now, my only driving, in our wonderful Toyota Prius Hybrid, is on country roads. The train allows me to do work or catch up on some reading each day on my way to and from work, something obviously impossible while driving. Also, the reduced level of stress from driving is substantial.

Cars and Trucks

Not owning a car, if you don't need one is a good thing. Having said that there are of course times when you have to have one in order to get certain things done. The other reality is that the freedom and flexibility for traveling large distances in almost any direction are without comparison. Trucks also, provide transportation capabilities that are incredibly flexible. Even once products have been moved by trains they often need trucks to get them to their final destination..

The time for a massive change in this mode of transportation is long overdue. We now have the technologies to make all of these vehicles produce 90% less pollution while increasing fuel economy by more than fifty percent, without sacrificing anything. I base this on my own extensive use of the Toyota Prius Hybrid car. This amazing machine, complete with computer, rechargeable batteries, turbine for charging, electric motor, regenerative braking system, and conventional gas engine works smarter in a wonderfully useful package, including lots of space for passengers, and a hatchback for plenty of cargo space. The car performs well on the highway, country roads and anywhere else you might choose to go. In the city and while driving slowly it is possible to rely entirely on the electric motor and battery system at times. When speed and extended acceleration and additional power are required the gas engine works smoothly with the electric motor system to thrust you past others.



> *Toyota Prius recently purchased by the Wilson family sitting in front of the Wilson Natural Home*

Chapter 15

VALUE CONNECTION

“The human being is part of the whole, called by us ‘The Universe’, a part limited in time and space. He experiences himself, his thoughts and feelings, as something separate from the rest—a kind of optical delusion of his consciousness this delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty. Nobody’s able to achieve this completely, but the striving for such achievement is in itself a part of a liberation and a foundation for inner security.”—Albert Einstein

Finding a connection with nature has the power to help us realize our greater selves. The way we live, the decisions we make, and what we make of our lives has a tremendous impact on our world, those near and dear to us, and an even greater impact on those far away, those poor billions, as we all suffer the destruction of the environment. This connection is very real and very direct although you would hardly know it if you didn’t try to find it. You are responsible: for the mother who is killed in a car crash every day, the child that dies of starvation in Haiti, the nuclear power plant meltdown that kills thousands, and the near slave labor which creates your shoes. These are the endless, non-stop, un-reported tragedies of everyday life on earth today. We must take responsibility for them as we find our awareness.

In awareness there is a chance that we can change. Change can take place if we consciously make the effort through our choices, through the use of our creative capabilities for sustaining life, and our ability to visualize an alternative that can be achieved through a plan.

Lifestyles today hide nature and our destructive way of living. The causes and effects of our lifestyles may be separated by large spans of time and large distances. We need to make the connections between the wars in the middle east and our fossil

fuel driven economy even though the distances are great and the political complexities confounding. Then we must understand that the exhaust from our cars and trucks that burn fossil fuels are accumulating over a long period of time in the environment all around us. Also, each day that we live in a polluted environment increases the probability that we will be affected. The next time your oil fired furnace explodes into action, just think of all the pain and suffering caused in the many wars of our modern era and the terrible acid rain that will destroy the forests north, south, east and west of your home. In this light, we find the will, the desire to save ourselves, nature and our children from destruction.

In his book, *The Future of an Illusion*, Freud explains the psychological basis for our beliefs, needs and desires. He states that “What is characteristic of illusions is that they are derived from human wishes.” (*The Future of an Illusion*, pg. 48) This critical point suggests that we must be very careful in our analysis and search for the truth. The power of illusions is partly maintained by the incredible power of our wishes and desires. In the search for a true way to live we must be prepared to question every aspect of human creation, including culture, government, religion, capitalism, economics and even democracy. These illusions are a reflection of our desires. We must base our desires, or in other words, the illusions we create, on the strongest possible foundations of truth. This means understanding nature. This awareness will link us to the responsibility we have for the illusions we live, and help us create the new visions that reflect our true connections to the infinite creativity of the universe.

Our Values

The heart of remaking our world is our ability to change ourselves. The changes we make must be based on a set of values that set priorities and direction based on our new understanding of the problems and potential solutions found in our connections to the rest of nature. These fundamental values should be our guiding lights for living a more natural sustainable life:

Truth

- The highest priority and principle upon which all others are built is truth; the endless search for the truth.
- This endless quest holds the foundation upon which we build and constantly question.

- Under the bright light of truth , each problem, solution , priority, desire, value and system is placed in the full understanding of humanity's true place in nature, the universe, and time.

Love

- The deepest energy within, our humanity, our ability to love ourselves, our children, our family, the family of all humanity and the sustaining natural world with which we are symbiotic.
- Our highest priority is the application of love to the journey in search of truth.
- Through the continual application of principles of love and peace we can find a way of living that does not find benefit in selfishness, power, and evil.
- The only answer to the most difficult problems of our and all ages is the application of love against the powers of evil, hate, anger, lies, ignorance, murder, and war.
- Love is the only weapon in the arsenal of those who fight for the truth that can overcome the most difficult problems.
- Love is the ultimate reflection of true happiness.

Partnership

- In nature we see the incredible power of symbiosis which is our own true nature.
- We find our place in nature by reconnecting to it, returning to a partnership pattern with nature and each other.
- The lure of power may try to corrupt us along this path but it has always failed in the end.
- Working together, we find our true place within nature . Together we search for the meaning in our lives through the application of our unique talents.
- It is only in relation to others and nature that we truly exist with any meaning.

Peace

- True peace is a symbiosis with nature , love of our fellow humanity through equality, and the opportunity to live freely.
- The search for peace is found in the defense and love of the weakest, the voiceless, the small, the few, the poor, the enemy and the true heart of love within us.
- Acts of hate, untruth and war are the solemn enemies of peace.
- Acts of peace, which must be every act of our lives, are a non-violent fight for truth, love, and partnership.
- We must make peace with our creator, that which sustains us and nurtures us through time, that which is nature .

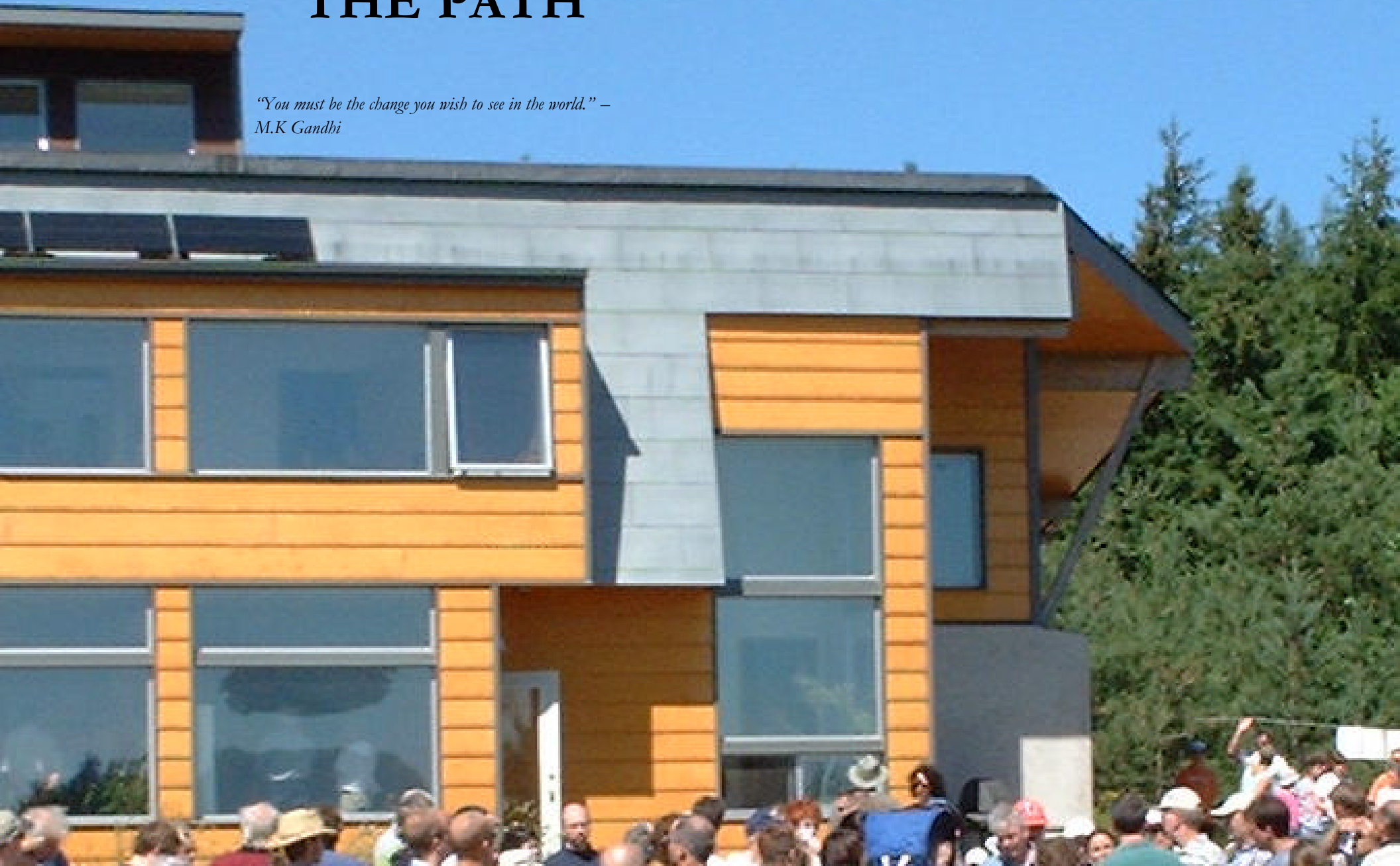
Wisdom

- We must find the power to be the change that reconnects us to our love of nature.
- There can be no arrogance in this search, as true wisdom is beyond us all. But in the humble search we should be willing to apply the largest part of our energy and time in the attempt.
- The wise maintain a sense of humor, as does nature , but one that is pure and good, not negative, sarcastic, bitter or hurtful. Forgiveness through love has been the greatest answer to so many problems that seem insurmountable.
- We all return to the earth and so our reconnection will be established with nature no matter who we are.

The process of finding our place, our unique way of applying these values is to find the meaning of our lives. This process is by no means complete, perfected or precisely the one I have followed. However, it does represent, as best I can describe it, the essential elements of what has worked for me and my family. I believe it will provide a guide that may help you create your own natural path.

SECTION 3: FINDING THE PATH

*"You must be the change you wish to see in the world." –
M.K Gandhi*



Chapter 16

THE JOURNEY

It started when my son Ian was born. The birth of my son Ian and then just 22 months later, my daughter Claire, triggered an understanding of how we're all connected, and how that connection continues through time. My son Ian brought tears of joy through 43 hours of hard labor, pain, agony, and finally joy, when he appeared calmly with a look of peace on his face. My daughter Claire appeared after just eight hours of labor. She literally flew into this world, looking terribly lost. She turned purple as she could not breathe from the shock of having to breathe on her own. She was eventually resuscitated by a calm miracle worker of a doctor after what seemed an eternity. I cried with joy as never before or since both times. This miracle of birth is our connection to each other and the life force through time. I am them and they are me.

These moments of truth, these connections between child and parent that link us all together, the miracle of life, and the recognition of our simple humanity, these connections are why we must take responsibility for the problems all around us.

What does it take to achieve a lifestyle that is restorative to the earth? First you have to imagine what the result will be like. At the dreaming stage you really need to be open to all the options and opportunities around you. Let your mind run free and dream of all the incredible things you can do to create a lifestyle that lets you enjoy nature, provides a healthy environment for your kids and allows you to explore a new way of living. I have found that keeping a journal is an excellent way to keep track of all the ideas, thoughts, task lists, pictures, poems, and news clippings of interest. Having these notes, and reviewing them periodically, reminds me of dreams I may have forgotten – good ones, that might now be possible.

Creating a plan for lifestyle change requires a thorough understanding of your requirements, budgets, goals, objectives, values, and principles. This level of planning is important so you remain true to your intents and purposes. This is not

to say that the creative process of *Natural Living* won't alter your path as you take each step. In fact, it's important to be prepared to go with the flow that guides all processes. Sometimes the results will not be exactly what we envisioned. Nature accepts this type of process and so should you, as long as you adhere to the essential principles. Many times this process will lead to a more natural path towards your goals.

The story of my journey toward *Natural Living* begins with the birth of my children. The love we feel for our children is a deeply protective one. I have discovered that in the face of impending dangers, an almost primal urge wells up inside me giving me the courage and energy to protect my children. Protect them from what, I wondered. Any danger to their health and well being, any threat to their life, was a deep concern to me as a new father. The great danger I was reading and hearing about in the news, books, magazine and television reports was the threat humans were posing to their own "environment". The greatest scientists of our time issued a "Warning to Humanity" (see Appendix A for the full text of the warning) that struck me as perhaps the greatest long term threat my children would face. I posted this warning message on the bulletin board above my desk at home. My passion to act in the strongest way possible had been fully aroused.

Children

The late fall of 1992 saw the birth of my son Ian. At the time we lived in downtown Toronto, in a wonderful old neighborhood called Riverdale. Our beautiful old house had been perfect for Leigh and me as a couple working downtown. Now, with Ian our baby, the cost of living suddenly grew dramatically. Leigh's return to work necessitated the additional expense of day care. Our financial future became a concern.

Claire our daughter was born October 6, 1994. In my journal I noted:

Claire, our daughter is almost one month and a half. My little girl is so beautiful, so precious, so delicate, true innocence and expectation of a beautiful future. It is time to act. Somehow I must try to make a difference. We must give back to the earth a lasting natural park recovered from the rubble. Children can gain so much from simple, beautiful educational experiences on peace and nature and people's ability to affect change. An oasis in a desert makes a strong impression because it is so refreshing. We need to celebrate and enshrine and perpetuate the heroes of peace and nature in order to build on their foundations. The voices must be heard.

Shortly after Claire was born we realized that if we were to make our dreams a reality, we had to downsize. We found a townhouse twenty minutes from downtown by commuter train. This small townhouse was about half the price of our wonderful old house in Riverdale. These savings would go towards a fund for purchasing and building the solar powered house of our dreams.

Most of the changes we need to make depend on making the jump in understanding that we are all connected to each other, to nature, and the entire universe. Once you understand this, once this becomes your extended self, then you are ready to look at things as they really are.

Here is a list of objectives developed during the early years trying to understand what we needed to do:

1. Teach by example the benefits of environmental preservation and restoration.
2. Inspire a change in thinking, such that environmental preservation and restoration become the status symbols of society.
3. Emulate and live in harmony with nature.
4. Focus on the long term implications of planning, design and development.
5. Reestablish, encourage and preserve human consciousness of nature.
6. Abandon the notion of perpetual growth; instead, embrace natural equilibrium and symbiosis as the models for human systems.

7. Consider alternative solutions to environmental restoration and preservation.
8. Find and foster workable solutions to environmental restoration and preservation.
9. Persevere – remember that this process of change is a long term one and that it will never end.

This evolutionary process will be lead by ordinary people like you and me, not political leaders. Try to come up with your own set of objectives.

Algonquin

North of Toronto is a large provincial park called Algonquin. In the park are many lakes, trails, and campsites. Many of them are only accessible by canoe. My first canoe trip into the interior of this park was with my brother. Despite having grown up going to YMCA camps for many years as a youngster and as a teenager, this would be the first “out-trip” as an adult. We prepared in characteristically Wilson cavalier fashion, with a minimalist approach bordering on foolhardy. This was the wild where anything might happen.

We rented the traditional aluminum Grumman variety familiar to us as YMCA campers...just in case we took some difficult rapids, the thick aluminum walls would save us. We did this despite planning for two long portages in order to “get away from everybody”. Leaving Toronto on a Friday evening is never a pleasant task with all of the other traffic racing to get north. We would arrive too late, we feared, to pick up our canoe. We arrived around 6pm as the sun was starting to set. The clouds looked ominously gray. With pots dangling and clanking from our packs we loaded up the only ultra heavy Grumman aluminum being used by any campers. Every other wimpy group was using some red Kevlar canoes that looked terribly light and breakable. Hmm?

We had little time to waste, as our first campsite was a considerable distance paddling and a long portage away. As we paddled hard into the wind the rain started pelting us. The winds got stronger the further we got out onto the large lake. We could hardly see the shore. We didn’t really know where we were going. Our map was getting soaked. It started getting darker and darker. After an hour or two we looked at each other and agreed we weren’t going to make it to our planned campsite. We made for shore partially with some level of fear that the growing

waves, wind and rain would soon swamp us. Exhausted we made it to the shoreline. As the darkness began to engulf us we found a bright reflective sign indicating a campsite. We decided we'd share if we had to but we needed to stop for the night.

The site was little used...or so it appeared. It was dark. We set up the tent sloppily and as quickly as possible. It was cold and we were soaked. The fire we tried to start simply fizzled. We had a few crackers and went to sleep in our tent with the rain continuing to fall heavily. The wind blew harder. It was getting colder and colder. We weren't comfortable. Then, all kinds of strange noises started all around us. Something was trying to scratch its way into the tent, above us, at the corners, everywhere! We were terrified. Bears. Wolves. What could it be? It was, we soon saw by way of flashlight, tiny silhouettes of mice crawling all over the tent. Horrifying but not deadly. Needless to say we did not get any sleep that night.

The morning was cold and damp but at least it wasn't raining. The mice had found our crackers and eaten most of them. Mist rose from the lake. My brother and I looked at each other. We both saw, without speaking, that we were both thinking, "this is a nightmare". Our heads ached. What should we do? We could pack it in and head back to the city. We decided, instead, to take off our clothes and go for a swim as the sun began to rise. We dove into the frigid waters. We swam more and more joyfully, roaring, and laughing and splashing to warm ourselves. Our heads cleared. We felt free, cleansed, happy, energized, totally liberated and fully in touch with nature. It was so utterly unexpected! That moment changed our lives. We continued the canoe trip and enjoyed several days of calm quiet beauty in the back lakes with no other campers, as the portages did prove brutally difficult, a great barrier to those unwilling or unable to break through especially those with big heavy Grumman aluminums. And yet the challenge, the exhaustion, the satisfaction of going deeper into the quiet places brought a greater calm, a more wonderfully surreal aspect to the sunsets, and a sleepy openness to the clear star filled skies at night. Food tasted better. Things made more sense. We talked late into the night about nothing ordinary. We were one with the universe.

O Me! O Life!

*O me! O life! Of the questions of these recurring,
Of the endless trains of the faithless, of cities fill'd with the
foolish.
Of myself forever reproaching myself, (for who more foolish
than, I and who more faithless?)
Of eyes that vainly crave the light, of the objects mean, of the
struggle ever renew'd,
Of the poor results of all, of the plodding and sordid crowds I
see around me,
Of the empty and useless years of the rest, with the rest me
intertwined,
The question O me! So sad, recurring—What good amid
these, O me, O life?*

Answer.

*That you are here—that life exists and identity,
That the powerful play goes on, and you may contribute a
verse.*

- Walt Whitman, Leaves of Grass

Wilsons Beach House

The summer of 1991 found the Wilson family north of Toronto at a rented cottage. Despite typically hot and humid summers in cottage country, frost warnings were the weather warnings this particular week. At the end of June. Ian Wilson told his family it was time to go somewhere warm. Son Dan Wilson had mentioned a place called Cabarete in the Dominican Republic that was beautiful, with wonderful beaches, and hotels that offered reasonable rates. Dan recommended that his parents, my parents, Lynn and Ian Wilson check it out as it might be the place where they could find their dream of a beach house in the tropics. Exploring the north coast of Dominican Republic Lynn and Ian found the tropical paradise they had been dreaming of. Walking the beach west of Cabarete they rounded the point to find hundreds of wind surfing fanatics flying across the water. This “honky tonk” little town was hopping with Europeans, Americans and Canadians who loved the sport of wind surfing in one of the best locations on earth. As Lynn decided that the

local restaurant was far enough to have walked that day, Ian decided that perhaps just around the next bend would be something.

Yes. At the far end of the beach was a big, blue, red and white house sticking out prominently, right on the edge of the beach. There it was. The perfect spot. A run down house with an old “For Sale” sign on it.

Over the next four years the Wilsons spent summers and vacations renovating while working in Abu Dhabi. Ian is a professional engineer. Lynn is a teacher specializing in English as a Second Language. Together they reshaped, redesigned and reinvigorated what was at first an eye sore with no views on the beach side of the house.

My first direct experience with the use of photovoltaic (PV) solar panels, which convert sun light into electricity, came about after discussing their benefits with my father. After explaining the potential I saw in them, an opportunity arose to purchase some for the beach house my parents owned in the Dominican Republic. Frequent (daily at the time) power failures required the use of a noisy diesel generator in order to provide light, hot water and fans for guests. Solar panels, batteries and power inverter offered the perfect solution. Installing the eight year old used solar panel system has worked well for the better part of the last ten years now. Last winter my father added two more new solar panels and a solar hot water heating system.

Having spent our winter vacation there for the past ten years, I can personally testify to the benefit. When the power fails, and it always does several times during our stay, the beach house has lights for reading, fans to cool us, and even warm water for our showers. The system works in perfect silence while, unfortunately, the neighbors must power up noisy polluting diesel generators to keep their guests happy.

Ian Wilson, now a prominent member of the Cabarete community, got a set of four photovoltaic solar panels, from a Canadian who had used them for several years in about 1998. Then in 1999 the family brought down four more panels in large suitcases. These solar panels have worked essentially flawlessly since then. The mixed set of panels generate approximately 560 watt hours combined. This is enough power to keep the house operating without electricity from the grid for about twenty four hours. Of course a large bank of batteries is used to store the electrical energy generated during the day. As well, the batteries can be charged up using the electrical grid when available.

The electricity situation is erratic in the Dominican Republic. The power may be shut down for extended periods of time. Wilson thought the reliability of the country's electrical utilities would improve but it has continued to be unpredictable up to the present.

The result of the investment in this system starting almost six years ago is the ability to supply seven bedrooms, two living areas, and two kitchens and with one electrical fridge and fans in most rooms with enough power. This despite the fact that the grid utility power is typically down from late morning until the evening every day. Power outages are typical at night as well. With the solar system Wilsons Beach House maintains lights, fans and fridges without any interruption during these frequent blackouts. Other hotels often can be seen along the beach with their lights flickering off as the power fails, and then slowly coming back as their noisy diesel generators blast into action.

The system has only failed once because the batteries were not maintained properly. The key to maintenance is cleaning the batteries using WD40 and having good wire connections. The beach house has always had power despite frequent outages.

The Wilsons have a small diesel generator as a backup which they don't like to use due to noise and air pollution. But from time to time they turn it on and it does



> Photovoltaic solar panels constantly collect the sun's energy and convert it into electricity. The combination of new and old panels has worked flawlessly for many years. These panels are not visible from the beach so that few people walking by even know that this beautiful beach house has solar power. If you are interested, however, be sure to ask Ian for a tour of the utility room and a peek through the vent in the roof for this view.

charge the batteries when power is out for especially extended periods of time. Dull weather would be another reason they sometimes charge things up with the generator.

The original system of 6 panels (2 died), with inverter, and batteries cost about US\$4,000. Four additional panels were purchased for about US \$1,000 each. Replacement of batteries over the years has cost about US\$1,000. The original hot water heaters only worked with city power that was out so often they didn't have hot water when it was needed. Now, with the MegaSun solar water heater, they and their guests have hot water pretty much whenever it is needed. If they get a few cloudy days, the showers provide warm water instead of hot. The system has a glycol type fluid that is heated and in turn heats water in the tank. This avoids direct heating of the water that can have problems since water at times has sediment that could clog the system.

The solar hot water heating system was about US\$4,000. It was installed by a local plumber without any special skills related to solar systems. The MegaSun systems are made by a Greek company and sold through a local distributor in the Dominican Republic. The system has worked flawlessly for the past three years.

All the solar panel systems are essentially maintenance free. Cleaning the surface might be a good idea. The rain seems to keep things pretty clean.

Inside the beach house all the lights are compact florescent to reduce power consumption. Of course the Wilsons are careful to make sure that lights are not left on especially when the electricity grid has failed and the house is operating on solar/battery power only.



Ian Wilson shows us the Trace inverter monitoring systems and batteries in the utility room. The inverter converts DC current generated by the photo voltaic solar panels into AC current that can be used by appliances in the beach house. The batteries store electrical energy so that it may be used for extended periods when the electrical grid fails. The simplicity of the system is critical to the reliable operation over the past six years. Each of the systems installed, both the active solar (photo voltaic/inverter/battery) system and the solar water heating system were installed and have had essentially no maintenance since then.



Some other things the Wilsons have learned over the years. They save vegetable waste so that their friend Gaby can use it in her garden. This reduces their garbage which you have to pay for pickup in the Dominican Republic. They don't have a car since they can walk to everything. Life is simple. No need for a car. Sports are wind powered as in wind surfing and kite boarding. No motor boats or jet skis are allowed in the bay except for the local fishermen who bring in fresh fish every day.

Getting started with solar power is quite an initial investment and requires some additional investment in time but it is worth it according to the Wilsons. It is a nice feeling to have power supply in your own control especially in countries like this where it is essential for keeping food from going bad and keeping guests happy.

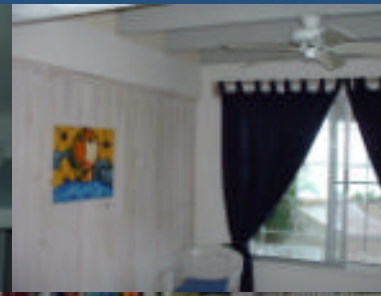
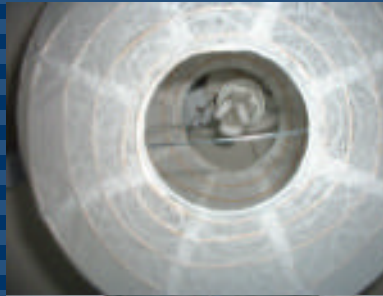
The strict restrictions on types of electrical devices that may be used can become a problem when guests who are not used to this level of strict energy conservation start using a blender or hair dryer for instance. It is a great learning lesson for those of us so unaware of all the energy we waste.



Solar water heating is a standard feature of homes all over Greece, Cyprus and much of the Middle East. These systems have been used for decades to reliably provide warm water for showers and other domestic hot water heating. Of course in colder or milder climates the sun's ability to heat the water is less, limiting their effectiveness. In climates where the temperatures go below zero degrees Celsius there are requirements for ensuring that the liquid in the solar collector panels do not freeze with chemicals like Glycol. As Wilson says, even in the tropics providing a closed loop system that doesn't use pure water that may have sediments improves the reliability of these systems. The tank above the solar water heating panels stores the heated water for use in the beach house. The system's simple proven design has provided the Wilsons and their guests with all the hot water they need and then some all without burning any fossil fuels or adding to the electricity load that is limited by the solar electrical power systems.

The town of Cabarete provides plenty of low impact activities for the energetic EcoTraveler. Of course the wind surfing and kite boarding can't be beat. Check out one of several great wind surfing shops right on the beach, such as Vela, Bic or Mistral for some great deals on wind powered sports.

Other attractions include Iguana Mama, an award-winning provider of natural and ecotourism related adventures. These include mountain biking, inner tubing down rivers, horse riding, and whale watching.



Compact florescent lighting reduces energy requirements.

Notebook computers use less power that desktop units.

Efficient ceiling fans provide additional cooling without being energy hogs like air conditioners.





Gaby's Solar and Wind Powered Farm

My parents' good friend, who looks after the beach house business, is also a solar pioneer. In fact, using the *Solar House Book*, Gaby was able to integrate a number of different second-hand panels and some new panels in order to provide power for water pumps on their farm. She also has enough power for home lights, TV, VCR, and stereo. Recently, she installed a wind turbine on top of an old windsurfing mast.

Every time we visit the wind is blowing enough to keep the turbine going at a steady clip.

Gaby was a major inspiration in our determination to create a solar powered home here in Canada. She has implemented many of the ideas of *Natural Living* on her farm, which is completely off -the-grid. She's shown us how easy it is to:

- Install and use solar panels of various types to provide power to her home
- Set up a wind turbine on a used windsurf mast
- Install independent solar panels for the work shed, water pumps and outbuildings
- Raise chickens that produce the most delicious eggs
- Grow organic vegetables using lots of compost
- Cultivate wonderful fruits including a daily supply of grapefruits

The dream of an organic farm, in the breezy hills of Dominican Republic, independent from the electricity grid, is the result of a creative, strong, independent visionary. This is the life Gaby Reiners has created and she loves it!

Gaby bought the finca, which is Spanish for farm in 1995. At the time one of the ideas she had was to cultivate Neem trees. These trees, from India originally, have many valuable properties including an organic insecticide. As it turned out these trees did not do as well as had been hoped. Fortunately everything else that Gaby grows and looks after on the farm does very well as we shall see.

Gaby originally came here on vacation more than fourteen years ago. She fell in love with the wonderful tropical weather, friendly people, great food, fantastic beaches, and a more natural lifestyle. For the past ten years now Gaby has established herself as the agent for many of the better rooms and homes to stay at in Cabarete. Cabarete is a wind surfers' and kite boarders' paradise. It offers the world's best conditions including an off shore wind that doesn't start until afternoon so you can party all night, sleep until noon and not miss the great boarding action.

Gaby has a house in Procab, a development off the beach strip in Cabarete, that she rents to tourists and residents. She also looks after many other beautiful homes and rooms including those at world famous Wilsons Beach House www.wilsonsbeachhouse.com.

The finca where Gaby lives and farms is about ten to twenty minutes out of town, or about forty minutes from Puerto Plata international airport. The finca house is completely off-the-grid as are a number of other solar power systems used for lighting and small pumps throughout the farm. Given the chance, when she bought the property, Gaby declined to invest in the new hydro electricity connections that her neighbors did. Instead, she favored the independence of a completely self-sustained, off-the-grid, setup. She has no regrets given the frequent power outages on the grid in Dominican Republic and problems with people connecting illegally to the hydro wires.

The two primary energy generation systems for the home she has expanded extensively, include a Whisper 1440 wind turbine and a mixture a several brands of photo voltaic solar panels that you can see on the roof. The house system s are all connected to a simple controller that lets her know how much power she has generated on a digital readout in the media room. A set of eight batteries store the energy generated during the day. A small PortaWatt 1750 inverter converts the DC current generated by the photo voltaic solar panels and wind turbine into AC so that her lights, appliances, television, stereo and computer have power whenever she needs it.



This system also provides power for about

twenty lights all of which are fitted with compact florescent light bulbs that consume dramatically less energy and last ten times longer than conventional light bulbs. Each light has a beautiful local fixture that gives the home a wonderful touch of character.

During the winter, when it rains the systems generate less power even in this part of the world. Given this circumstance Gaby connects an extra set of eight batteries so that she is able to store more electricity during this time. In the summer she only needs eight. By changing the systems number of batteries she is able to extend their life span by better optimizing the level of charge and discharge. She has found that having good, properly gauged cables and clean connections makes a big difference in their ability to store electrical energy efficiently especially in this humid climate.

The finca has several other renewable energy systems. For the driveway lights a single small panel near the entrance gate (you can see it on the right post in the picture on the previous page) provides enough power for about four lights along her driveway at night. In order to do some small scale pumping and provide lighting in one of the farm's work sheds, another panel is used along with several batteries. Gaby says that she prefers a more distributed system since there is then less chance of all systems



SOLAR HOT WATER SHOWER

- **Solar Hot Water Panel** – The glass paneled box above and behind Leigh in the shower is the solar water heater panel. Water arrives by gravity from the cistern which is located on a hill above the house to the black storage tank.
- **Black Water Storage** – The storage tank is a black metal one that also increases the temperature of the water during the day by absorbing sunlight. Black absorbs heat as compared to white that reflects heat. Both colors provide important opportunities for heating and cooling naturally.
- **Water from River** – The water for the entire farm comes from a natural stream that flows through the center of the property. Water is pumped up to a cistern that existed when the property was purchased.
- **Cistern** – The concrete cistern can store about 2500 liters of water. This water is piped down to the house and shower for domestic usage. Other pipes are laid so that the animals and gardens can be watered. Her dream is to have one water pump powered by independent photo voltaic solar power panels connected to an electric pump.
- **Natural Feeling** – That natural feeling is enhanced by surrounding the shower with native plants and trees.



failing at once. This is a good analogy for the large scale centralized systems prevalent in North America. Witness the devastating Blackout we had in 2003, throughout eastern North America that cost the economies of Canada and the US millions, if not billions of dollars. By getting more distributed we can avoid such major disruptions.

The system is also able to supply power for the occasional use of a blender which Gaby really hates to use. She is an amazing cook. However, she does not have any iron or toaster since these are such big energy hogs. She is also very careful about not leaving lights on at any time unless necessary. This can become a problem when she has guests who are not used to this level of strict energy conservation. It is a great learning lesson for those of us so unaware of all the energy we waste.

Gaby has had to learn how to setup and maintain the all of the energy systems over the past several years. She says that for her it is a wonderful rewarding challenge and can be really fun. She especially likes that feeling when she gets something working...wow, look at those lights go on/off automatically at night. She has become so aware of the difference positioning the solar panels makes in energy production that she would like to get an automatic tracking system that would keep the solar photovoltaic panels facing the sun at the optimal angles throughout the day.

The wind turbine system, after several years of flawless operation seized up on Gaby. She had a local electrician come up to take a look. The unit was brought down from its forty foot pole. The electrician found that many of the screws had corroded. The entire unit was taken apart, parts that had corroded were replaced, and everything greased up again. After this maintenance that took a few days, the system was back up and operational again. This particular unit was very quite despite the heavy winds...testament to the name Wharrisper.

On the finca Gaby grows many wonderful fruits and vegetables. The partial list she could come up with during morning visit included:

- ⊗ Grapefruit
- ⊗ Lime
- ⊗ Avacado
- ⊗ Tamarind
- ⊗ Rose Apple

- ⊗ Coconuts
- ⊗ Mangoes
- ⊗ Papaya
- ⊗ Cherries
- ⊗ Bananas
- ⊗ Plantain
- ⊗ Bamboo
- ⊗ Neem trees
- ⊗ Cherry tomatoes

With rapid growth of trees near her first vegetable garden Gaby is now moving it to a location that gets more sunlight. An important additive to the garden is compost that she collects from Wilsons Beach House and her own food waste.

Compost here consists of:

- ⊗ Chicken manure
- ⊗ Cow manure
- ⊗ Cut weeds
- ⊗ Vegetable waste

These supplements are very important as the soil is quite thin and rocky just beneath the surface. In some places the land is so harsh only undesirable weeds grow. Gaby is trying to figure out a way to improve the soil and get grass growing for the cows . Currently the only way she knows of is to use a poison weed killer and then manually plant grass. She hates the thought of having to do this.

Since the finca uses a large amount of water the 2500 cubic litre cistern is very important for both domestic and farm usage. The property has a stream that runs through the middle of it. Gaby fills her cistern with a portable pump.



Energy Management

- **System Monitor (Center and Top Left)** – The control systems are placed in the living area so that Gaby can monitor the state of the battery charge provided by the wind turbine and solar panels. The monitor registered 13.3 kilowatts stored. The system can store up to about 25 kw/h.
- **Inverter (Right)** – The inverter is housed outside of the house near the parking shed. Eight batteries are connected to store electrical energy.
- **Batteries (Right)** – The eight batteries are used so that they are optimally charged and discharged according to the usage patterns that Gaby has established. More batteries would reduce this effect. Gaby does have an additional set of eight batteries in the summer.
- **Kitchen/Living (Top)** – The house that Gaby has expanded and fixed now includes a gas fridge and stove. The living area shows the television, video and stereo systems powered using conventional AC supplied by the inverter.



Being an organic farmer is not always easy. Recently Gaby invested in some bees. As with any new venture this involves learning many new things. First of all, the bees had to be picked up in the dead of night while the hive was asleep, for obvious safety reasons. With a friend Gaby arrived to pick up the hive from a local keeper who was keeping them in an old palm tree log. The stock was placed gingerly in the back of her jeep for fear of waking the hive that was producing a slight buzz. This ominous buzz got louder as the trip progressed along the bumpy roads. Fortunately the transit was accomplished without incident.

Recently the bees decided they wanted a new home. So, left the hive and took up residence in a nearby tree. The local experts said that all Gaby had to do was make loud noises all day and night until the bees returned to their home. This was tried for some time without effect. For whatever reasons the bees decided that the wind turbine was the next logical place for their home. Unfortunately this was a mortal mistake. The little bees bodies were found strewn all around the turbine pole as the winds picked up and the determined bees made every attempt to stick with their new home.

The finca is expanding. On the day we arrived a new born calf roamed the pasture. Gaby has planted bamboo trees. Sheep are kept as pets. The chickens and geese are producing lots of eggs. Our kids were fortunate enough to get a ride on two of the seven friendly horses that Gaby keeps for riding and as friends. Gaby loves animals and quite clearly they love her. The five dogs she currently has are her constant companions.



Wind Turbine (Left) – The Whisper wind turbine, mounted on a hydro pole extended with an old windsurfing mast provides about half the power Gaby needs for the house. The beautiful bougainvillea grows all around the house creating wonderful shaded pathways. The brilliant red, orange and pink flowers create a cool paradise all around the home.

Composting (Top Middle) – The composting pile is critical to enriching the thin soil. Gaby is liberal with the variety of organic matter she adds to the pile. The thin soil makes this compost critical to the productivity of the finca.

Cows (Bottom Middle) – Gaby loves her cows. The day before we arrived this new calf was born. With the several cows that Gaby has she is able to make some money supplying a local dairy with about four bottles of milk in addition to meeting her own needs. Gaby loves the wonderful peaceful nature of the cows and is looking at getting more.

Bamboo (Right) – The bamboo that Gaby planted several years ago has grown rapidly. This tropical relative to grass can be cut back, the bamboo wood used for building things, and it will grow back again. This plants' natural hardness properties are still not matched by any modern manufactured materials for some purposes.

Toronto Healthy House

Reading about sustainable communities and homes is one thing. Actually seeing one is quite another. One of the most powerful experiences in our journey toward building a solar powered home was visiting the Toronto Healthy House. We visited the “Healthy” house in, ironically, Riverdale, Toronto, the neighborhood we had left as a downsizing measure. We were thoroughly impressed by what we saw, and left with a collection of brochures and a thirst for more. Reflecting on what we’d learned, Leigh and I found that we had many more unanswered questions, so we booked a second visit to see it again and take notes, pictures, and video-tape the tour. The Toronto Healthy House demonstrated all of the ideas I had read about for years, including passive solar design, solar photo voltaic panels, solar water heating, high insulation values for walls, windows and roof, and predominantly natural building materials. What’s more, this duplex demonstrated both an independent solar-powered “off-the-grid” setup on one side, and “grid-connected” solar-power electrical system in the other unit. It could be done!

For us, seeing was believing. Having seen, touched, and experienced the Healthy House, we knew this was what we wanted. For Leigh, this was a turning point – the idea of living in a solar home became conceivable, even desirable – not just another one of my “pipe-dreams”. We made a decision to contact the architect when we were ready to design our own home.

Features of the Toronto Healthy House as outlined by CMHC (Canada Mortgage and Housing Corporation) included:

1. Occupant Health: Cleaner, Fresher Air

- **Ventilation:** The fresh air system and associated heat recovery unit provide continuous ventilation and heating, cooling or dehumidification. The system draws fresh, filtered air into the house while removing odors, molds, dust and pollen. The heat recovery unit recovers about 70 percent of the heat from stale indoor air while providing a continuous supply of fresh air.
- **Construction materials:** Construction materials have been carefully selected to reduce emissions of chemical vapors that cause indoor air pollution.



- Airtight walls: Airtight walls eliminate drafts and minimize the entry of outdoor air pollutants and moisture. They provide exterior weather resistance and eliminate as much as 75 percent of the heat loss of conventional houses. They are like a Goretex® jacket for the outside of the house.
- Low-emission cabinets: Hardwood or formaldehyde-free alternatives, which emit little chemical vapor into the indoor air, replace particle board, plastics and other synthetic materials in kitchen cabinets.
- Low-emission trim and mouldings: Mouldings such as birch and basswood trim emit few chemicals, particularly when sealed with a low-toxicity sealant.
- Water-based paint: The water-based interior paint reduces chemical vapors, which improves the quality of indoor air.

2. Energy Efficiency Cuts Costs

- Building envelope: The envelope of the house incorporates high levels of insulation and air tightness to promote energy efficiency and, in combination with ventilation system, better indoor air quality.
- Rigid board insulation: Rigid board insulation under the concrete slab results in 75 percent less heat loss through the slab than in conventional construction.
- High-efficiency lighting: The use of natural lighting and a well-chosen mix of task and area lighting reduces energy consumption.
- Energy-efficient windows: Suitability oriented and designed windows allow the sun to provide passive solar heating. Overheating in the summer is prevented by awnings and vines. The thermally efficient window system reduces heat loss and increases comfort for the occupant.
- Solar panels: Rooftop solar panels generate most of the electricity required. The peak electrical output of about 2 kilowatts is sufficient because the house uses energy-efficient appliances and natural lighting.
- Heating: Heating is provided by solar energy and a co-generator which generates both auxiliary heat and electricity. Because the house is well insulated, use of the co-generator is minimized.

3. Resource Efficiency is Good for the Environment

- Water systems: The house has 2 integrated systems to handle drinking and reclaimed water. Together with simple and inexpensive low-flow shower heads, taps and water faucets, these systems can use up to 90 percent less water than conventional homes.
- Rain and snow that fall on the roof are the only source of water. The water is collected and directed to the cistern. The water is then purified and pumped to the kitchen and bathrooms for drinking and washing.
- All waste water is directed to a purification system in the basement that mimics nature's treatment of waste water, rendering the water pure and suitable for re-use. The water is then recycled to the toilets, washing machine and showers.
- Low-volume toilets: Low-volume toilets use only 6 liters of water per flush compared to 18 liters per flush for regular toilets. Each flush is even more efficient because it uses recycled water.

4. Environmental Responsibility: Benefits for the Community

- Reduced greenhouse gases: Reduced demand for heating, cooling and electricity cuts the emission of greenhouse gases.
- Conservation of the water supply: The on-site water system eliminates the demand for municipal drinking water. The self-contained sewage treatment system, which discharges only clean water into the environment, does not contribute to the contamination of waterways.
- Efficient land use: The house can be built on small infill lots in the city that may not have the municipal services required for a conventional house. As a result, land is used more efficiently.
- Reduced infrastructure needs: Because it is designed to be self-sufficient, the house reduces the need for urban infrastructure in the form of water and sewer systems.
- Reduced automobile pollution: The downtown location of the house provides easy access to existing public transportation. A large den close to the front door is ideal for a home office. Decreased use of cars helps reduce air pollution.

- Reduced disposal of toxic products: Non-toxic products are used in construction to minimize the contamination of landfill sites.
- Effective waste management: Careful choice of construction materials, and composting and recycling by occupants, contribute to responsible waste management.

5. Affordability: Healthy Housing Saves Money

- Low operating costs:
 - Annual water consumption is zero.
 - Energy requirements are dramatically reduced. Hydro costs are zero.
 - Annual space heating requirements are less than one-quarter that of an average house; in some years, there may be none.

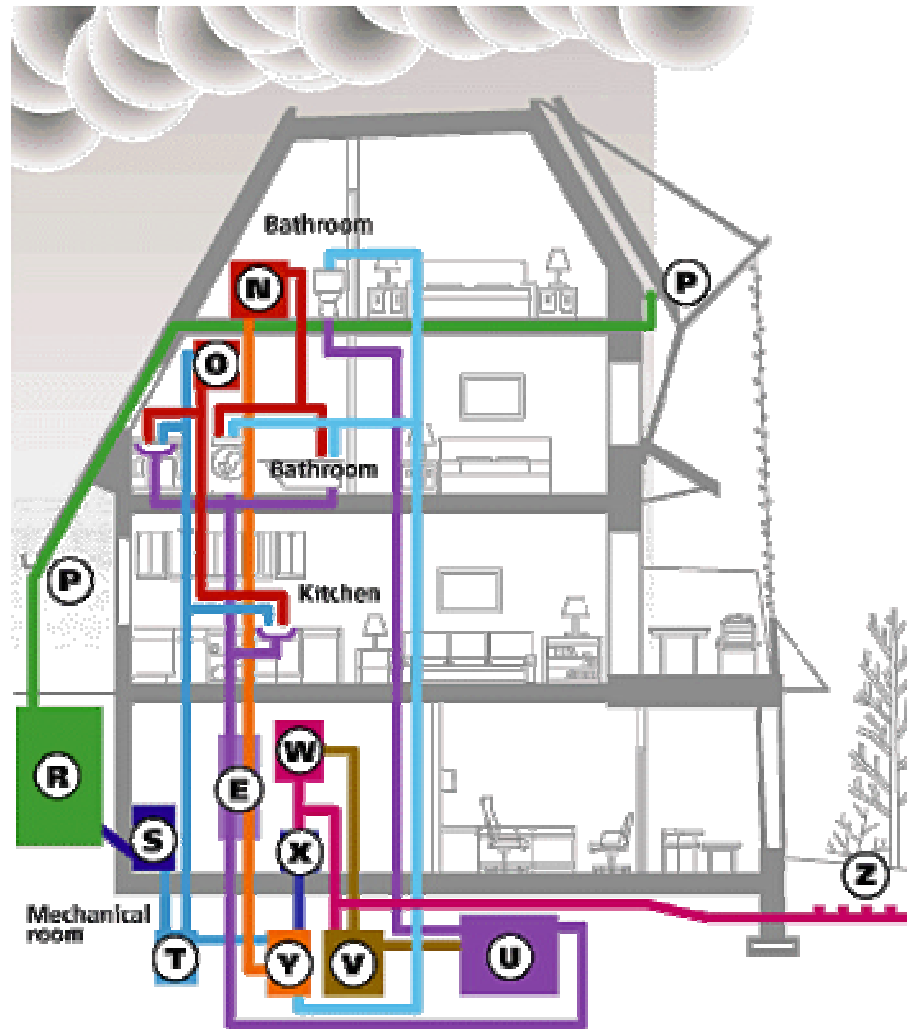
Water and Waste Management Systems

DRINKABLE-WATER SYSTEM

- P** - EAVESTROUGHS
- R** - RAINWATER CISTERN
- S** - COMBINATION FILTER
- T** - DRINKABLE-COLD-WATER TANK
- O** - DRINKABLE-HOT-WATER TANK

WASTE WATER MANAGEMENT

- E** - GREY WATER HEAT EXCHANGER
- N** - RECLAIMED-HOT-WATER TANK
- U** - SEPTIC TANK
- V** - RECIRCULATION TANK
- W** - WATERLOO BIOFILTER™
- X** - TWIN COMBINATION FILTERS
- Y** - RECLAIMED-COLD-WATER TANK
- Z** - GARDEN IRRIGATION



> Source: Canada Mortgage and Housing Corporation (CMHC). "Healthy Housing A Winning Design: Martin Liefhebber Architect Incorporated Creative Communities Research Inc. Toronto" brochure publication, "Heating, Cooling, Ventilation and Electrical Systems" (<http://www.cmbc.ca/popup/bbtoronto/heat.htm>), and "Water and Waste Water Management" (<http://www.cmbc.ca/popup/bbtoronto/water.htm>). All rights reserved. Reproduced with the consent of CMHC. All other uses and reproductions of this material are expressly prohibited. For more

Solar Living Center

In the winter of 1998 I visited my brother who was living and working in San Francisco, California. During this vacation we visited the “Solar Living Center”, a brilliant example of using the principles I would one day call *Natural Living*. We found this oasis for natural living in the middle of a desert, in a place called Hopland. We took a guided tour of the facilities and I was blown away by the inspired thinking that had created the highly integrated systems of water flows, shading, straw bale construction, natural lighting, and art. The solar powered fountain at the heart of the center was constructed to display many elements of nature including orientation of the sun, time, water, and space, with a built in calendar to mark the cycles of nature. The amazing, inspiring story of the design, development and construction included:

- using soil to color the walls despite the laws preventing it
- use of straw bales on such a large scale
- powered by photovoltaic solar panels on a very large scale, combined with wind turbines
- ventilation systems optimized for the local orientation, location and environment – and it worked well on the sunny warm day we visited
- natural sunlight as the primary source of light, supplemented by fluorescent lights
- ponds that were naturally populated with fish from the local river
- the incredible beauty of the naturalization process

Inspired by my parents, Gaby, the Toronto Healthy House and The Solar Living Center, it was time to start designing our own home.

Chapter 17

PLANNING THE NEW HOUSE

In order to become familiar with the design and building process we began to read many books on the subject. Some of the books we read are as follows (see the Bibliography for the details and other excellent reading):

- ⚙ The Healthy House
- ⚙ The Natural House
- ⚙ Natural House Catalog
- ⚙ Living Spaces
- ⚙ The Independent Home
- ⚙ Be Your Own Home Contractor
- ⚙ Real Goods Catalog
- ⚙ The Solar House

All of these books provided important background information, inspiring ideas and practical details on how to achieve our dreams. My favorite is *Living Spaces*. This book was originally published in German for the European market. The acceptance of new ideas is clearly evident in the book. Details for the use of green roofing, composting, and many other techniques are shown in great detail with many inspiring examples. Get this book if you can find it.

Early in the design stage we started listing our basic requirements, and this list grew and changed over time as we broadened our knowledge and processed what we had learned. For example, it was our dream to have the kitchen as the center of the house, since our family life seemed to revolve around it.

Next, we developed a schedule that included:

- ⊗ Budget/Financing
- ⊗ Requirements
- ⊗ Purchase of Land
- ⊗ Selling current house

Having downsized to a townhouse in the suburb of Mississauga our finances were on track to allow us to buy the property for building our future home. With the smaller mortgage and small monthly payments, we were able to put money aside each month into savings. This also allowed us to consider the additional burden of monthly payments on a mortgage for a property.

First we had to find the right property. Initially we had hoped to find an “in-fill” lot, in a city or town around Toronto where we work. The limited availability and high cost forced us to look further away from the city. We had estimated that we would spend about \$100,000 on the property. The budget for construction was estimated at about \$250,000 during this early stage of our search (approximately \$100 per square foot we were told). In other words we planned on owning at \$350,000 (Canadian dollars in 1995) home by the time we were done. Since we could not find properties in Toronto within this price range, we began looking further from the city and suburbs.

We looked at more than ten properties over about a two year period in our search for the perfect place to build our new lifestyle. The first one I saw was on the escarpment just south of Milton. The price was a bit beyond our budget, due to the GO Train service to the city and proximity to a prime wine growing region, but the added convenience of the location made it worth considering. When I took Leigh and the kids to see it, the property had a bright red “Sold” sign on it. That was our first disappointment.

We began watching the real-estate flyers. I noticed a listing for 25 acres of land that looked nice in the picture. This property turned out to be in Caledon, about 45 minutes north of Toronto. We dropped in on our friends Krista and Mike who lived in the area, and talked about our plans. Krista and Mike were very happy living in the country and were finding the use of the Go Train, a local commuter train service, quite good. This encouraged us to continue searching for a property in this country setting.

Most properties we saw had problems, such as proximity to a highway or railway, which I feared would produce too much noise and pollution. Others were too big or too barren. Having some trees to protect the home from the cold north winds seemed essential to the natural landscape I had in mind. We were looking for a good southern exposure and some mature trees, which would shelter the home from cold breezes.

The search for the perfect property seemed fruitless. For the budget we had there did not seem to be a property that had the right natural features. Finally, one weekend we walked through about one hundred feet of forest to find a beautiful wild grass filled hill sloping south. The land was rough with rocks and many young pine trees. A row of trees was also fairly established along the back fence. This might be it, we thought.

We visited the site many times in order to get a sense for its natural qualities through the changing seasons. In the winter the land was more visible and provided great views to the south. The southern exposure was amazing. From the very south end of the property we could see for miles...into Toronto, the big city.

We made a couple of unsuccessful bids on the lot, but the owner was holding out for a higher price that was slightly over our budget. Before making a third, higher bid, we met with Martin Liefhebber the architect of the Toronto Healthy House, to ask if he would work with us to design our home. Martin was eager to see the site to make sure it provided some of the natural features we would need. This would be his first project in the country, but he knew what to look for. For Martin it was perfect, because of the protective tree cover on the north, open exposure to the south for sunlight, gentle slopes for great views, some protective trees to the east and west, and natural swales for water drainage.

In summer the woodlot on the north 100-200 feet of the property provided nice cool breezes, and a sound and dust barrier from the sometimes busy dirt road. In the winter we found the roadside about 5-10 degrees colder than south of the woodlot, where we planned to build the house. We visited the property several times before deciding that it was the right one. As Martin would later say, he wanted to use the local environment and the design of the house to extend the seasons, summer into fall and spring into winter. That all seemed to be possible by locating the house on the north east portion of the property near the top of the highest point, but just south of our pine woodlot, essentially nestled into the trees.

So we decided to go for it, and our third offer was accepted. We were fortunate that the vendor was agreeable to a vendor-take-back mortgage, at a very good rate. This worked out well for us, because banks will not mortgage vacant land. (Recently I've learned that it may be possible to get a "development" plan approved for a property that you haven't purchased. With this it may be possible to get development financing that can cover both the land and the future structure...at least up to 65% of the overall projects expected value.) They'll only get involved once the property has a structure on it – at least a foundation. We would need to finance the land *and* the first stage of construction (building the foundation) without any assistance from the bank. We would later discover that it is best to have cash reserves for this, since the bank will only finance what is *completed*. Ideally, you should own the land outright before beginning construction. We learned this the hard way, after having purchased the land!

We made many visits to our property once it was purchased. During these visits, we noticed that good winds typically flow from the north both in winter and summer. In the winter the shelter provided by the trees was always a great relief from the wind on the north side of the woodlot. At all times of the year the place where we planned to build the house seemed protected and naturally warm, with great solar exposure. We had many great picnics with our extended families in our future "kitchen", a patch of wild grass between the many scotch pines growing rampantly, the remains of a formerly thriving Christmas tree business.

We began to consider the type of home we wanted to build. We picked up material at home shows. We read the books we'd purchased on various "natural" building techniques. Some of the insight we gained through our research included:

- ⚙ **New Standards** – "R2000"-type super-insulated homes, which are tightly sealed with a vapor barrier, do make sense for our cold Canadian winters but do NOT make sense for the hot humid Canadian summers. Technologies like straw bale offer a much more appropriate solution that has advantages through all seasons – cooling in summer with no condensation to cause wood rot, warmth through insulation in the fall, spring and winter – all with good air flow for good indoor air quality. This type of wall "breathes", creating naturally healthy indoor air, while at the same time providing superior insulation so critical to keeping the home comfortable in the winter and summer.
- ⚙ **Building Code Limitations** – Using rainwater is a simple concept that is not allowed in the building code. Therefore, an expensive ground water well, a pump

and piping systems would be required. There are also difficulties with the handling of gray water (used water from sinks, showers and baths), which would necessitate a septic system. We were well aware that this type of system had led to the incident in the nearby town of Walkerton, which suffered through a terrible tainted water situation in 2001. Water contaminated by sewage led to a serious outbreak of e-coli. These building code restrictions create barriers that prevent creative workable solutions that would eliminate the contamination problems. The solution is to handle different types of water and sewage optimally. Then there is no need to drain the ancient, non-renewable ground water sources or pollute these with archaic septic sewage treatment systems. Unfortunately, the current building codes work against nature and our health in some ways. We tried to convince the building inspector to allow us to use a composting toilet rather than a septic field system. We were not permitted to do this. This failure of the building code system cost us more than \$13,000 for the septic system. This cost that we had hoped to avoid made the additional \$10,000 for the composting toilet system too much for our budget. We did get permission to operate a composting toilet, but the code required at least one conventional toilet to feed the septic system. We have a long term plan to make an application to convert to a composting toilet system by requesting an exemption from the code.

- ⚙ **Green Roof** – The idea of creating a natural green roof came from Martin. The green roof would keep the home cool in the summer. Rainwater collected from the roof would be stored in a large cistern. Our plan was to either use rainwater directly or purify it for all of our water needs. The used water could then be processed optimally by type as well. Grey water can be used to clean clothes, water the garden plants, and flush water toilets until we get a composting toilet system. Sewage can be separated into urine and feces or combined and processed using composting techniques. The compost can then be used in the garden as a soil fertilizer. The result is that valuable gray water is re-used and sewage is turned into a valuable soil amendment, all of which eliminates the potential contamination problems of ground water and septic systems.

Chapter 19

FINANCING

Having bought the property with a vendor-take-back mortgage we thought we were well on our way to financing the construction of our new home. The money we saved during the four years in our Mississauga town home left us with approximately \$100,000 in cash after we sold the house. Our construction budget was based on an estimated construction cost of \$100 per square foot. We had originally hoped to build the home at under 2,500 square feet. The property costs totaled \$130,000 plus \$250,000 in construction meant a total budget of about \$380,000. Adding in solar and wind power brought the total to about \$400,000. In the end, by the time we finished the designs for the home, we were at 3,500 square feet. So, our total building budget ended up at \$450,000.

One of the first surprises that just about stopped everything was the requirement of owning the “land” outright before being able to finance the construction. We had not known this until well into the final stages of getting our building mortgage arranged. Our bank, one of the big five here in Canada, was getting out of the building mortgage business just as we were trying to arrange for this type of financing. Fortunately we were able to get in under the wire. In addition to getting our bank to provide the building mortgage we had to get Canada Mortgage and Housing Corporation (CMHC) to insure the mortgage since it was for more than 75% of the value of the home and included non-conventional construction. This added thousands extra to the overall costs.

Compounding our cash flow problems was the need to complete construction before being able to make a draw from the building mortgage funds. In order to get to these payments we had to leverage every credit card we could get our hands on, plus increase our line of credit, and then finally borrow money from family.

The only other problem was going over budget on some of the construction costs. Our zinc roofing, the windows, a very deep well (250 feet) and of course the septic

system pushed costs beyond the originally budgeted amounts. The winter was also particularly harsh, and delays in getting permits pushed a large portion of the construction through the bitter winter months of an unusually harsh winter in terms of amount of snow fall.

If we could go back and do things differently I would recommend the following:

- ⚙ Wait until the land is paid off before starting construction. In Canada, the construction mortgage is based on the construction budget, and doesn't include the land.
- ⚙ Build a smaller house over all.
- ⚙ Plan for adequate financing to fund each stage of construction.
- ⚙ Reduce the number of windows on the east and west sides of the house.
- ⚙ Simplify the design of some parts of the home.
- ⚙ Find a way to convince the building inspector to allow use to use composting toilets rather than septic.

There are, of course, long term advantages to some of the things I would do differently, but in hindsight our cash flow difficulties caused more stress than I would wish on anyone else.

The bottom line is that we were able to build our phenomenally efficient home, complete with solar panels and a wind turbine for about \$128 per square foot. This puts us on par with conventionally built custom homes. Given the long and short term advantages of our home, the cost of our home is quite remarkably affordable. If the size is scaled down, less costly siding and window finishing considered, more straw bale used, and better luck with the weather I firmly believe the costs could be in the \$60-100 per square foot. For smaller homes and apartments the long term benefits are particularly appealing.

Now just imagine if the building industry became determined to bring down pricing through economies of scale, automation, pre-fabrication, and bulk orders for materials. Also, when applied to town homes, semi-detached homes and apartment buildings the potential is even greater. That more builders aren't taking advantage of these ideas is a shame. More and more builders are starting to especially in Europe and even Japan where solar panel sales and wind power is growing rapidly.

Chapter 20

DESIGN

We first met with Martin Liefhebber at the Mövenpick on York Street in downtown Toronto for lunch. We had talked several times on the phone, but this was our first meeting. It was a strange feeling to finally meet the man who had designed and built the Toronto Healthy House, which had been such a great inspiration for us. Right from our very first conversation, I knew that Martin was a practical, down to earth, and caring designer who shared the same ideals that I held. My excitement at the prospect of working with him on the design of the house grew as we discussed his thoughts, ideas and stories.

Through our many conversations with Martin, he told us of his other projects – the “pharmacists” who built a house on a hillside, a co-housing project in Mississauga, the earth house in Caledon, the retirement home on the Toronto Island, and of course the Toronto Healthy House. All of these have provided insight into the opportunities and problems to be solved in our own project. Each site, each client represents different opportunities and challenges for designers and we are all designers. While working with Martin I had some pretty strict principles I wanted to follow.

Design Principles

In designing and building a home, there are many decisions to make. To ensure some consistency in our decision-making, we came up with some principles that we shared with our builder, Colin, and Martin, as well as family and friends, in order to be clear about our direction.

1. No fossil fuels

Example: Most homes in this region have a furnace powered by natural gas or oil. We have eliminated the need for this through a combination of primarily passive

solar home design, excellent insulation levels with the use of straw bales in the walls, photovoltaic panels and a wind turbine for electricity, a plan for solar water heaters, solar powered lighting, a wood stove and a wood barbeque pit.

2 Optimize efficiency in order to reduce overall energy requirements

Example: The use of natural light was optimized throughout. Portal windows in the floor allow light to flow into the basement, minimizing the need for lights during the day. Outdoor lighting selected is primarily independently powered solar garden lights.

3 Use natural materials

Example: During site visits before we began construction, Martin determined that we could use the tree logs we removed from the driveway as posts for the solar shading system. Other local natural materials included sand from our own pit. The straw bales purchased from a local farmer provided a natural, renewable resource for insulation.

4 Select materials that are renewable

Example: The posts and beams used for the main structure of the house are made from fast growing tree farms rather than old growth forest timber. Bamboo for hardwood flooring can be harvested every 3 or 4 years from the same plant, since it grows back. The straw bales used in the north wall are an annual crop available from a local farmer.

5 Invest for the long term

Example: The passive solar design, which requires many windows, an in-floor heating system and photo voltaic panels, will not likely pay for itself within conventional time frames of three to five years. Instead, we are prepared to invest in these for a period of fifteen or twenty years before “payback”. As a bonus, should fossil fuel prices rise substantially, our pay back may be significantly less. As well, by selecting products that adhere to the other principles listed here, pay back or economic principles do not get top priority. Instead, as these principles suggest, we apply top priority to nature, which our children will inherit from us all.

6 Inspire others to build a natural home incorporating the same principles

Example: The “Straw Bale Happening” was an event that allowed us to invite many of our family and friends to join us in the process of building this house. Because of this experience they now have a greater awareness of the vast potential for this type of construction. The house warming party was also designed to allow as many people as possible to see the beautiful results, ask questions, and experience the potential in action. As well, we have initiated what we plan on making an annual event we call the SunFest to celebrate the sun that provides us with our energy and inspiration throughout the year.

7. Flexibility

Example: The need to provide for the individual preferences and view points of the four people in our own family, as well as Colin, Martin and others in the design team, necessitated some flexibility in these principles in order to support the overall vision. For Leigh, this meant a larger house than might be optimal for pure efficiency. For Martin, this meant some aesthetically pleasing design features like angled walls, reveal moldings and zinc roofing, and these features increased costs. For Colin, this has meant some simplifications in the design to make the construction process more efficient.

At some point during one of the first few design reviews, I provided Martin with some drawings that Leigh and I had sketched during a vacation in the Dominican Republic. My purpose was to help Martin understand some of the key features I wanted, such as locating the kitchen in the southeast portion of the house in order to get the great morning sunrises that have inspired me through the years. The kitchen has always played a central role in our home activities. A bright beautiful place for morning breakfasts on the south east section seemed important to me as well. Another important feature for me was placing the living room and work area on the southwest area of the house to maximize the daytime sunlight and to enjoy the magnificent sunsets.

The design stage required many review sessions. This process of review, decision making and changes necessitated a willingness to compromise, look for creative solutions in order to adhere to principles, and finally, come to agreement as a group.

Designing with Nature

The method for solving these complex problems, like the ones that power the earth’s atmosphere, can be found in a new natural design process. The new design

system that is being used to transform ourselves, homes, work, food , transportation, communities, government, spiritual institutions and economic systems must be based on ecological principles of design. Ecological design principles include:

1. Plan with an awareness of the endless connections of nature
2. Work within natural boundaries
3. Limit energy requirements to those renewable sources available from the sun, wind, and earth
4. Connect your community to the local place in nature
5. Use our broad historical knowledge of nature, place, and time
6. Look to nature for guiding principles, patterns and processes

These design principles require a far deeper level of understanding of the systems inherent in nature and humanity. “Design manifests culture, and culture rests firmly on the foundation of what we believe to be true about the world. Our present forms of agriculture, architecture, engineering, and industry are derived from design epistemologies incompatible with nature’s own. It is clear we have not given design a rich enough context. We have used design cleverly in the service of narrowly defined human interests but neglected its relationship with our fellow creatures.” (Van Der Ryn and Cowan, *Ecological Design*, pg. 9) Clearly something has gone wrong, as manifested in the terrible gap between rich and poor, the monstrous destruction of the natural world that sustains us, and the thwarted initiatives of the best among us. Still, this new design paradigm, the processes and principles of *Natural Living*, offers hope as a new generation of creative people, including you and I reconnect with nature.

The difficulty here seems to be that this type of design , which may be used in the processes of redesigning our lifestyles, requires us to take a path that may seem to be more difficult, more complex, more costly, and more creative. All of this means more effort. Personally, I have long felt that one of my greatest weaknesses is my laziness. In trying to achieve a *Natural Living* lifestyle, one in which I have developed and applied the eight steps, each day I confront my own lack of “energy” to get down and do the hard work required to achieve these goals. Change is like that. Change is a form of creativity that requires more energy than might otherwise be required.

In order to get to the parts I've enjoyed so much, I have had to overcome my natural desire to simply rest, not try, do nothing, and accept things as they are. I have had to fight against the urge of leaving it for a future day. For me, overcoming this is a constant struggle. One thing that seems to help in applying these new design processes to my life, is to give myself some time each day to think about it. For me, this means with a pen, paper, and a coffee. I simply write a to do list for the day, week or year, note some ideas I've had, record the story of some wonderful experiences, express a new thought, create a poem, remember a dream, or describe the vision of something that has inspired me. Whether it is the caffeine or the creative energy this daily activity generates, this process has helped to focus my awareness so that I stay on track and get just a few of the hard things done each day, or celebrate the new connections, or remember a recent accomplishment, or rejoice in the new connections with a friend with a similar vision. This constant celebration of the creative process seems to provide the energy that feeds further effort towards the next step.

The design process, the early creative vision stage, for me, provided the essential structure for achieving a higher level of awareness by opening my eyes to the deeper aspects of place and process. The design process is significant since it applies, essentially, to any kind of change required. As you go about planning for the changes you need to make, take the time to refer to these design processes in order to ensure you include the complexities of nature in your creativity.

From the book *Ecological Design* by Sim Van Der Ryn and Stuart Cowan, the process of Ecological Design can be summarized as follows:

1. Solutions Grow From Place – design in harmony with place
2. Ecological Accounting Informs Design – account for all costs to nature
3. Design with Nature – design in harmony with nature
4. Everyone is a Designer – take advantage of local knowledge and your own creativity
5. Make Nature Visible – allow nature to retain its place

It is the goal of *Natural Living* to apply these design principles. These design principles may also be applied to the broader context of the way we live, the work we choose, the food we eat, and the understanding we maintain of our deep connection with nature throughout our lives. Once these principles evolve within the context of our society, once our cultures evolve, once the most powerful institutions of our communities, corporations and nations evolve to support and incorporate these principles in a more complex set of integrated systems we will have achieved an ecological or natural based lifestyle that will support us now and our children well into the future. These principles have been applied to the step-by-step process of *Natural Living* provided here.

Priorities

The design process provides a chance to deal with the complexity of requirements from a number of perspectives. In general there are a number of priority levels to the design process. These levels or priorities reflect a measure of the long-term energy, cost, and simplicity of various aspects of the design. The following list provides a rough measure of where the largest long-term impact can typically be found:

1. Site – solar access, trees, soil, and local materials, orientation
2. Efficiency –reduction of openings, size
3. Insulation – ability to retain heat or coolness
4. Passive Solar – heat collected and stored directly from sunlight
5. Passive Cooling – cooling using convection currents and natural ventilation
6. Solar Hot Water – sunlight heat collected by panels and transferred to water
7. Wind/Hydro Power – transformation of wind/water motion into electricity
8. Active Solar – transformation of sunlight into electrical energy
9. Energy Storage – chemical means of storing electrical energy for peak demand

Home Plan Requirements

The following are notes on our requirements for the site and home we wanted to build. Some of these ideas haven't made it to reality, for a variety of reasons. They

were based on the principles we had developed, best practices I'd read about in books on the subject, site conditions, creative thinking, and the ideas of Martin Liefhebber, our architect for the project.

Design

In every aspect of the design process consider the local site conditions and environment, year round, and over longer periods of time.

- ⚙ Protect the house from prevailing winds during winter with local site barriers such as trees, hills and a wall.
- ⚙ Provide openings to collect cool forest breezes in the summer in order to eliminate the need for air conditioning.
- ⚙ Orient the position of the house to take advantage of passive solar design principles.
- ⚙ Design with and for nature.
- ⚙ Apply the concepts of Permaculture (get the amazing text book by Bill Mollison) as they apply to the design , location and site of your home.

Work with nature to ensure that the design fits in with the local environment.

- ⚙ Prepare designs that are in harmony with the local climate, rainfall, plants, soil, wind patterns, and amount of sunshine.
- ⚙ Incorporate locally available materials that harmonize in color, texture, shape, and substance.
- ⚙ Retain or restore as much of the natural landscape as possible by planning for a green roof, swales for natural rain water management, rain water collection systems, and even potentially a living machine sewage waste processing system.

Use as many of the natural resources provided by the site selected.

- ⚙ Local wood logs if trees must be cut down.
- ⚙ Local sand, soil, stones, gravel and large rocks.
- ⚙ Allow local wild grasses to grow on the roof, walking paths, and on the septic field.

- ⚙ Take advantage of the local straw bale harvest as a low cost, highly effective alternative for insulation.
- ⚙ Build on marginal land, use the fertile areas for growing vegetables, and maintain the largest portion possible to naturalize.
- ⚙ Remember that trees provide one of the most powerful cooling and pollution reducing engines known.
- ⚙ Spend time on the site throughout the year in order to determine local site attributes that provide resources.
- ⚙ Local wind variations and strength may allow for a wind turbine .
- ⚙ Solar access may be optimized by ensuring that large trees do not impede local solar input while providing a buffer from cold winds and cooling in the summer.

Site

Re-use local natural materials available, such as logs of wood, local straw bales, local timbers, and local raw building materials.

- ⚙ Use local trees where possible for the posts and beams.
- ⚙ Use locally available rocks, sand, trees, bushes, air, and solar access.

Take full advantage of local solar, wind and hydro through proper orientation, location, building design and landscaping.

- ⚙ Locate near a dense forest to break the cold winds in winter.
- ⚙ Orient the house in order to take optimal advantage of solar gain.
- ⚙ If a wind generator makes sense, given enough windy days, then locate it at a high point in order to collect the greatest amount of wind energy .
- ⚙ Landscaping features should include a sod roof to cool in the summer and provide extra insulation in the winter especially when snow accumulates.
- ⚙ Electricity connection will be made by laying cable in a trench to be dug along the north east perimeter of the property. The electricity grid connection will provide power throughout the project. Eventually the photo voltaic solar panels will provide electricity generated by the sun and returned into the electricity grid.

- ⚙ Driveway to curve as plotted on survey or as adjusted once house placement on site has been made. The curved driveway is designed to reduce the flow of wind from the north by providing some forest barrier whereas a straight driveway would not.
- ⚙ Trees to be cut down for driveway will be re-used in construction so logs must be placed in a good location for “drying”. Martin continually reiterated his desire to try and use as many of the natural materials available on the site as possible.
- ⚙ A Garden Pond that includes a bathing pond to be constructed on south side of property. Solar powered pump to be used for water circulation/waterfall. See pages 340-347 of *Living Spaces*.
- ⚙ House to be built on natural high ground towards the northeast area of the property just south (about 100-150 feet in from the road on the north) of the woodlot. The trees will provide a natural wind barrier to reduce the effects of cooling in the winter and improve cooling in the summer.
- ⚙ Landscaping to be level with main floor on the North and South sides of the house at the center of the house, and to the east of center. The landscaping will gently slope from the center on the north and south at ground floor level down to the basement level on the west side of the house where a basement walk-out will allow for exit from the house (solarium enclosed sliding glass door as an air lock to be built).
- ⚙ An area for growing vegetables, herbs, and other food should be planned for and located optimally for access from the kitchen but with ideal soil, sun and other parameters considered.
- ⚙ Planting of apple trees as well as wild raspberries and strawberries to be planned and located.
- ⚙ Rainwater harvesting system to be used for all landscape maintenance requirements.

House

- ⚙ Ecological design and building principles to be adhered to for all aspects of design, construction and operation.

- ⚙ Straw-bale wall on north side of the house to provide superior insulation from the cold north winds.
- ⚙ Earth covered roof, natural vegetation on roof, cultivated pitched roof, grass-roofed home (natural grasses). The grass roof should provide significant cooling capabilities in the summer and some increased insulation in the winter. Typically green roofs provide a 30 -40% reduction in energy requirements for cooling in the summer.
- ⚙ Extensive 6'x6' triple glazed windows (we ended up with double glazed) predominantly along south side on both 1st and 2nd floors.
- ⚙ 3 x Fireplace/Wood burning stoves to be planned for (models of optimal efficiency and minimal pollution to be selected). First to be located in main Living Area. Second to be located in or near the Kitchen/Dining area. Third to be located in the basement and located for optimal heating during winter.
- ⚙ Natural lighting to be used as much as possible to minimize lighting requirements during the day.
- ⚙ Rainwater harvesting system to be incorporated wherever possible.
- ⚙ Water conservation to be maximized for all appliances and fixtures.
- ⚙ If regulations allow, integrate a large built-in composting toilet system. See page 369 of *Living Spaces*. This system combines both organic kitchen and toilet waste. Garden waste composted in a separate receptacle. If composting toilet is not permitted then a Garden Waste composting system should be integrated into the kitchen separately.
- ⚙ A root cellar/cold room will be used to minimize refrigeration requirements. Optimally designed root cellar to be incorporated, preferably on north side of house near kitchen

Appliances to be purchased will be highest efficiency models available:

- Dish washer
- Stove top range
- Clothes washer
- Clothes dryer (plan on using indoor and outdoor clothes line whenever possible as an alternative to the electric clothes dryer)
- Refrigerator

- Microwave oven
 - Computers – 4 notebook models (low energy requirements) + 1 low energy printer
- ⚙ The kitchen should be U – shaped most likely with an island. A 4’ table will be placed near the window on the south side of the kitchen for breakfasts and light meals. Bar stools and a counter should be provided between the breakfast nook table and the kitchen.
 - ⚙ There will be 3 bathrooms. One in the Master Bedroom on the ground floor (bath, shower, toilet and 2 sinks). Second on the ground floor with a toilet and sink only. Third on the middle level or second floor with a bath, shower, toilet and sink. Roughed in washroom (3-4 piece) in the basement
 - ⚙ Mud room will provide access to the house from the northwest side; lots of good storage will be provided. The laundry facilities may be located in this room. Access from the garage should be provided. Space for 2 big dogs will be required to sleep.
 - ⚙ Garage for 2 cars and some storage space. Firewood storage may be near the garage.
 - ⚙ Main entranceway will be near the center of the house on the north side. In order to create an airlock a glass solarium will be built out from the front of the house. The air lock will be in the solarium so that the lobby doesn’t need to be air locked. This air lock and front door arrangement will provide a layer of solarium in order to provide light from the north without compromising the insulation and sealing.
 - ⚙ 3 bedrooms will be located on the second floor all along the south side of the house. Like on the ground floor, each room’s south wall will be dominated by 6’x6’ triple glazed windows (we ended up with double glazed, krypton filled glass which provided the best benefit for a reasonable cost).
 - ⚙ The fourth bedroom – the Master bedroom – will be on the ground floor. Room for 2 large antique dressers, a small seating area (two chairs) on the east side, two walk in closets (a 6’x6’ minimum and a 4’x6’) and a bathroom.
 - ⚙ The basement should be predominantly open concept with a walk -out to the west near the north side. The basement will be used as a play room and television viewing room, as well as an occasional spare bedroom for guests. Some storage space will be required. 9-foot ceilings to be finished. A window should be located

on the south side of the basement near the west side to let in the sun light coming from the south for natural lighting. These windows should be slightly above ground level as the landscape descends towards the walkout at basement level on the west side of the house.

- ⚙ Space will be required in the basement for a water cistern, composting toilet system, electrical room, and root cellar. (The cistern ended up being placed outside the house.)
- ⚙ A central vacuum system should be built in.
- ⚙ The Living/Family room will be located on the south west side of the house. Both the view to the south and the west should be viewable through windows.
- ⚙ The Dining room should be just west of the kitchen on the south side of the house.
- ⚙ The Work/Studio area will provide a space for working from home. Four desks should be able to be accommodated along with book shelves, filing space and good natural lighting. The view to the south should be available even if the sliding glass doors are closed between the Work/Studio and the Living/Family room.
- ⚙ Total space for the house not to exceed 2500 square feet.
- ⚙ Excellent natural ventilation to be built into the design.
- ⚙ Natural passive solar heating to be optimized wherever possible.
- ⚙ A green house will be built on the south east side with easy access from the kitchen. Growing herbs and some vegetables in the winter can be expected.
- ⚙ Patios should be provided on the west side walkout from the basement and near the green house and south east walkout near the kitchen for summer breakfasts outside.
- ⚙ Water supply to be provided by rain water. A secondary source in a drilled well may also be included.
- ⚙ Electrical supply to be provided primarily by Photo Voltaic panels. Solar water heating panels also may be considered. A wind power device may also be integrated into the power systems. Back-up power to be purchased, and excess power sold, through the Hydro One connection.

- ⚙ Heating will be primarily through the radiant floor heating systems and passive solar systems.
- ⚙ Natural materials will be used to minimize potential indoor environment hazards from synthetic materials.

Smart Housing Design

One of the most important things I've learned is that the true power of smart housing design resides in the basic structure, the quality of the foundation, framework and walls/windows. By orienting the building structure correctly for sunlight (spring, summer, fall and winter), by insulating optimally through-out, by applying shelter from sun, rain and wind using the local environment and simple shading, by providing natural ventilation in the structure, by putting heat absorbing mass in the water pipe filled flooring and double glazed argon or krypton filled high quality windows on the south side, you get a nearly complete self-sufficient, minimally mechanical, simple to maintain house. These key elements also provide, for the lifetime of the house, free heating, cooling, lighting, fresh indoor air quality and all water requirements without the additional expense and ongoing expenses of a furnace, air conditioner, duct work and water systems – not quite as “cool” as photo voltaic solar panels for power or a fancy modern kitchen or low water/power dish washers or efficient sealed wood burning stoves, but far more important. As our architect likes to say it comes down to simple basic quality of design and construction of the house.

In terms of the finishing details, we discovered that beauty of leaving things basically “unfinished” and open concept is that you are able to make decisions when you can actually see and feel the space, that you can change things around using simple moveable walls, closets and doors. Also, through the elimination or minimization of trim, finishing, paint, façade, and coverings much of the high costs can be minimized and potentially used on the basic quality of the design and structure.

Building Code and Permits

Through the design and planning phases we've learned how the building code standards have been setup primarily for tract housing developments. The building codes typically define the **worst** possible design that you can get away with legally. Developers are able to conform to the code, avoiding costly design and engineering

costs. The results are houses of the poorest quality of design and construction allowable by the law. To be fair, some well-intentioned programs like Canada's "R2000" standards are designed to set guidelines and standards for super-efficiency. These have resulted in higher resale values for these better-quality homes. However, for the vast majority of home builders there is little or no incentive to build beyond the minimal standards. Sadly, this is more a reflection of society than of the government bodies or developers. We must all demand simple quality, smart design and compliance with sustainable design principles so that government and developers will find it necessary to change things.

In a book called *the Toilet Papers*, Sim Van der Ryn outlines the key reasons why these "bureaucracies" fail to allow for sensible, safe alternative solutions even as the environment so obviously needs them.

- 1) As a general rule bureaucracies like to deal with other bureaucracies rather than with people. The more a problem can be centralized, the better.*
- 2) It is easier to come down on the little guy than the big guy. I have heard of cases where permits were denied until the applicant could prove that dry toilets killed viruses, which no conventional sewage treatment can do.*
- 3) Regulatory processes are set up for routine. It is easier to say "no" rather than rethink the problem and design a better procedure.*
- 4) Like most bureaucracies, the assumption of regulation follows Murphy's law: "If anything can go wrong, it will." Alternate systems do require more individual responsibility than conventional systems. Bureaucracy assumes you are incapable and unwilling to take responsibility for such basics as managing your own waste.*
- 5) Regulations are oriented towards control, not towards education. Most people who are using or have built alternate systems are valuable sources of information for neighbors. Yet the person who rocks the boat is often viewed as part of the problem, rather than part of the solution.*
- 6) A keystone of sanitation practice is water borne sewage. For years the United States Census measure of progress was the number of flush toilets in the country. Any departure from this practice, no matter how rational or safe, is looked at as a step backwards.*
- 7) Most local health departments are not set up to evaluate unconventional systems.*

We experienced an example of this bureaucracy related to our plans for composting toilets.

Composting Toilet System

During our design discussion we had agreed that a composting toilet system was required in order to meet the requirements of our principles. Ideally the composting toilet system would cost no more than a sewage system hookup or a septic system, and could be significantly less. Unfortunately most building codes in North America do not allow for a composting toilet system to be built inside a full time residence.

The local building inspector was very comfortable with the straw bale walls. He had approved quite a number before ours. However, when it came to the composting toilet system, it appeared as though this was something that had not been done before, and the inspector was not willing to go beyond the code. Rather than work through the legal process we decided to proceed with a hybrid approach to our sewage processing problem. Martin thought that he could convince the inspector if we included a backup septic system for one toilet and provided direct access to the outside for disposal of the composting systems waste through the greenhouse. Essentially, the composting toilet system had to be separate from the house. Martin was able to get approval for the composting toilet system using the combined small scale septic system and an exit from the greenhouse.

By taking this approach, we were able to prove out the ability of the composting toilet system to meet a household's needs, and get on with the project by having the septic system as a backup. The downside is that we've had to pay upwards of \$15,000 extra for the septic system we hadn't originally budgeted.

Building with Straw Bales

Since straw bale wall construction has been approved in this area before we had no trouble with this part of our design. Not so with the house our architect built in the popular suburb of Mississauga. It took more than a year in the courts to get permission to build with straw bales. The City had big concerns around the lack of a vapor barrier, which is required by the code. Sadly, the problems associated with vapor barrier sealed houses don't seem to have reached the building codes yet. The straw bale walls, which are covered by several layers of plaster, can in fact breathe. This type of design provides a very good barrier to air leakage, with the added advantage of some air and vapor transmission. Air quality is improved by this exchange. As well, problems such as trapped condensation on vapor barriers causing wood to rot and molds to grow are much less likely.

Chapter 21

BUILDING

On my 34th birthday – August 16th 2000, we visited the site of our new home. The initial excavation work for the foundation had been done, and the devastation to the earth, to our favorite picnic spot – the place where we dreamed of a kitchen – came as quite a shock. The deep hole was gigantic. I remember thinking to myself, “Oh my god, this is real.” I said to Leigh, “I was just kind of dreaming...I wasn’t really sure it could be done.” This was my sense after seeing the results of my dreams coming true. It was truly a great shock, and one that still surprises me.

Trying to find a builder open to the challenges of a natural home proved surprisingly easy for us to find. While Martin Liefhebber, our architect suggested a builder, Leigh had found, through discussion with her hair dresser, that a friend of hers was a builder. In fact, this builder actually lived near the property. This as it turned out, was a critical moment. We met Colin Richards, toured homes he had built in northern Ontario, and decided he was the right choice. Colin told us that he had been building homes for thirty years. He was looking for a challenge, something new and different. Although the essentials of a natural home can be quite conventional, in the case of our home, post and beam construction. The use of straw bales, solar panels and a green roof were not conventional.

Colin is a big man, with very large paws for hands, and a comforting, confident swagger. Speaking with Colin you get the sense that there is nothing to worry about, that he has figured it out before and will again. Over laying his confidence is an easy going, laid back attitude. Leigh and I both felt Colin was the right choice in terms of his experience, willingness and interest in new ideas, and perhaps most of all his easy going confident manner. We knew we’d be working together for many months through some tough phases. We both felt that the relationship would work. In hindsight this sense of trust and comfort with the relationship proved critical. Many custom home construction projects I am aware of have been derailed by difficulties in with the owner/builder relationship. This relationship required that

a diverse set of personalities work well together. As it turned out Martin has discovered a great partner in the design/build process with Colin. Both Leigh and I found that as a team we worked well together even through difficult problems that lead to many tensions. In the end we understood each other well enough and knew what each others priorities were.

Both Colin and Martin worked well together finalizing the details of the design. The drawings went to the towns building permit group and within several weeks they were approved. Several design ideas proved difficult to get approved. The first sticking point was composting toilets. Martin was eventually able to get approval by providing easy access to the central composting unit in the basement for removal of the waste. Unfortunately the code, we were told, required that we have a septic field despite the composting toilets. Given that the septic field would cost more than \$10,000, composting toilets would have to be postponed to the future for reasons of cost. Martin had in mind the idea of using grey water (from sinks and baths) to feed planters in the green house and through the south end of the living room. Again, the building inspector lead us to believe that this was not something he could approve. The rest of the design requirements passed this review including straw bale walls, rain water collection, solar panels and a wind turbine.

Once Colin and Martin got approval, delayed a few weeks for the updates to accommodate the composting toilet access, the planning and preparation proceed very quickly. We met at the site with both Colin and Martin to precisely position the home. Colin brought his new GPS device in order to be sure we were facing due true south. We staked out the general area of the home. We had planned to tuck the home quite close to the trees on the north side. We ended up a little further south as new trees and the driveway made this necessary. The driveway was staked.

Solar Energy Systems

On August 30, 2000 our builder, Colin, and I met with Pers Drew to discuss our solar power requirements. Pers had been the director at Ontario Hydro for solar power applications. His setup at the Kortright Conservation Centre that provides an excellent learning center for those interested in the different types of solar power systems available, how they are constructed, their advantages and disadvantages. Pers brings a great deal of experience – more than 20 years – during which time he has implemented photo voltaic and wind power systems in some remote areas of northern Canada, in southern countries, and in various places throughout Ontario.

Pers walked us through the Kortright Centre. A solar powered Living Machine facility, which processes all waste water requirements for the center, was recently added. This very impressive building, funded by the steel industry, is a giant solar powered greenhouse. Within the facility, a Living Machine quietly processes the Centre's sewage into clean water. This system is powered by a solar photo voltaic and solar hot water heating system integrated with the building structure. The electric system is inter-tied with the power grid system so that the electrical meter runs backwards during the day when the solar panels are generating more power than the Centre needs.

Next on the tour was the self-sufficient demonstration cottage. This small building provides working examples of both grid connected and off-the-grid solar power systems. Inside the cottage are examples of a small composting toilet system, an efficient wood stove, wind-up radio, and natural passive solar heating through orientation and windows on the south side of the structure.

Just past the demonstration cottage are four structures for teaching students how to setup and install photo voltaic power systems. Further on down the path are facilities that demonstrate the full integration of solar panels into the building structure. The first structure integrates conventional aluminum framed cells as the roofing material, simply laid together and sealed. This integration was done around eight year ago and still functions well as shown by the demonstration inside the structure. Beside this structure is a new three-year-old demonstration of a roof shingle system with embedded photo voltaic cells. This system, although providing less energy per square foot, provides for easy integration wherever roofing material exists.

We sat with Pers in the demonstration cottage to discuss our power requirements. Pers showed us some of the other projects he had done. Most were in quite remote locations where off-the-grid systems were required. Recent projects, like the straw bale Meadowood house in the large city of Mississauga near Toronto, were grid-connected solar power systems. It is comforting to know that a large number of people are starting to do this without any support from government or society in general.

We had already decided to implement a grid-connected system – to which Pers' responses became quite simple. "How much do you want to spend?" The basic principle is that since the grid can supply as much energy as you need, you are only getting the photovoltaic and wind power generators to "make a statement". In my

head, I am thinking yes and no. Yes – I would like to make a statement. On the other hand, no, I also want to save money by being a net supplier of energy to the grid. Who knows, maybe one day they will pay me for this at a rate that makes it worthwhile to supply more. In the end, our decision was to start with a smaller system, although large where essential like in the inverter system, so that we can add panels as required to meet our demand and budget. We budgeted \$20,000 for the system although an average quote is around \$15,000. In my own mind, if I am buying my energy for the foreseeable future I don't mind spending \$30 -40,000 if my loan on that money isn't more than I would spend on conventional electricity. If I get lucky, energy prices will go through the roof and our investment will look brilliant.

Essentially, we decided to implement a hybrid approach, which would allow us to store some energy for the large loads like the oven, washer, and dryer, while still supplying excess into the grid and taking power from the grid if required. There are many experts at supplying and installing these types of systems. Take advantage of their knowledge and experience as you plan your own system. The technology is constantly changing and improving. Many options exist. Do your own research as well, so you know what questions to ask.

Creative Ideas

On Martin's suggestion, we approached construction as an organic process, leaving ourselves open to opportunities that present themselves throughout the building stage. The idea is to continuously look for ways to use natural site features for things like better natural lighting, improved ventilation, use of local site materials and simplification of the construction.

Martin dreamed up the idea of allowing more light into the basement by providing small portals in the main floor near the south facing windows. Just before the concrete was to be poured we modified the floor to allow for tempered glass plates to be inserted, allowing light into the large basement area.

Another of Martin's ideas was to install vents in the hallway floor to draw cooler air from the basement into the rest of the house during the summer. We left an 8-inch gap between the straw bale wall and the flooring. The vents could then be cut into the plywood sub-floor, and covered with standard heating vents or some kind of grate. Then we could fill the gap with stones to finish it off. This design feature serves many purposes, including ventilation, safety (it keeps people away from the

rough stucco wall, so they don't get scratched by it), economy (time and money to cut the flooring to match the uneven wall), and aesthetics (we get many compliments on this unusual "trim"). Taking the time each day to review the construction site for unrealized opportunities provided many advantages.

The water system was designed to collect rainwater and store it in the cistern installed to the north of the house, near the well. Once this system is connected, the water will need to be run through a sand filter and ultra violet light cleaning system so it can be used for drinking.

The single conventional toilet, required by code to properly operate the septic system, was installed on the second floor. The composting toilets were to be placed in both bath rooms on the ground floor, in order to allow the visitors to try out these systems.

Using the local sand from the site saved us approximately \$20,000. This local sand was used for the septic bed, and resulted in a smaller septic field than would otherwise have been required.

At some point we decided to use one-side-good Fir plywood as the finished floor and on some of the walls on the second floor. The ground floor would get a bamboo floor. The existing concrete flooring on the south side would be left as is. Martin came up with the idea of adding gravel to the greenhouse area and "landscaping" indoors for this area.

Construction Photo Journal



Hydronic In-Floor Heating

October 2000

Looking west down into basement. The square wooden boxes provide the forming for the tempered glass windows which would eventually be inserted into the concrete floor. This brilliant design idea that Martin suggested will provide additional lighting to the basement.



Letting Light In

November 2000

The ground floor on the south side is in. Martin has suggested we leave the opening through to the basement so that we get lots of natural light. Looks good at this stage.



Post and Beam Supports Green Roof

January 2001

Most of the post and beam construction has been completed. The steel "A" frame on the east and west sides of the house provide extra strength to support the green roof.



Green Roof with Central Sky Light

February 2001

The green roof takes shape through a difficult winter. The central sky light provides light and ventilation.



Straw Bale Walls

April 2001

The straw bales were stored inside to keep them dry. Straw bales were used only on the north wall.



Stacking Bales

April 2001

Up go the bales as they are stacked one row at a time before being sewed together.



Straw Bale Work Volunteers

April 2001

Filling gaps and
adjusting the bales
required lots of
ingenuity.



Finishing Stucco on the Straw Bale Walls

April 2001

Pete does the finishing touches on the stucco applied to the straw bale walls.



Passive Solar Design

June 2001

Shortly after we moved in the work continued on the exterior finishing of the house. This is the south side where windows let light and heat in to warm the concrete floors.



Green Roof Concept

Martin Liefhebber provided this touched up photograph of what the green roof will look like once we get the soil and plants on it.



**Photo Voltaic Solar
Panels on the Roof**

December 2001

Just above the
windows on the second
floor you can see the
new photo voltaic solar
array.



**Wind Turbine
Operating while
Solar Panels are
Covered by Snow**

January 2002

The new Bergey
1KwH wind turbine
installed on a 60 foot
pole.



**John Wilson on the
South Side of the
Home**

August 2003

That is me in front of the house. You can see our clothes line on the far right side of the house. The open windows provide all the ventilation we need to keep things cool at this time of the year despite sometimes hot and humid temperatures.



Wind and Solar Going Full Blast

August 2003

You can see the wind turbine on the left, mounted on a sixty foot pole, and the house with solar panels just above the windows.

Heating System

We decided to avoid a conventional boiler for our radiant floor heating system. One thought was to build a masonry -type fireplace in the center of the house with built in water circulation coils. Once we reached the stage of construction where the wood fireplace was required, we switched to an EPA-rated wood stove instead of the masonry heater. This also required a switch to a small electric boiler that would support a solar hot water heater.

Straw Bale Walls Construction

Before doing the straw bale walls on our own home we participated in the work on the Mississauga house that Martin had designed. We learned how to divide bales for different spacing requirements, stack them like bricks for strength, secure them with chicken wire fencing, sew them together with giant needles and finally how to sponge the last coat of plaster applied to the straw bales for the final finish. We spent two weekends working on the bales the first weekend and plastering the second weekend.

We sent out a press release to try and attract some press attention before having our own straw bale wall raising. Although one local television station said that it would send a camera crew to the event, they never showed up. The local newspaper did print a version of this release which did garner a few calls from local residents interested in this type of construction. One lady who called asked whether this technique could be used to construct a Church. There could be no better structure suited to this type of construction in my mind. We referred her to our architect and said we'd be glad to meet with her to discuss our experiences and be of assistance should they decide to proceed with design and construction.

The following is our press release:

PRESS RELEASE: Like an Old-fashioned Barn Raising

The pioneering spirit is alive and well in the Mono Township, North of Toronto, this Easter Weekend. Friends, family, and a host of volunteers will join homeowners John Wilson and Leigh Geraghty for a "Straw Bale Weekend" at their home near Mono Mills. "The idea", says John Wilson, "is to create a home which is healthy, beautiful and sustainable, by turning to old/new

technologies such as straw-bale construction, sod roofs, and composting toilets."

John and his family look forward to moving into their "healthy house" in May, a dream that has taken over seven years to realize. Since his children were born, John has developed a strong interest in preserving the natural environment, and leaving a healthier world for Ian and Claire to grow up in. The natural warmth of the sun will heat the house, while a sod roof and straw bale walls protect it from the heat of summer and the cold of winter.

Early settlers in Nebraska first used straw bales to construct homes in the late 1800s. Faced with no trees to mill and soil too sandy to use for sod homes, they turned to the abundant supply of prairie grasses and their recently invented baling machines. Many of these turn-of-the-century homes, schools and churches still stand today. Modern straw bale construction uses the same basic principles applied by the Nebraskan pioneers, but updated to meet current building code requirements. Straw bale homes offer insulation values more than double that of standard frame homes. Environmentally, the use of straw bales replaces the majority of the framing lumber, manufactured insulation and plastic barriers with an annually renewable, agricultural waste product. Straw bale homes consistently use less than one half of the heating and cooling energy required by standard frame homes.

The straw bale post and beam house has been designed by award winning architect Martin Liefhebber, to compliment its natural surroundings and capitalize on readily available resources, such as the energy of the sun, the natural slope of the land, and protection of the trees. The living roof will grow low-maintenance plants typical of the surrounding area. The house is structured to maximize passive solar heat with concrete floors that also have hydronic tubing as a back-up heat source. Composting toilets will allow the recycling of human waste without polluting the environment.

Straw Bale Happening

One of the best things about building with straw bales is the opportunity to involve others, whether amateurs or experts, in the construction of your home. With minimal instruction and supervision, a team of inexperienced family, friends, and other enthusiasts can help you to erect your straw bale walls in just a few days. We call it a "straw bale happening".

Friends, family and a small group of experienced straw bale builders gather for a few days to prepare and stack straw bales for a building. For a volunteer, it's a chance to exchange experience with others, and plan for their own future straw bale structure. The new skills you learn can be used in preparing to build your own home. Whether or not you plan to build with straw bales yourself, the opportunity to participate in a straw bale happening provides a great sense of accomplishment. It just feels good to help others.

We met some remarkable people including the straw bale experts from Camels Back Construction...Tina, Pete and Chris. These folks are leading experts at the trade. Peter Mack and Chris Magwood have written a book on straw bale construction that is one of the best available on the subject called *Straw Bale Building*. They build up to twenty projects a year out of straw bales. Like a rock group, they have their groupies who show up at the construction site when called on, and work their hearts out over a weekend or two to raise the straw bale walls. Before starting construction Chris gives everyone some tips on the process. Complete one layer of bales first, offset the second row by half a bale, interlock the corners, make sure the walls go up straight, fill in gaps with loose straw before starting on the next layer, be safety conscious, and have fun. With these experts keeping an eye on family, friends, groupies and strangers things went incredibly smoothly. We had it all done in two weekends.

A Sense of Community

Working together like this on the straw bale walls, you develop a sense of teamwork and camaraderie. Networking with people of all ages and backgrounds, who share in a common interest and purpose, leads to the sharing of ideas, solutions to problems, and an all-important level of encouragement. The resulting optimism and positive attitudes generate a sense that it can be done – and we're doing it together. It's amazing to witness the enthusiasm of volunteers so interested in learning by working hard, for free, for somebody else.

For me, one of the most valuable lessons was the importance of good site preparation. Our builder Colin and architect Martin put a lot of thought and effort into preparing the work site, ensuring a prompt start with less waiting around for volunteers and helpers. This includes preparing the base that the bales will sit on, as well as careful planning of windows and electrical outlet placement.

I also picked up some great tips for building with bales, for example:

- ⚙ Staple the chicken wire to the outside frame before starting to stack the bales of straw.
- ⚙ Complete one row before starting the next one.
- ⚙ Decide which side of the wall needs to be the straightest (usually one side will have a bit more “character” than the other). Then use huge wooden mallets on each side of the stacked bales to straighten the walls.
- ⚙ Don't forget to stuff gaps on the outside and around posts before starting the next level.
- ⚙ You can apply either two or three layers of stucco. If you plan to add color, apply the final pigment layer with a paint roller several weeks after completing the first two layers. This allows time for the stucco to dry properly, and the color layer will hide any cracks or flaws.

Straw Bales vs. Conventional Construction

The natural curved lines and spaces formed by straw bale walls produce a spiritual sense of closeness to earth, a sense of harmony with creation and life. Look at the teepee, igloo and many other examples of aboriginal dwellings. When you enter one of these structures, this spiritual feeling surrounds you. You can feel it if you spend a night in a cozy warm round teepee with an opening in the top to the stars above. This is the feeling I get in my own home, both inside and out. When guests visit my home, they feel it too.

Shortly after finishing our straw bale walls, I spent a day insulating other parts of our home with Roxul insulation. I realized with startling clarity that straw bales are much more pleasant to work with than conventional insulation material. It doesn't irritate the skin, you don't need protective goggles, and a day of straw bale building is actually lots of fun. Now, who can say that about a day of working with fiberglass or Roxul insulation?

Chapter 22

LIVING

We moved into our new home on May 26, 2001. I slept at the site for two nights prior to the actual move to safe guard construction materials. The first few nights, with insulation not yet in place, were cold. It was striking how much warmer it got once the insulation was in.

For the first eight weeks the main south windows were covered in a thick plastic sheet in order to prevent water leakage during rains until the windows had their final seal, flashing and siding applied. This, during the middle of our summer, has meant some warm evenings. With the few small windows on the east and west side that have been completed we do get a good up-draft at each end of the house. Without the windows on the south side operating the second floor remains quite hot during the night. We believe that once the green roof is filled with plants and the outside sun shades are installed, the overall natural ventilation and a minimization of solar heat gain will create a much cooler pleasant indoor environment for sleeping.

Already a dramatic temperature difference exists between the basement and the 2nd floor of the house. In fact a constant flow of air is pulled up through the vents from the basement into the ground floor. This natural air conditioning system, even at this very early stage, appears to have great potential. The solid concrete floors, stay cool. This coolness reaches me as I sit in the living room reading a book on a hot and muggy evening.

Tour

The opportunity to tour a natural home can be a turning point for people who are serious about renovating or building. Many people are surprised to learn that a large part of the design is determined by the particular conditions of the site. Unlike large-scale developments the orientation of the sun at different times of the year, location of trees for protection from cold north winds, the slope of land, and access to

sunshine from the south are where the design starts. The Wilson natural home is oriented to true north/south. This was accomplished during site visits long before construction began. A GPS was used to determine this location information as precisely as possible. Once the solar orientation was determined the house was staked out facing due south.

To retain the benefits of the trees to the north of the house that block the cold north winds, the laneway through these trees follows a long curve to prevent the wind (and dust) from blowing directly through to the house. The house was then tucked in to the trees on the north while leaving the south exposed. The site also slopes gently to the south leaving plenty of solar exposure on the south side. The east and west sides are buffered with more trees, since the winds from the northwest can be fierce during the winter months. These simple orientation concepts provide significant long-term savings on heating and cooling. In the summer the cool breeze is pulled in through the trees on the north maintaining a cool pleasant temperature in the home. In the winter the trees block the coldest winds from hitting the home directly. The temperature difference is optimized for cooling in the summer and warmth in the winter. In fact, the temperature south of the trees where the home is located can be more than several degrees warmer in the winter and can seem much warmer as the wind is so much milder in this area compared to the north side of the trees.

The next layer of protection for the home is the straw bale wall on the north side. This wall provides excellent insulation (R50-R60). Straw bale is a renewable building material that comes from local farmers. The bales are used like bricks to build the walls. Then a chicken wire mesh is stapled to both sides and sewn together compressing the bales. The final treatment is several layers of stucco on each side of the wall. Straw bale walls have the added benefit of being breathing walls. This means that some level of air transmission occurs, while maintaining the high level of insulation. There is no vapor barrier, unlike almost all modern Canadian homes. This ability to breathe eliminates the need for a mechanical heat recovery ventilator and vapor barrier, while providing better indoor air quality without any additional energy costs.

The tour continued at the south side of the home. Here the concepts of passive solar design were explained. Essentially this passive solar concept is the primary heating system for the Wilson home. Windows on the south side of the home allow light into the home especially in the winter when the sun is low in the sky. Inside the house, thick concrete floors absorb the heat so that it can slowly dissipate over night

when it is needed during the winter. The fiberglass windows, filled with krypton gas, provide exceptionally good insulation levels for windows thus keeping the sun's heat from escaping. Throughout the home, hydronic tubing is embedded in the floors to capture and circulate the heat (or coolness in the summer). This system eliminates the need for any furnace.

Think about the thousands of dollars that are saved in reduced oil, gas, or electricity bills each year. All these cost savings without producing any pollution. People who came to the open house said they were paying anywhere from \$1,500 to more than \$5,000 each year in heating costs. Over twenty years that adds up to \$100,000 assuming the cost of these energy sources stay the same. There is no doubt that gas, oil, and electricity prices will continue to rise. It is possible that the cost of energy required to heat conventional homes may reach numbers far greater than the cost of actually building the home in the next thirty to fifty years, especially as fossil fuel reserves become exhausted. Most scientists agree that we are reaching the peak. Since the cost to extract the rest will only increase – as supplies diminish and become harder to reach – it is quite possible that prices may skyrocket. When this happens the investment in passive solar will look simply brilliant.

As the tour continued, groups were told how the two levels of windows on the south side *double* the potential for passive solar heat collection. This design is optimized for the specific climatic conditions of the site. There is a great need for solar heating in the winter. Two levels of windows to collect this heat doubles the storage capability. In the summer the planned shading system and green roof will ensure the passive solar system does not overheat the home. A green roof will reduce heating in the summer by 30-40% while providing additional insulation in the winter when it is so critical. People are surprised to learn that more than 20% of houses in Germany have a green roof. The shading system (not yet installed) will also help to prevent overheating in the summer. A vine-covered pergola will also improve the cooling properties of the passive design in the summer.

The solar photovoltaic (PV) panels are located above the upstairs windows. The solar PV panels turn sunlight into electricity. The DC electricity generated by the PV panels is transformed into AC by an inverter in the basement, for use by home appliances. The wind turbine also produces DC electricity. Again, the inverter turns DC to AC. When more solar/wind power is being generated than used in the home, the inverter feeds the excess AC power into the public electricity grid, turning the meter backwards. The ten Siemens solar PV panels produce up to 400 watts an hour when the sun is shining directly above them, without any cloud cover. The Bergey

XL wind turbine can generate up to 1,000 watts an hour when there is a relatively strong wind. Many people were surprised that the entire system, which could be retrofitted for most homes in this area, cost only \$20,000 fully installed and CSA certified. Many people believe that the minimal level of investment is in the \$100,000 range.

Inside the house the tour reflected on the benefits of a natural air -cooling system provided through the skylight tower in the middle of the house. This idea, thousands of years old, is still used in the Sahara to provide a natural air conditioning system during hot weather. The cool air is naturally drawn up from the basement and through the house, eventually venting out of the skylight at the top using convection. The window in the skylight is opened during the summer in order to drive this effect. At all times of the year the light coming in through the large central skylight means electric lights don't need to be turned on nearly as often. The use of opaque materials like Plexiglas and fiberglass allows light into places like bathrooms and hallways.

Some of the materials used in the Wilson natural home include bamboo for wood flooring. Bamboo is a grass. After it is harvested for use in the floors the bamboo grows back. Bamboo is also a very hard wood so that it withstands the beating that many hardwoods might not. Other materials included parallam posts and beams for the framework of the house, birch for the paneling and kitchen cabinetry, as well as MDF cardboard for much of the shelving. Other natural materials used include slate, local pinewood, and gravel.

Wilson Natural Home Features

Passive Solar

- ⚙ Eliminated the need for a conventional fossil fuel powered furnace system for heating;
- ⚙ Eliminated the need for air conditioning system with high energy requirements;
- ⚙ Used the structure as the main heat store removing the need to transfer energy over long distances;
- ⚙ Provided extensive natural lighting, minimizing the requirements for electrical lighting systems and reducing overall electricity requirements;

- ⊗ Super insulating, double glazed, krypton filled fiberglass windows, with special low-E coating on the west side to minimize over-heating. Large 6 x 6 foot windows with minimal units that open to ensure superior insulation capability while maintaining optimal solar gain;
- ⊗ Extensive roof overhang and large external shades ensure that shading is maximized during the summer while solar gain is optimized in the winter;
- ⊗ Vines to cover the shades on the south side to improve shading and cooling effects in the summer while providing maximum solar gain in the winter;
- ⊗ Effective use of natural forest in the north to protect the house from north winds while producing a cooling effect in the summer;
- ⊗ Ventilation and light tower to maximize solar gain even in the center of the house, with a large overhang to prevent overheating in the summer;
- ⊗ Outdoor clothes line dries clothes in about the same amount of time (May through October) as our efficient automatic dryer, using only the sun and wind.

Straw Bale Walls

- ⊗ Produced from a waste product – available annually;
- ⊗ Biodegradeable;
- ⊗ Easy to use;
- ⊗ Durable over time;
- ⊗ Easy to maintain;
- ⊗ Inexpensive;
- ⊗ Requires only simple tools and unskilled labor;
- ⊗ High insulation value – between R32 and 54;
- ⊗ Lower heating and cooling requirements resulting in reduced fossil fuel use and reduced CO₂ emissions;
- ⊗ Nontoxic;
- ⊗ Breathability, improved indoor air quality;

- ⚙ Extremely quiet, good sound insulation;
- ⚙ Natural curved surfaces and thick plaster-covered walls, create a sense of comfort;
- ⚙ Reduced burning of straw which is an environmental hazard;
- ⚙ Reduced use of timber;
- ⚙ High rating as a sustainable building material;
- ⚙ Durability – effectively survives earth quakes, tornados, and even fire;
- ⚙ Good load-bearing capacity;
- ⚙ Good long-term cost savings through low total life cycle costs over 30-100 years.

Frequently heard concerns with straw bale construction include fire hazard, strength, and rotting. These concerns have been consistently proven to be unfounded:

- ⚙ Fire safety tests have found straw bales to be more fire resistant than most conventional building materials. Because of the thickness of the walls and lack of oxygen available, it takes two hours to burn through plaster, straw and stucco walls (double the resistance of most wood frame homes);
- ⚙ They successfully survive humidity and moisture in almost all climates. Protection against water damage is the main concern. Even unplastered straw bale walls have shown excellent resistance to deterioration over long periods of time;
- ⚙ Pests, allergies and odors have proven to be of minimal or less of a problem than conventional building materials. Anecdotal evidence indicates that there are no problems with bugs in straw bale buildings;
- ⚙ Building codes are beginning to accept this material with specific inclusion in some areas;
- ⚙ Insurance and financing has become possible now that this material is more recognized as a standard in eco-housing; in fact there are reportedly more than 20 straw bale houses built each year in Ontario, Canada where we built our home.

Green Roof (Sod Roof)

Cultivating our roof instead of using steel, plastic tiles, shingles, or wood seemed like a good idea. According to the ecological design books I had read, people

consider these houses unusual looking, although highly desirable from an environmental standpoint. In fact, if roof agriculture were adopted on a broad scale the positive impact for the environment would be substantial.

Some of the key reasons for selecting a green roof were to be found in the book *Living Spaces* which we purchased during the design phase:

- ⊗ Thicker roof structure leads to better sound and thermal insulation;
- ⊗ Improvement to the surrounding microclimate due to the much cooler roof surface and the moisture given off by plants;
- ⊗ Increased thermal mass thereby stabilizing indoor temperature swings;
- ⊗ Absorption of dust and pollutants;
- ⊗ Retention of 50-70% of rain water and resulting reduction in site run-off;
- ⊗ Plants provide habitat for small mammals and birds;
- ⊗ More esthetically pleasing;
- ⊗ Reportedly reduces cooling energy requirements by 30-40%;

Photo Voltaic Solar Panels

Conventional systems linked to the electricity grid are environmentally damaging in a big way. Existing standard systems including coal, oil, gas, nuclear, and large scale hydro exact heavy penalties on the environment including major carbon contributions to global warming from fossil fuels, loss of power in transmissions over large distances, inability to safely dispose of nuclear power waste, dangers of catastrophe with nuclear accidents, and terrible environmental destruction of natural habitats caused by hydro. The future answer will be a combination of super-efficiency in appliances combined with solar, wind and geothermal generated electricity. The latest generation of these systems has proven to be efficient, long lasting and easy to implement in almost any area. Fuel cell technology, which involves the storage of energy as hydrogen, may also provide greater flexibility for both solar photo voltaic and wind power.

Some of the advantages of photovoltaic solar power are listed below:

- ⊗ Uses silicon, a waste product from the electronics industry;

- ⚙ Silent operation;
- ⚙ Solid state electronics with no moving parts results in long-term problem-free operation;
- ⚙ Flexible design potential for local integration into power grid, isolated systems design or a combination;
- ⚙ Simple, easy and cost effective to maintain;
- ⚙ Stable and declining price, while fossil fuel prices are fluctuating rapidly and increasing – especially in the next 25-50 years when shortages can be expected;
- ⚙ The cost of energy production from photo voltaic may be paid back in as little as 3 years. With a 20 year or more life span, the energy generated far exceeds that used in the manufacturing process.

Heating & Cooling

Use solar power sources, good passive design, efficiency, cooling ventilation, heat exchange, controlled air exchange and insulation to meet your heating, hot water and air conditioning requirements.

- ⚙ Minimize the size of your home as the first level of efficiency.
- ⚙ Use natural materials to create thermal mass (e.g. stone, brick or ceramic) in the floor and wall systems. These are also typically long lasting materials.
- ⚙ Integrate solar hot water heaters to provide hot water.
- ⚙ Ventilate through the use of strategically placed windows.
- ⚙ Plan water flows to provide natural cooling in the summer and a natural humidification in the winter.
- ⚙ Maintain as much of a continuous wall as possible (especially on the north side in the northern hemisphere and the south side in the southern hemisphere), and seal any cracks. In a post and beam house ensure that the posts are inside the structure. Minimize seams—they cause leaking of warm air in the winter and cool air in the summer. This is especially important on the north wall of houses in the northern hemisphere (the south wall in the southern hemisphere).

- ⚙ High quality building design provides a complete heating and cooling system and a high quality indoor environment, through proper passive solar gain, insulation, ventilation, and sizing.
- ⚙ The use of straw bale construction maximizes insulation while being a non -toxic, renewable, natural material.
- ⚙ High quality double or triple glazed windows provide passive solar gain while minimizing heat loss.
- ⚙ A few operable windows are needed to provide summertime cooling through cross breezes.
- ⚙ Integrate extensive shading structures into the window design, to minimize solar gain in the summer, while optimized for solar gain in the winter.

All heating, hot water and air conditioning requirements are being met with solar power sources, good design, efficiency, ventilation, heat exchange, controlled air exchange, a wood stove, and insulation.

- ⚙ Lyle Jory installed the in -floor heating system. The system is composed of the tubing embedded in the concrete flooring throughout the house. The water heater is a Seisco Microtherm device. The large thermal mass of the floor with water tubing stores solar heat collected through the super efficient Inline Fibreglass windows. Warm water may be re -circulated through the in -floor tubing to provide heating. Ambro concrete floors are used with plastic tubing.
- ⚙ A ventilating “air scoop” in the center of the house and thermal design eliminates the need for any mechanical air conditioning system.
- ⚙ Ventilation is through strategically placed operating windows. In floor vents from the basement into the open concept ground floor provide cooling in the summer. The upward flow of air is encouraged by an operating window opening in the “air scoop” in the center of the house which has a single operating window high above the second floor. Eventually ventilation can be enhanced by efficient electric powered fans in the central “air scoop” and the vaulted ceiling in the living room on the ground floor. The green house also incorporates a natural air scoop with openings at the lowest level and up at the top of the second level.
- ⚙ Water flows are planned which should provide natural cooling in the summer and a natural humidifier in the winter.

- ⊗ The north wall has a minimal number of doors and windows.
- ⊗ The posts supporting the framework of the house are inside the structure and do not interrupt the wall structure minimizing seams that cause leaking of warm air in the winter and cool air in the summer or the reverse.

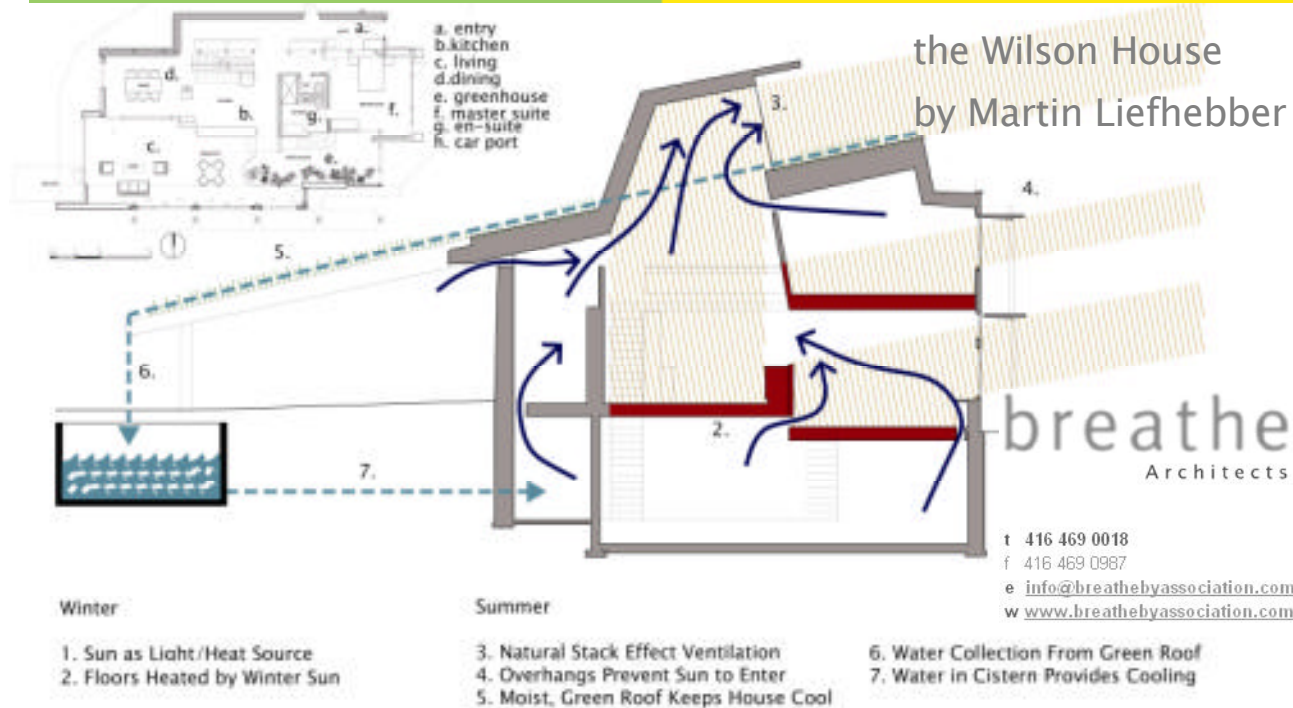
High quality building design provides a complete heating and cooling system and provide a high quality indoor environment through proper passive solar gain, insulation, ventilation, and sizing.

- ⊗ High levels of natural straw bale insulation maximize insulation where required.
- ⊗ High quality double glazed windows provide passive solar gain while minimizing heat loss.
- ⊗ A few operable windows provide cooling through cross breezes in the summer.
- ⊗ Extensive window shading designed to minimize solar gain in the summer while optimized for solar gain in the winter are integrated into the windows designs.
- ⊗ The green roof system improves insulation in the winter and increases cooling in the summer.
- ⊗ A Pacific Energy EPA rated wood stove provides additional heating in the winter.

In-Floor Heating

This system was selected for a number of reasons that include both environmental and health benefits:

- ⊗ The large concrete mass required for in-floor hydronic heating systems provides the perfect storage medium for passive solar design;
- ⊗ Natural heat distribution through radiation instead of forced air through duct work (which has the potential for molds and dust);
- ⊗ Ability to store and recover heat naturally from passive solar absorption, solar water heat exchange, and water heated by the wood stove;
- ⊗ Ability to control temperature separately for each room for optimal efficiency and flexibility.



Ultra Efficient Appliances

The use of high efficiency, super insulated, high quality appliances throughout was necessitated by the photo voltaic solar power system design. The advantages of this type of appliance typically include better overall design, high quality, durability, and ease of use. The refrigerator uses the most energy of all appliances, because it is in

constant use. The second is lighting systems. Third is actually the television, based on American statistics. Fourth are clothes dryers. Obviously these depend on your usage patterns. We decided to focus on the most efficient refrigerator, lighting and clothes washer and dryer systems as well as an efficient dish washer. We have no cable or satellite connection so our television usage is minimal.

One SunFrost fridge was originally planned. A high efficiency conventional Maytag was selected in the end because it provided more space (meaning we would not need a second SunFrost), was almost as efficient (actually it is rated at about twice the 19 cubic foot Sun Frost, although the Maytag we selected is 22 cubic feet of internal space) which we rationalized by committing to taking the reduced cost of the Maytag (about half the price, a savings of more than \$1,500) and applying that to extra photovoltaic panels to make up for the extra energy requirements.

An Asko dishwasher was the most efficient we could find at our local discount appliance retailer "Home and Rural Appliances". The Bosch clothes washer and dryer were the most efficient available we believe. The washer has an "Energide" sticker that showed a rating of only 189 kwh per year that is off the scale when compared to other washers. It also uses much less water than other washers. The machine also appears to be of a very good quality design and construction so it should last longer.

A microwave/convection oven provides much of the cooking requirements. It is an old Panasonic model. We have justified this because it is one we have had and by not buying a new one we save on the waste. In general microwave ovens are very efficient so we use it for many tasks. As well, this oven provides a convection oven mode which is also quite efficient for jobs that require a small oven instead of the wasted energy of heating a small amount of food in a large conventional oven.

We selected the Creda oven because it was the smallest we could find at our local retailer. It was however big enough to cook a reasonably sized turkey for family dinners. This electric oven is very simple but is a convection oven which enhances the efficiency. In fact, in the first several weeks of use we were amazed at how little time it took this oven to heat up, minimizing any pre-heating requirements, reducing overall cooking times and doing an excellent job of cooking at lower than normal temperatures. Unfortunately this model did not come with any Energide ratings and we have been unable to get this information from the manufacturer. We selected a GE cooktop because it had the lowest Energide ratings of those available at "Home and Rural Appliances". The new standard glass top, fast heating elements have performed well.

Appliances we selected are as follows:

Refrigerator: Maytag 463kwh rated 22 cubic feet size

- ⊗ Requires only eight solar modules as apposed to approximately twenty four for a conventional unit, or more than half the energy requirements of many other conventional units;
- ⊗ Well insulated to minimize cooling requirements;
- ⊗ We considered the SunFrost super efficient refrigerators commonly used in solar powered homes. We selected the Maytag instead because it used only twice the amount of energy while providing 3 cubic feet more space and automatic defrost features. The other rationale was that since it cost less than half the price of the SunFrost we would put the savings into the purchase of more photo voltaic solar panels to make up for the increased energy requirements;

Lighting: Compact Florescent & Low Voltage

- ⊗ Uses less than a quarter of the electricity of standard incandescent bulbs
- ⊗ Lasts nine times longer
- ⊗ Overall lifespan cost of two and half times less than incandescent bulbs
- ⊗ Less waste produced
- ⊗ Fewer changes required
- ⊗ Better full spectrum light provided

Television: Elimination and Reduction

- ⊗ Disconnected cable and satellite services in order to reduce regular usage potential
- ⊗ Limit usage to planned video taped programs
- ⊗ Limit units to one in the basement only

Clothes Dryer: Bosche 189kwh

- ⊗ Minimize usage by using outdoor clothes line in fall, summer and spring
- ⊗ Energy efficient compared to competitive units

Dishwasher: Asko 377kwh

- ⚙ Smaller size reduces energy requirements and water requirements while retaining capacity to clean the same amount of dishes
- ⚙ Reduced water usage through powerful cleaning mechanism
- ⚙ Quite operation through insulation

Clothes Washer: Bosch

- ⚙ Front loading design minimizes water requirements and provides efficient cleaning mechanism
- ⚙ Uses 30 percent less water
- ⚙ Uses less electric energy

Stovetop: GE

- ⚙ Highest efficiency rated for electric unit.

Oven: Creda

- ⚙ Convection
- ⚙ Small size
- ⚙ Non-electronic controls

Green House

The integration of a greenhouse into the house had always been a part of the dream for our new home. I had visions of growing all kinds of wonderful fruits, vegetables and herbs all year long. Other benefits of the green house include:

- ⚙ Improve indoor air quality – many plants actually “clean” the air;
- ⚙ Natural humidification of the indoor air.

Organic Gardening

Our property offered an opportunity to grow our own food . Through some research, advice from neighbors and friends, and trial and error, we have created an organic vegetable garden that supplies most of our vegetable requirements for the summer and well into the fall. Some of the techniques we use in our garden include:

- ⚙ Composting food waste as a fertilizer;
- ⚙ No chemical fertilizers or pesticides;
- ⚙ Mixed planting to naturally deter pests;
- ⚙ Rotating crops to minimize pests;
- ⚙ Selecting plants and seeds that are native to the area;
- ⚙ No lawns that require any lawnmower except for a mechanical push mower.

Water

- ⚙ The roof should have earth and natural grasses growing on it for insulation, esthetics, and minimizing the impact of the house on the natural environment.
- ⚙ Water can be collected from a large roof surface that provides some natural purification through drainage from a vegetative covering (green roof).
- ⚙ The living roof or green roof also provides a cooling effect through evapo - transpiration in the summer.
- ⚙ Use water barrels to provide water for agriculture and garden irrigation.
- ⚙ Ponds can be created to provide natural habitats, cooling in the summer, and emergency water supplies. Larger ponds can provide an extra source of water for irrigation, fire emergencies, swimming, fish, and wildlife drinking water.

Energy

We have integrated photo-voltaic and a wind turbine supply to supply electricity. Leonard Allen of Phantom Electron Corporation supplied and installed our solar/windpower system. The system was composed of the following major components:

- ⚙ 10 Siemens ST40 all -black 40W solar modules, solar photo voltaic panels
- ⚙ 1 Xantrex SW4024 4kW inverter
- ⚙ 1 Bergey XL-1 1kW wind turbine
- ⚙ 1 SB50 Power boosting solar charge controller
- ⚙ 2 Sealed batteries

- ⚙ We selected only the most efficient appliances and only those that are really required to minimize the scale of the photo voltaic system required.
- ⚙ We've combined the photo voltaic system with wind power to provide a more consistent supply of renewable energy.

Construction Materials

- ⚙ Logs from the lot provided some of the posts and interior façade.
- ⚙ Locally made concrete blocks were used requiring little timber for forming.
- ⚙ Parallam PSL wood engineered wood products were used for much of the post and beam construction.
- ⚙ The north walls were insulated with natural fiber or better known as straw bales.
- ⚙ Locally made Inline windows and doors were used.
- ⚙ Other insulation requirements were met with the use of Roxul which is partially composed of lava rock and waste steel slag materials.
- ⚙ Sand from a hole dug locally was used for much of the grading and concrete.

The orientation of the house was optimized for solar gain using several techniques including:

- 1) building the two story portion of the structure on the south side to maximize potential solar gain without overheating in the summer using simple awnings
- 2) orienting the south windows due south with optimal shading for the summer and minimal for the winter
- 3) extending the solar gain through an open concept design and internal windows to maximize solar penetration for heat and light
- 4) the layout of the kitchen and breakfast table on the south east to naturally gain the morning sun and the layout of the living room, work rooms, and dining area on the south west to get the maximum daily sun and the evening sunset on the south and south west sides
- 5) using local straw bales on the north wall with minimal windows and doors to optimize insulation and wind barrier from the north

6) positioning of the house facing south, at the top of a hill, shielded in the south by a forest

We left as much as possible “un-finished” and natural so that it does not require continual maintenance.

- ⚙ We decided not to paint the inside stucco on the straw bale walls since the natural gray color was quite pleasing. The sponging we applied as the stucco dried left a sand like finish which would have lost some of the natural texture with painting.
- ⚙ The steel beams and posts which remained exposed indoors were simply sanded down to their natural metallic color.
- ⚙ Exposed metal brackets inside were allowed to retain their natural rust colors.
- ⚙ The reveal molding and window frames are a dark metallic and light silver. These two materials naturally contrast and need not be painted.

Minimize the “finishing” in order to put as much investment into the quality of the design, foundation, framework, windows, insulation, passive solar heat collectors and photo-voltaic systems.

- ⚙ Don’t use standard wood, plastic or plaster moulding and base boards.
- ⚙ Plan the look into the construction materials so that finishing is not required.
- ⚙ Use conventional building material instead of expensive specialty products. For instance, we used Fir ply wood with a water based varathane for the second floor flooring. This high grain wood looks interesting, provides a warm surface, and is relatively in-expensive.

Work & Travel

I plan to work at home when and where possible.

- ⚙ Use high speed network technology to allow for communications, meetings and information and services exchange using the internet.
- ⚙ Minimize work for salary or contract pay by spending more time growing food, taking care of children, and minimizing expenses through efficiency.
- ⚙ Select work which supports the local community and enhances the natural landscape.

- ⚙ If office work is required then try to negotiate the options of working from home when appropriate.
- ⚙ Select products and services which are necessary for the local community and provide a benefit for the local natural landscape.

Phantom Loads

I have read over the years of the need to try and remove all “phantom” electrical loads especially when solar PV systems are to be used. Phantom loads are typically phones where transformers are used, built in rechargeable batteries when charging or devices with clocks that stay on all the time as well as those instant on electronic devices like TV, stereo and other electrical equipment. They are quite pervasive in modern electronics due to the exceptional convenience they provide. Unfortunately this convenience comes at an invisible price. Most of these devices require a tiny trickle of energy to maintain these devices in a “standby” mode. Often no visible indicator will show that the device is on or using energy but they are. Some strategies we use to minimize these phantom loads include:

- ⚙ We unplug the microwave oven when we aren’t using it. Eventually I plan on connecting a switch to make this very easy.
- ⚙ We unplug the electric tooth brush that we’ve grown used to using. This device has a built in NiMH batter which requires periodic charging. The mini transformer if left connected will slowly use electricity even though the batteries aren’t being charged. That is why transforms feel warm even when they are not charging batteries.
- ⚙ For all the computers we have a power bar with a switch. Most of the older modems, speaker systems and other peripherals have transformers which will stay “hot” even while the systems are turned off. Even some power bars come with switches that have a light that uses a small but constant stream of electricity.
- ⚙ Our wireless phone is another device that requires a transformer and has a built in rechargeable battery for the handset. Unfortunately I have been unable to determine a configuration that would allow us to use this system as the receiver that connects to the phone jack on the wall. Power is required to allow for the wireless handset to send it information.

- ⚙ Cell phone chargers that we used to leave connected to the wall socket are now unplugged after each charge. The phones we've picked are all NiMH battery powered. We also have chargers that work using the cigarette lighter outlet in our car.
- ⚙ Ground fault interrupt (GFI) plugs usually found in bathrooms can be a constant source of a tiny amount of electrical energy usage. Given their requirements in the building code you may not be able to avoid them.
- ⚙ The antique clock we got as a wedding present requires a constant connection to an electrical outlet. I suspect it probably uses about as much power as our refrigerator if we had it plugged in as the old mechanical system is severely outdated. Sadly, until I can find a way to remove the constant trickle of power required by these clocks we'll have to use our wrist watch. I recently purchased the Solar Alarm Clock that I found at the Real Good web site at www.realgoods.com. It has a solar cell that charges a battery so that no electrical connection is required.
- ⚙ For some time now we've enjoyed a Fujifilm FinePix 1400Zoom digital camera. It has captured many of the photographs include in this book and on our web site at www.NaturalLifeNetwork.com. These cameras seem to suck conventional alkaline (four AA batteries in our case) battery power very quickly. The preview mode and connection to computer modes are also hard on the batteries which means we go through four every month or so. This past week I finally got four NiMH rechargeable batteries for this device and use the Dorcy (www.dorcy.com) charger. This takes about 16 hours to charge but lasts about the same time as each set of new alkaline batteries. These NiMH batteries are recyclable and do not contain any heavy metals like alkaline or NiCd batteries. Real Goods (www.realgoods.com) has a solar powered charger which might make a good replacement for the Dorcy unit which currently plugs into a wall socket.
- ⚙ Several years ago I bought Leigh an HP Jornada 690 handheld computer which has allowed us to keep up to date on our finances wherever we are. These units come with rechargeable batteries. While not in use we turn off the powerbar which ensures that the transformer and tiny green LED does not stay on all day while the device is not connected using up a tiny amount of energy all the time.
- ⚙ The new Asko dishwasher we bought was the most efficient model we could find in our area. It is rated at 375 kwh. Unfortunately by the time we finally got the unit up and running we found that the electronic controls remain illuminated,

albeit with just a single small LED, all the time. Our plan is to install a switch on this circuit in the cupboard next to the unit so that we can disconnect this tiny trickle of power when the unit is not in use.

- ⚙ The VCR we have is quite old. Surprisingly it does not have the usual time display found on most machines, yes the one that flashes 12:00 all the time because we can't figure out how to use the system. Again, these constant unused electronic indicators mean that these machines are always on and using power. We've hooked everything up to a power bar which we use to turn everything off when we are not using them.
- ⚙ The stereo system and T V also require a power bar to switch them off. This of course causes the internal clocks to require re -setting each time we turn them on again. We find this a small price to pay. We rarely use these features now since we don't have a cable or satellite dish connection any more.
- ⚙ When we purchased a new computer we chose a "notebook" model which is designed from the ground up to minimize energy consumption especially when the built-in rechargeable batteries are in use (ours uses NiMH batteries). The built in software on the Sony Viao computer we purchased provides extensive automated power management some of which we can control. For the most part this minimizes energy usage whenever possible. Since all battery recharging systems use a transformer of some kind either built in or external it is still necessary for us to use a power bar to turn off power once we have completed using or charging the batteries in the computer. One day it is our hope that the software that manages these notebook computers will be enhanced to allow the kind of control we require for eliminating any kind of power usage when not required (eliminating the slow trickle of transformer systems used for charging batteries). It would also make sense for the computer systems to eventually be able to monitor all electrical system activity and actively minimize usage.
- ⚙ Garden path lights usually are simply plugged into an external outlet. Instead we've purchase a pair that are solar powered and use LED technology to provide the light that is highly energy efficient. These packages come with rechargeable AA NiMH batteries and solar cells. The first unit we bought at our local Canadian Tire retailer has proven inadequate for our purposes. It does not provide enough light. Plus our dog ate one of them recently. Until we find a unit that is sturdy enough and provides sufficient light we are doing without these devices.

Organic Vegetable Garden

One of the great joys of this first summer in our new solar house has been a twenty by twenty foot square vegetable garden. In early spring we got my parents out for the weekend, leveled out the area in preparation for a load of top soil from our local garden center. We picked a spot that is protected on the north and east sides by trees. In addition, it is sheltered by the house to the north and west sides. The area gets full sunlight all day. We chose twenty or so packages of seeds from our local organic supermarket, Harmony Market. We erected a fence with the leftover chicken wire from the straw bale construction on the house.

One of the back to the country books we purchased years ago gave us the idea to create growing beds about two feet wide, with walking paths around a foot wide. We also left a foot around the edges. Then we simply read the seed packages and planted as directed once the chance of frost was gone. We even got a bag of planting potatoes and put them in around the outside of the vegetable garden. Over about a month's period we planted romaine lettuce seeds, beans, peas, carrots, tomatoes, peppers, onions, mescaline lettuce and of course the potatoes. The kids helped us plant the seeds more often than not. Some books suggested planting the seeds in a more random pattern. We tried both at different times.

Leigh put leftover straw bale along the paths between the beds. This reduced the number of weeds early on but eventually weeds grow no matter what. We waited and finally some shoots came up. First, we started to enjoy some fabulous mescaline mixed green salads which in fact lasted most of the summer and even into the fall. We found it wonderful with a simple dressing of olive oil, balsamic vinegar, salt, and pepper along with some pine nuts. Or for some variety we stole the idea of mixing in organic goat's cheese and a raspberry vinaigrette with some walnut slivers, from one of our favorite local restaurants Hiding in Hockley.

Then later in the summer the beans and peas became a daily fresh vegetable with most meals. The romaine lettuce was smaller than the grocery species with a lighter leaf, still excellent for a Caesar salad. We battled the bugs with our fingers since we will not use pesticides. The potatoes were wonderful plants, popping dark green leaves that were always under attack from the potato beetle that we'd been warned about. Sadly, the potatoes died while we were on vacation during the first two weeks of July despite our attempts to keep them happy with straw bale supplements under their leaves. Having returned from our vacation and hoping to be able to start enjoying our potatoes their demise was taken quite hard as we couldn't understand

what we had done wrong. Several weeks later our children's friends' parents, who are professional landscape artists told us that in fact, if we dug under the soil where the potato plants had been we'd find our long lost harvest! Yes, apparently the potatoes don't grow on the potato plant stems. They grow underground and are safe from harm even after the plant above ground dies. What luck! The potatoes are delicious and we may have enough to last us a few months into the winter.

The success of our very first vegetable garden, the many pleasurable hours plucking out weeds, fussing with the bugs, using straw bale remains as a perfect ground cover, and picking the fresh vegetables for our dinner has been enlightening. Sharing our tomatoes with friends and family has proven a great gift during their time of plenty. The onions have been a wonderful sweet addition to our summer pastas. The kids have also enjoyed the magic of seeing those seeds transform into plants and then food that is more delicious than anything we've ever had from the super market. We all learned a great deal about the food we eat and how precious it is. There is something wonderful about sharing the fresh vegetables from your garden with family and friends on a warm summer afternoon.

Solar Panels

As I make the last few edits on this revision of the book the folks from Phantom Electron, Ben and Chris, are installing the photo voltaic solar panels on the roof above me. Next week the wind turbine will be erected on the sixty foot tower. We've started to log the amount of electricity we generate. Monitoring the electrical meter has illuminated how much electricity certain activities use. When we run the clothes dryer for instance the disc in the meter spins so fast it is almost a blur. Just the other afternoon, however, I got to see the meter run backwards as our new Siemens photo voltaic array composed of ten modules, in the middle of the day was able to generate enough electricity for our needs and send the excess into the electrical grid thus moving the meter backwards. It was a thrilling experience. I felt a bit like David fighting the powers of Goliath.

Wind Turbine

The Bergey XL wind turbine was installed in January 2002. The monitoring thus far indicates that we get lots of power generated from this device especially during those blustery winter days. In our location, on the top of Hockley Valley, we get between 2 and 7 kilowatts per day typically. Ben and Leonard of Phantom Electron

Corporation installed the wind turbine during several bitter cold days. Our tower is sixty feet high and uses guy wires to secure the pole.

Renewable Energy Grid Connection

One of the more confusing matters when it comes to generating your own electricity is how to hook up to the utility grid. Working with Phantom Electron Corporation made this a simple matter for us as they have installed many other systems. Confusion arises because there are several options for making this connection.

1. Run the Existing Meter Backwards
2. Net Metering with Two Meters
3. Net Metering with Two Meters and Getting Paid for Excess

Chapter 23

FREQUENTLY ASKED QUESTIONS

The following are questions we've answered many times during the tours we give each year. For a more up-to-date list see our web site at

www.NaturalLifeNetwork.com .

Why pebbles along straw bale wall on the north?

- ⚙ These pebbles serve several purposes.
- ⚙ Since straw bale walls are not perfectly straight it looks better and is easier to finish by simply laying the pebbles on the floor. Cutting the tile to this edge would not have been easy.
- ⚙ Below the pebbles we plan to cut holes in the sub-floor to allow the cool basement air to flow up to cool the main floor in the summer when the vent in the skylight is opened.
- ⚙ The space keeps people/kids from rubbing the walls which can be abrasive.
- ⚙ It looks beautiful!

Why did you do straw bale only on the north wall?

- ⚙ Straw bale construction provides a comfortable home. The walls provide R50-R60 insulation values.
- ⚙ They breathe providing better indoor air quality.
- ⚙ The cold winds in the winter come from the north.

- ⚙ The complexity of the other sides of the home made straw bale more difficult although in hindsight we would consider using it.
- ⚙ Our research showed that there was no reason to be concerned about fire, pests, rot, or any other fairy tale type concerns.
- ⚙ Our home uses straw bales within a post and beam construction so that the bales are not load bearing. Load bearing straw bale home designs are possible and do exist.

What kind of wood is it that you used for the posts and beams and why?

- ⚙ We used an engineered wood product called Parallam. The wood fibre is taken from fast growing trees rather than old growth forest products. The engineered nature of the product provided better rigidity and strength for the high roof and heavy weight of a greenroof (that will have eight inches of soil, plus snow at time), not to mention strong winds.

How can I learn how to do my own straw bale construction?

- ⚙ There are several excellent books on the subject exist. Building with Straw Bales is one of the best. Contact the experts at Camel's Back Construction - <http://www.strawhomes.ca/> . The folks at Camel's back have an email list that lets you join in the construction of a straw bale home as a volunteer. That way you can learn all you need to know to do it yourself.

How much did it cost?

- ⚙ The cost was approximately \$120 per square foot, similar to a quality custom home built using conventional methods and materials.

What is the pay back period?

- ⚙ We expect to pay back our investments in the home in general within twenty years. Assuming energy prices go up this pay back period may be significantly less.

Are you going to do anything with concrete floors?

- ⚙ The concrete floors in the Living Room, Master Bedroom, and Basement will remain as they are. This type of flooring (mass, such as concrete, ceramic tile, slate, stone) is ideal for collecting and holding the sun's warmth in the winter. It also transmits the warmth from the radiant in-floor heating efficiently. In the

summer, it absorbs the heat so that the air feels cooler. We like the natural look and feel.

What type of wood did you use in the kitchen and why?

- ⚙ We used bamboo in the kitchen because it looks good and is a type of grass that grows back after being cut down.

What is that big concrete thing north of the house?

- ⚙ That is a cistern, which is intended to hold rainwater collected from the roof. It has also been installed to allow for filling directly from the well. The cistern will hold water for household use, and also provides a water source in case of fire.

Does it get warm in the summer?

- ⚙ Surprisingly, most of the house is quite comfortable in the summer. The basement is quite cool, and the main floor area is very comfortable also. The bedrooms upstairs can be quite hot on sunny days. We have plans for a shading structure to be built on the south side of the house, which will shade only the high summer sun, and allow the lower winter sun to shine through. A fan will be installed in the "tower" that will draw the hot air up in the summer also, pulling up the cooler air from the basement.
- ⚙ The roof is designed to hold six inches of soil and allows us to plant native plants on it. Once we do that this type of roof can be expected to provide increased cooling in the summer up to 30 -40% which should significantly improve the 2nd floor temperatures in the summer. In addition, the extra soil will improve insulation levels for the winter.

Does the \$400,000 include the cost of the land?

- ⚙ No, that is the cost of building the house only. It is advisable to own the land outright before beginning construction.

Does the electric utility company pay you for the energy you generate?

- ⚙ No, Hydro One does not pay us for the power we generate. Our meter often runs backwards, however to date we have never generated more than we use in a month. Under the current regulations, Hydro will not pay us - the best we could expect in any given month is a \$0.00 bill.

- ⚙ We do however save a lot of money. Last year we spent approximately \$1,000 on electricity before we had installed the wind/solar power system. This year, based on savings thus far, we expect we'll save about \$500 each year.

Can all electricity meters go backwards?

- ⚙ No, some models run in only one direction (forwards). You should be able to have it switched to a model that does run backwards although that might be an additional cost to you.

Is straw bale safe...fire, pests, rot, strength...can you do it in the city?

- ⚙ There is no problem with pests, rot, fire or strength. The concrete stucco coating prevents any pests from entering and together with the compression of the bales, provides sufficient strength. The straw bale walls are considered more fire-retardant than conventional stud walls. Since the wall breathes (that is, air and moisture pass through freely), there is no problem with rot. Straw bales are supported by the building code. A 6000 square foot straw bale home was built in Mississauga.

Did you have any problems getting the building permit?

- ⚙ No, we were fortunate to have a building inspector who is familiar with straw bale construction. There were some issues with central composting toilets and rain-water collection. In the end, the Town allowed both the composting toilets and rain-water collection, but required a septic field to be built (along with one flush toilet so that it would operate properly), and a well to be dug.

Did you have any problem getting insurance?

- ⚙ Some insurance companies required inspections because of the "unconventional construction" of the home. The only issue they identified was the wood stove, due to an error made by the inspector. He listed the pipe as single-wall, when in fact it is double-wall. We had no difficulty finding an insurance company willing to insure the home at a reasonable rate, with no issues. Our insurance company ended up being State Farm Insurance.

Did you have any problem getting building financing?

- ⚙ Our bank provided a construction mortgage, although these are becoming harder to get. Because of the unconventional construction, the bank required the mortgage to be insured by CMHC, even though we had a 25% down payment.

How much is the wind turbine?

- ⚙ The wind turbine requires batteries, a tower (60 feet in our case), a charge controller, and an inverter (to convert the DC current to AC for use with conventional appliance and to supply to the electricity grid). Our system also included ten Siemens 40 watt photovoltaic solar panels. This complete system installed was \$20,000. We purchased our systems from Phantom Electron Corporation - <http://www.phantomelectron.com/> . Contact Leonard Allen or Bed Rodgers.

Does the wind turbine make much noise?

- ⚙ The wind turbine is actually very quiet. In a moderate breeze, you will hear a quiet whisper, and occasionally a mild hum from the wind turbine. When the wind is very strong and gusty, you may at times hear a low "growl". Each type of turbine is different. It is best to check out the unit you expect to purchase if you can.

What was most valuable in your research into how to do Natural Living?

- ⚙ Toronto Healthy House tour
- ⚙ book Living Spaces – try GrassRoots store <http://www.grassrootsstore.com/> or have it ordered from your local book store.
- ⚙ Architect Martin Liefhebber - check out his new web site at <http://www.martinliefhebber.com/>
- ⚙ Solar Living Center in California - web site: <http://www.solarliving.org/>
- ⚙ The Solar House book - look for it at your local book store
- ⚙ Natural Home magazine - web site: <http://www.naturalhomemagazine.com/>
- ⚙ Natural Home book series
- ⚙ Kortright Centre for Conservation - they have a wind/solar power tour and learning facility as well as a large Living Machine.

If you could have done anything different what would it be?

- ⚙ Reduce the size of the house...reduced cost of construction...keep below \$400,000 to take advantage of GST rebate. Eliminate the basement space for the most part.

What should you do if you already own a home since that is the majority of people?

- ⚙ Renovation of existing home is by far the most important task. First, start by being as efficient as possible...insulate/seal cracks, reorient windows/walls for passive solar design, use straw bale for additions and even replacement of existing walls, improve insulation in roofing, install solar photovoltaic panels with inverter and grid connection (\$5000-30,000) on your roof/yard - contact Phantom Electron Corporation - <http://www.phantomelectron.com/> .

What are you going to grow on your green roof and how are you going to cut the grass?

- ⚙ We plan to grow native grasses, possibly setums, and hopefully some strawberries. The intent is to grow vegetation that requires minimal maintenance and watering. We don't intend to cut the grass on the roof. Well, maybe we'll get a goat!

Can anyone create a green roof on their home?

- ⚙ The green roof is quite heavy, and requires a very strong support structure. Our roof is engineered to support the weight of all the soil, moisture and potential snow.

Can you get any rebates or do any incentive programs exist for solar systems?

- ⚙ Yes. In our area it is possible to get the retail sales tax rebated. For more information see <http://www.naturallifenetwork.com/wilson/tax.asp>

Why did you decide to have a green roof?

- ⚙ The green roof will provide several benefits, the most significant being to keep the house cool in the summertime (similar to a basement). It also provides additional insulation to keep the house warmer in the winter. This type of roof helps to conserve the natural environment, providing habitat and food for wildlife. A conventional roof can get very hot, and heat the surrounding air significantly. Finally, the green roof has a natural beauty that is unmatched by any other kind of roof!

What is the grey/tin/silver roof/siding and what is it for?

- ⚙ The material on the sloping south face is Zinc. Zinc reflects the sun for cooling, and is a natural, long lasting material. It ages nicely, and reflects a spectrum of colors that vary with the angle of the sun.

How did you get a permit to build this house in Mono Township?

- ⚙ It wasn't easy. We have had to duplicate some of our systems to get around building code requirements. For example, although we will have composting toilets, and want to recycle our grey water, we had to install a septic system, along with one flush toilet so that it will work properly.

Fortunately, the building inspector at the time was open to new ideas, and willing to discuss ways to make our objectives possible. An experienced architect, Martin Liefhebber was able to explain the technologies and methods directly to the Town authorities, and work with them and the builder to develop solutions.

Aren't you worried about pests and fires?

- ⚙ No, these of no more concern to us than they would be for anyone building a conventional frame house, in fact, the straw bale construction is more fire resistant than frame construction. A special lime compound is applied to the straw, to increase its fire resistant properties.

What are the actual insulation values (R-values) of straw bale buildings and why do they seem to be so much higher than regular construction?

- ⚙ The insulation value is approximately R43. The R-value comes from the natural insulation properties of straw bale, which is basically just cellulose.

How is a straw bale building constructed – is post and beam the only way to build?

- ⚙ There are a variety of construction methods that can be used, in addition to post-and-beam. The straw bales themselves can be used as load-bearing walls, without any other framing material.

How affordable is straw bale building?

- ⚙ Straw bale construction, by itself, is very economical. Depending on the seasonal conditions, you may pay \$1 to \$4 per bale. Volunteer labour helps to keep costs

down too. Other factors may affect the cost, such as the non-standard design of such homes.

Will the house be warm enough?

- ⚙ Yes, the high insulation, good quality windows, well-designed roof, and ventilation system will ensure a comfortable indoor environment year-round. An EPA-approved wood-burning stove will help to supplement the heating on those cold, cloudy winter days.

How is the sod roof constructed?

- ⚙ The sod roof is engineered to sustain the weight of the soil, plants, moisture and winters' snowfall. A waterproof membrane covers the plywood layer, which is insulated on the inside. Other special layers are applied over the waterproof membrane to channel water off the roof and keep roots from penetrating. Finally, 8 inches of soil is added, and then planted with "alpine growth" and local hearty varieties that require low maintenance.

Will you have to water and mow the roof?

- ⚙ No, plants are specially selected to withstand dry spells. They are left to grow naturally.

What are the benefits of a sod roof?

- ⚙ The main benefit is that it doesn't heat up in the same way as a conventional roof. On a hot summer day, a conventional roof can heat up to 120 degrees Fahrenheit. A sod roof will maintain a temperature of 72 degrees Fahrenheit or lower. This has the effect of keeping the home, and even the surrounding environment cooler.
- ⚙ Other benefits include reduced rainwater runoff, and good insulation for cold winters provided by a layer of insulation, soil, and potentially snow.

What is "passive solar heat" and how does it work?

- ⚙ The warmth of the sun passes through low-e windows and is captured by the concrete floors. From there it is transferred to water running through tubing embedded in the floor, and circulated throughout the house.

What are composting toilets and how do they work?

- ⚙ Composting toilets are like a garden composter, but constructed to decompose human waste using heat, air circulation, and natural bacterias. The resulting compost can be used to fertilize non-edible gardens, and is safe for the environment.

Will the house be difficult to maintain?

- ⚙ The house was designed to be low -maintenance. Interior and exterior finishes are minimal, and much of it will never require painting or re-finishing. For example, floors are constructed of concrete, which may be expected to last a lifetime, and requires minimal upkeep. With no furnace, there is no ductwork to clean, and no fossil fuel burning needing annual service.

Why did you go to all the trouble to build such an unusual house - wouldn't it have made more sense to build something that most developers build?

- ⚙ It may have been easier, but not more sensible. This environmentally -friendly construction has long-term benefits, such as lower heating and utility costs, minimal maintenance, and will not be impacted by rising fossil fuel costs. It has a minimal impact on the natural environment, leaving a healthier, sustainable legacy for our children.

Why did you choose the architect Martin Liefhebber?

- ⚙ We became familiar with Martin's work through the award -winning Toronto Healthy House, which he designed. After a few meetings, it became clear that Martin's experience and creativity would support the project's principles.

How did you find a builder who could manage this project?

- ⚙ We spoke to several builders, and selected Colin Richards because of his considerable experience, very high quality work, and interest in alternative construction techniques.

What are your plans for the garden?

- ⚙ Ultimately, we would like to grow our own food, using organic growing techniques and permaculture design.

Why are you concerned about the ability to be self-sustaining?

- ⚙ The rising cost of fossil fuels, and their effect on the environment had us very concerned about the future for our children and grandchildren. It is well known that non-renewable fossil fuels will be depleted in the next 50 to 100 years, making self-sustaining home design a necessity. We want to raise awareness of the feasibility and ease of this type of design, even today.

What are the new building materials you chose and what is special about them?

- ⚙ The radiant floor heating is constructed of "mass" (stone, concrete, etc.), which collects and stores solar heat. The heat is circulated to other areas of the home by water tubing embedded in the floor.
- ⚙ The windows are double-glazed, krypton gas filled, low-e and fiberglass framed. This offers insulation, while allowing the heat of the sun to pass through.
- ⚙ The roof is covered with soil, which absorbs heat and moisture, and insulates.
- ⚙ Straw bales are an annually renewable resource, and very inexpensive, while offering a high insulation value (approximately R43).
- ⚙ Bamboo flooring is another annually renewable material, which has the warmth and superior quality when compared to hardwood floors
- ⚙ The post-and-beam structure uses glue-lam beams, which are constructed of compressed "waste" wood and glue. They are much stronger, and more durable than conventional wood beams.

Chapter 25

LOOKING BACK

We've lived in the house for more than a year now. The home we've created has been a constant source of education for us and the kids as we'd hoped. There are still many things we want to do to be more efficient; grow more vegetables, and improve the various systems. All in all it has worked out better than I had ever imagined. From sunrise to sunset the majority of our light, energy, heat and water is supplied by the power of sunlight. The new wind turbine supplies energy frequently during the duller, colder days, a remarkable and fortunate weather pattern in our area.

Building our new lifestyle is an on-going learning experience. We've gotten so much more out of our closer relationship with nature. We've become far more in tune with the amount of sunlight we get each day, the strength and direction of the wind, the materials that earth supplies to our vegetable garden, our need to work as a team to get things done, and a constant feeling that we've got it very good, that we are very lucky.

Curiously since our switch to organic foods, more indoor sunlight, straw bale walls that breathe for better indoor air quality, and concrete flooring for passive solar heat storage (rather than conventional duct work which is susceptible to molds and mildews), we found our family's general health has been improved. This I can only say is our sense as compared to a number of years ago when we lived in a conventional townhouse. Of course this could be due to many other factors. But I know we've got a much healthier home which will be especially important as the kids grow up in this environment.

There is so much you can do to make a difference in the way you live and how that will affect nature. Start today:

- Cultivate a sharper and deeper AWARENESS of your connection to nature which will inspire you to achieve a *Natural Living* lifestyle.
- Start eating organic FOODS, and try to eat only vegetables one day each week.
- Develop a PLAN which details how you will achieve your *Natural Living* goals according to your own principles.
- Transform your HOME into one that is composed of natural materials, derives power from the sun , and is as efficient as possible.
- Make CHOICES which support a harmonious coexistence with the natural world which sustains you. Be conscious of your ability to make real CHOICES each moment of each day. Use your power of CHOICE.
- Find ways to make use of alternative TRANSPORTATION such as commuter trains, subway systems, walking, and bicycle.
- Be CREATIVE in the way you approach this opportunity to find your way to *Natural Living*.
- Transform your life's WORK to be in harmony with your new *Natural Living* lifestyle.

And so the process continues. Each day now I review these steps and look for more ways to make my life sustainable. The future is now. If we can envision it we can make it happen.

Chapter 25

NATURAL LIVING VISION OF THE FUTURE

You awake to the sound of chirping birds as the sun streams through the windows of your bedroom. Sitting up in the soft wholesome smelling organic cotton sheets you peer out through the triple paned “smart” windows sculpted into the straw bale walls. The natural undulations of the earth surround you like a nest. The sun peeks over the tree covered panorama filling the sky with pink, orange and yellow splashes of color on the fluffy layer of clouds on the horizon. The sun appears, a bright fire ball pouring warm rays of golden light deep into the cozy room. Your face is warmed. The sunlight re-energizes you for a new day. The smell of fresh pine forest wafts through the air as a breeze rushes by the small window opening. The chirp of birds, the buzz of crickets, the soft rustling of the leaves softly sing nature’s symphony.

You catch a glimpse of a wild deer wandering through your back yard, into your neighbor’s clover patch for breakfast. The warm shower you take is refreshingly soft – chlorine -free water, efficiently sprayed through a low flow shower head, from the rain water collection system. The water is heated each day by the solar heater on the roof of your house and stored in an insulated tank, something the Cypriots perfected decades ago. The sun penetrates into the shower stall through the rice paper blinds. The smell of natural biodegradable ingredients used in the shampoo and soap waft up through the vent into the main areas of the home creating a natural level of moisture. The excess water vapor is naturally transferred slowly to the outside through the straw bale walls that “breathe” while providing superior insulation values. In the summer a vent high up in the central portion of the home sucks cool air from the basement through the main part of the home creating a natural cooling system, a trick learned from homes in the Sahara.

For breakfast you join your family for a bowl of organic grain cereal topped with fresh berries from your own garden and filled with fresh local organic milk. The natural flavors seem more powerful than the sweet cereals you remember when you were young, even though the heavy coatings of sugar are gone. The fresh small berries are extremely sweet and full of flavor. Your kids bubble with excitement as they describe the activities planned for school. They will plant some vegetables, build a straw bale green house, and share their nature studies projects in an open air “Nature Festival”.

The kids ride their bikes to school with you. You ride your bike to the commuter train service that takes you to your office in the city. Your spouse stays at home some days with the consulting business that services the local business community requirements for employee training on “eco-design” processes and principles. Your company builds integrated solar systems for the condominium development business that is booming as older buildings are retrofitted with your products. The local

> Exterior view of an industrial and office building in Freiburg Germany.



organic farmers have teamed up with your technology company to provide a prefabricated straw bale building system. These prefabricated straw bale parts replace the antiquated fiberglass stick frame insulation in new and old buildings. With your company's integrated solar cell roofing replacement system and the straw bale walls, new houses can be constructed in just a few weeks with community participation. The new roofing system is often complemented with a recycled plastic compound, derived from the local recycling plant that provides a "green-roof" replacement for the large flat industrial buildings that are being renovated on a large scale for both industrial and creative co-housing communities.

At the local commuter train station a bustle of activity exists as community members, coworkers, friends and family enjoy an organic coffee, freshly squeezed fruit juice and organic grain pastries as they wait for the train. The train station provides an open green-house style courtyard that has replaced most of the parking lot now that people are walking, running, roller-blading, riding their bikes, or taking the fuel cell powered community bus to the train station. The cafes are open all year round using movable green house glazing in the walls. New local businesses have opened including an organic farmers' market, organic grocery stores, book exchanges, natural clothing ware, and an electronic paperless news agency.

The train station has become central to much more than just transportation. The entire terminal is powered by a large photo voltaic power array and four large wind turbines along the perimeter of the old parking lot. The parking lot has been transformed into a small naturalized park complete with biking and walking paths surrounded by native trees, shrubs, bushes, and naturalized grass and wildflower meadows. The sounds of birds and running water can be heard at the far end of the station where the previously concrete encased creek has been returned to its natural state. The people in the station all seem to know each other. They all live in the surrounding community and frequent the markets and transportation



offered at this central location.

The office building where you work is located two stations away in what was the industrial sector of the major metropolis that was sprawling into your community ten years before. Now the large industrial warehouse has been renovated and your company's solar roofing cells provide all of the power requirements for the production facilities and offices. The building was expanded upwards with two additional floors that have window systems built into the flooring throughout to provide natural lighting during the working day. The walls of the structure have been re-insulated with a manufactured straw bale wall replacement system that has eliminated the need for any heating system other than in-



floor solar water heating and passive solar design innovations that went into the renovation.

Most of the parking lot was transformed into a naturalized park, with condominiums added for the employees who wanted to live near their office. An organic coffee house and organic food store provide the local business and residential community with a common gathering area for events, discussions and street exhibitions, in addition to the organic vegetable, fruit, pasta and grain-based gourmet menu items which they supply. The improved air quality, lighting and fresh food has reduced employee sick days by ten percent. Productivity has also increased by ten



percent even though the average employee only works thirty-two hours a week with at least six weeks of vacation a year.

Taking the train home lets you see all of the newly invigorated community villages that have reforested many of the parking lots and roadways that are no longer used by cars. The streets are beehives of activity as people walk to the central squares or train stations for their fresh food essentials each day. Bike and walking trails snake through all the communities. The train is quiet due to the recent innovations in efficient electric motor design that uses ultra-efficient low cost fuel cells to produce electricity with water vapor as the only exhaust.

The bike ride home in early afternoon allows you to stop off at the village perimeter and enjoy thirty minutes of quiet contemplation and reading next to the restored marshes that attract all kinds of native birds which had disappeared from the area just twenty years earlier. The small pond at the center of the marsh reminds you of the pond that Thoreau describes so lovingly in *Walden* which you are reading for the third time.

As you arrive home, your children ride up on their bicycles buzzing with the thrill of having created a new straw bale greenhouse for their school. It was hard for them to believe that where there had been the outline of a small structure, there now stood a straw bale walled greenhouse complete with solar roofing cells that provided all of the required electricity for the building. They helped to stack the bales of straw and sew them tight together. Next week they would be setting up their indoor eco-biology experiments to see how fast the tomatoes would grow in this northern climate.

For the remainder of the late afternoon, the family plays badminton at the local community center which was built by members of the community during several weekends last spring. The community center construction created great bonds between all members, both old and young, as they could all contribute to the process of laying bales, sewing them stiffly together to form the walls, and then plastering the organic contours of the large multi-story building. Everyone had a corner, wall section, or edge that would be uniquely their own for as long as the building stood. One creative young lad had placed three bales in a row and then plastered them with the middle bale decorated with a chess board. Today a teenager and his grandfather were enjoying a game of chess in the open air of the third floor while others played sports all around them.

Back at home the sun provides the required energy for the electrical systems throughout the house, and enough solar heated water to keeping everyone warm during the night. The family sits down to enjoy a salad from their own vegetable garden, a delicious veggie burger cooked on the super efficient wood burning barbeque, that also provides additional heat to the warm water storage system used for heating the home. The local managed woodlot provides a sustainable supply of wood for the eco-barbeque and new efficient triple-burn wood stoves that are used by some residents for supplemental heat in the winter.

After dinner the children work quietly on their ultra-efficient notebook computers that are connected through the Internet to the school's computer system. The new screen technology provides all the reading reference material, text books and assignments they need in electronic paper form which is larger than conventional paper books with crisper text and plenty of colorful illustrations. Finally, everyone settles down in his or her cozy organically grown hemp fiber bed for a paperless read before going to sleep. The poetry of Shakespeare inspires yet another generation as the night is illuminated by the florescent reading lights that produce warm tones inspired by the sun's own rays which power them. Sleep comes easily as images of butterflies flutter through the children's dreams while crickets, running stream water, and critters provide a comforting natural background soundscape through open windows.

Natural Living has spread by word of mouth to communities all over the world. Everywhere the inspiration of your actions according to this new vision has transformed the way people think of living. The result is a world in which poverty has been eliminated, starvation is unheard of, population growth has stabilized, peace has reigned without a single war for more than five years, artistic creativity has reached new levels of inspiration, science has integrated the purposes of nature and humanity, business and finance are thriving for those companies that embraced this vision, government has returned to servicing the needs of the people, the world community has joined together as one and peoples' mental health has measurably improved including overall indexes of humanity's quality of life.



> *New solar panels can be integrated into the exteriors surface of buildings.*

Yes, this is just a dream. This vision comes from a guy with a typical job, and a relatively normal family just like yours. We've been near bankruptcy, failed at some projects, succeeded at others, had joyful periods, made tragic mistakes, overcome great difficulties, been lucky at times, and frittered away the fruits of our luck. However, we have made the shift to *Natural Living* that inspired this vision. We have made the changes in order to make this vision a reality as much as we are able. Now it is your turn.

Tell others to join us. That is all it takes for this vision to become reality. Let the journey begin now. Seize this moment!



> | *Wilson Natural Home, one hour north of Toronto, Ontario, Canada.*

Chapter 26

NEXT STEPS

I know this book isn't perfect so any feedback, comments, suggestions, ideas, or thoughts would be welcome. My thinking here was to get as much of what I know out as quickly as possible. Over the next several years I will update the book with your input, things that we learn, and with the experiences of building communities based the ideas of *Natural Living*. If you have any questions I'd be glad to try and answer them so that they can also be included in the next version of this book. The best way to contact me is through the web site at Natural Life Network –

www.NaturalLifeNetwork.com. My e-mail address is john.wilson@naturallifenetwork.com or wilsonjd9@hotmail.com.

My intention is to dedicate my life towards the goals of *Natural Living*. The main projects this will include are as follows:

Sun Rise – Continue to update, enhance, and improve this book with our experiences, your feedback, and the experiences of the future projects outlined here.

Natural Life Network – Non -profit organization dedicated to communicating, developing and sharing the idea of *Natural Living* – check us out and join us at www.NaturalLifeNetwork.com. Subscribe to our monthly newsletter *Natural Living Journal*. There is an online membership application and payment form.

Natural Living: The Wilson Natural Home – A 25 minute documentary that provides an introduction to the ideas of *Natural Living* as achieved by the Wilson family through our home construction – to order a copy see the order form on the second page of this book or through the Natural Life Network web site at www.NaturalLifeNetwork.com/documentary/.

BEING GREEN – A feature length documentary that reviews our astonishing accomplishments with sustainable living practices in the past, looks at current

projects that provide loads of inspiring ideas and a look the potential for the future of EcoCities. (Still in the planning stage.)

Solar B & B – Provide bed and breakfast accommodations for people interested in learning about and experiencing *Natural Living* in action.

Natural Living Consulting – Provide consulting services to business, developers, government, education and individuals who want to make the transformation to *Natural Living*.

The Solar Village – The key concepts of this community development multiply the benefits of *Natural Living*.

North – Develop a community that supports the principles of *Natural Living* as a model for the transformation of other villages. Contact me at the email address above for more information.

South – Develop a community in the Dominican Republic in order to develop the application of *Natural Living* principles in a developing country. Contact me at the email address above for more information.

Natural Living: Around the World – Travel by catamaran around the world in search of the best and most inspiring examples of *Natural Living*. Document these pioneering efforts for sharing through our web site, a photographic journal book, a documentary video, and presentations on our experiences.

If you actually have made it this far you know what you've got to do next. Get out there and do it! Change things. Make a difference. Good luck!

Chapter 27

RESOURCES

Breathe Architects + Associates / Contact: Martin Liefhebber

The firm is the award winning architect for the Wilson House. Breathe Architects is an unique design firm with leading edge expertise in ecological and renewable energy systems. The firm combines a variety of interrelated disciplines to develop affordable and environmentally adept housing.

Web: www.breathebyassociation.com

E-Mail: info@breathebyassociation.com

Phone: 416 -469-0018

Phantom Electron Corporation / Contact: Leonard Allen

We are innovators, committed to a leadership role in the development and utilization of solar electric technologies in mainstream applications. Our team is building a unique company that is powered by vision... a vision that sees our products providing an avenue for transparent integration of renewable energy into everyday markets.

Web: www.phantomelectron.com

E-Mail: sales@phantomelectron.com

Phone: 905 -430-6512

Kolapore Construction Inc. (formerly C & R Construction) / Colin Richards

Kolapore Construction is in the custom home construction business with a distinct view to the integration of natural, ecologically friendly, and renewable energy

resources. Kolapore was the primary builder and construction manager for the Wilson House.

E-Mail: gregory.richards@sympatico.ca

Phone: 905 -880-2732

Camels Back Construction / Contact: Tina Therien, Peter Mack, and Chris Magwood

Straw bale construction company. Builders of the straw bale incorporated into the Wilson Home.

Web: www.strawhome.ca

InLine Fiberglass Limited

Supplier of the fiberglass windows for the Wilson Home.

Web: www.inlinefiberglass.com

Phone: (416) 679-1171

K & M Bamboo Products Inc. / Contact: Ian Jackson

Supplier and installer of the bamboo flooring used in the kitchen area of the Wilson Home.

E-Mail: info@silkroadflooring.com

Phone: (905) 947-1688

A.C.E.S. / Contact: Lyle Jory

Radiant Floor Heating

E-Mail: radiantheatjory@yahoo.ca

Phone: 416 463 – 5835

Ikea

Birch wood kitchen cabinetry.

Web: www.ikea.com

Home Hardware

Supplier of parallam posts and beams use extensively.

InLine Fiberglass Limited

Windows

Phone: (416) 679-1171

Web: <http://www.inlinefiberglass.com/>

Quality Rooves and Custom Metal / Contact: Jonathan Wolfe

Zinc roofing.

Phone: (416) 239-2200.

APPENDICES



Appendix A

WARNING TO HUMANITY

Issued by the Union of Concerned Scientists (UCS) in 1992.

World Scientists' Warning to Humanity

Some 1,700 of the world's leading scientists, including the majority of Nobel laureates in the sciences, issued this appeal in November 1992. The World Scientists' Warning to Humanity was written and spearheaded by the late Henry Kendall, former chair of UCS's board of directors.

INTRODUCTION

Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about.

THE ENVIRONMENT

The environment is suffering critical stress:

The Atmosphere

Stratospheric ozone depletion threatens us with enhanced ultraviolet radiation at the earth's surface, which can be damaging or lethal to many life forms. Air pollution near ground level, and acid precipitation, are already causing widespread injury to humans, forests, and crops.

Water Resources

Heedless exploitation of depletable ground water supplies endangers food production and other essential human systems. Heavy demands on the world's surface waters have resulted in serious shortages in some 80 countries, containing 40 percent of the world's population. Pollution of rivers, lakes, and ground water further limits the supply.

Oceans

Destructive pressure on the oceans is severe, particularly in the coastal regions which produce most of the world's food fish. The total marine catch is now at or above the estimated maximum sustainable yield. Some fisheries have already shown signs of collapse. Rivers carrying heavy burdens of eroded soil into the seas also carry industrial, municipal, agricultural, and livestock waste -- some of it toxic.

Soil

Loss of soil productivity, which is causing extensive land abandonment, is a widespread by-product of current practices in agriculture and animal husbandry. Since 1945, 11 percent of the earth's vegetated surface has been degraded -- an area larger than India and China combined -- and per capita food production in many parts of the world is decreasing.

Forests

Tropical rain forests, as well as tropical and temperate dry forests, are being destroyed rapidly. At present rates, some critical forest types will be gone in a few years, and most of the tropical rain forest will be gone before the end of the next century. With them will go large numbers of plant and animal species.

Living Species

The irreversible loss of species, which by 2100 may reach one-third of all species now living, is especially serious. We are losing the potential they hold for providing medicinal and other benefits, and the contribution that genetic diversity of life forms gives to the robustness of the world's biological systems and to the astonishing beauty of the earth itself. Much of this damage is irreversible on a scale of centuries, or permanent. Other processes appear to pose additional threats. Increasing levels of gases in the atmosphere from human activities, including carbon dioxide released from fossil fuel burning and from deforestation, may alter climate on a global scale. Predictions of global warming are still uncertain – with projected effects ranging from tolerable to very severe -- but the potential risks are very great.

Our massive tampering with the world's interdependent web of life – coupled with the environmental damage inflicted by deforestation, species loss, and climate change – could trigger widespread adverse effects, including unpredictable collapses of critical biological systems whose interactions and dynamics we only imperfectly understand.

Uncertainty over the extent of these effects cannot excuse complacency or delay in facing the threats.

POPULATION

The earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the earth's limits. Current economic practices which damage the environment, in both developed and underdeveloped nations, cannot be continued without the risk that vital global systems will be damaged beyond repair.

Pressures resulting from unrestrained population growth put demands on the natural world that can overwhelm any efforts to achieve a sustainable future. If we are to halt the destruction of our environment, we must accept limits to that growth. A World Bank estimate indicates that world population will not stabilize at less than 12.4 billion, while the United Nations concludes that the eventual total could reach 14 billion, a near tripling of today's 5.4 billion. But, even at this moment, one person in five lives in absolute poverty without enough to eat, and one in ten suffers serious malnutrition.

No more than one or a few decades remain before the chance to avert the threats we now confront will be lost and the prospects for humanity immeasurably diminished.

WARNING

We the undersigned, senior members of the world's scientific community, hereby warn all humanity of what lies ahead. A great change in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated.

WHAT WE MUST DO

Five inextricably linked areas must be addressed simultaneously:

We must bring environmentally damaging activities under control to restore and protect the integrity of the earth's systems we depend on.

We must, for example, move away from fossil fuels to more benign, inexhaustible energy sources to cut greenhouse gas emissions and the pollution of our air and water. Priority must be given to the development of energy sources matched to Third World needs – small-scale and relatively easy to implement.

We must halt deforestation, injury to and loss of agricultural land, and the loss of terrestrial and marine plant and animal species.

We must manage resources crucial to human welfare more effectively.

We must give high priority to efficient use of energy, water, and other materials, including expansion of conservation and recycling.

We must stabilize population.

This will be possible only if all nations recognize that it requires improved social and economic conditions, and the adoption of effective, voluntary family planning.

We must reduce and eventually eliminate poverty.

We must ensure sexual equality, and guarantee women control over their own reproductive decisions.

DEVELOPED NATIONS MUST ACT NOW

The developed nations are the largest polluters in the world today. They must greatly reduce their overconsumption, if we are to reduce pressures on resources and the global environment. The developed nations have the obligation to provide aid and support to developing nations, because only the developed nations have the financial resources and the technical skills for these tasks.

Acting on this recognition is not altruism, but enlightened self-interest: whether industrialized or not, we all have but one lifeboat. No nation can escape from injury when global biological systems are damaged. No nation can escape from conflicts over increasingly scarce resources. In addition, environmental and economic instabilities will cause mass migrations with incalculable consequences for developed and undeveloped nations alike.

Developing nations must realize that environmental damage is one of the gravest threats they face, and that attempts to blunt it will be overwhelmed if their populations go unchecked. The greatest peril is to become trapped in spirals of environmental decline, poverty, and unrest, leading to social, economic, and environmental collapse.

Success in this global endeavor will require a great reduction in violence and war. Resources now devoted to the preparation and conduct of war – amounting to over \$1 trillion annually – will be badly needed in the new tasks and should be diverted to the new challenges.

A new ethic is required – a new attitude towards discharging our responsibility for caring for ourselves and for the earth. We must recognize the earth's limited capacity to provide for us. We must recognize its fragility. We must no longer allow it to be ravaged. This ethic must motivate a great movement, convincing reluctant leaders and reluctant governments and reluctant peoples themselves to effect the needed changes.

The scientists issuing this warning hope that our message will reach and affect people everywhere. We need the help of many.

- We require the help of the world community of scientists -- natural, social, economic , and political.
- We require the help of the world's business and industrial leaders.
- We require the help of the world's religious leaders.
- We require the help of the world's peoples.

We call on all to join us in this task.

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UNION OF CONCERNED SCIENTISTS

2 Brattle Square
Cambridge, MA 02238
617-547-5552
Contact us at ucs@ucsusa.org

Web Site: www.ucsusa.org

Appendix B

THE EARTH CHARTER

PREAMBLE

We stand at a critical moment in Earth's history, a time when humanity must choose its future. As the world becomes increasingly interdependent and fragile, the future at once holds great peril and great promise. To move forward we must recognize that in the midst of a magnificent diversity of cultures and life forms we are one human family and one Earth community with a common destiny. We must join together to bring forth a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace. Towards this end, it is imperative that we, the peoples of Earth, declare our responsibility to one another, to the greater community of life, and to future generations.

Earth, Our Home

Humanity is part of a vast evolving universe. Earth, our home, is alive with a unique community of life. The forces of nature make existence a demanding and uncertain adventure, but Earth has provided the conditions essential to life's evolution. The resilience of the community of life and the well-being of humanity depend upon preserving a healthy biosphere with all its ecological systems, a rich variety of plants and animals, fertile soils, pure waters, and clean air. The global environment with its finite resources is a common concern of all peoples. The protection of Earth's vitality, diversity, and beauty is a sacred trust.

The Global Situation

The dominant patterns of production and consumption are causing environmental devastation, the depletion of resources, and a massive extinction of species. Communities are being undermined. The benefits of development are not shared equitably and the gap between rich and poor is widening. Injustice, poverty, ignorance, and violent conflict are widespread and the cause of great suffering. An unprecedented rise in human population has overburdened ecological and social systems. The foundations of global security are threatened. These trends are perilous—but not inevitable.

The Challenges Ahead

The choice is ours: form a global partnership to care for Earth and one another or risk the destruction of ourselves and the diversity of life. Fundamental changes are needed in our values, institutions, and ways of living. We must realize that when basic needs have been met, human development is primarily about being more, not having more. We have the knowledge and technology to provide for all and to reduce our impacts on the environment. The emergence of a global civil society is creating new opportunities to build a democratic and humane world. Our environmental, economic, political, social, and spiritual challenges are interconnected, and together we can forge inclusive solutions.

Universal Responsibility

To realize these aspirations, we must decide to live with a sense of universal responsibility, identifying ourselves with the whole Earth community as well as our local communities. We are at once citizens

of different nations and of one world in which the local and global are linked. Everyone shares responsibility for the present and future well-being of the human family and the larger living world. The spirit of human solidarity and kinship with all life is strengthened when we live with reverence for the mystery of being, gratitude for the gift of life, and humility regarding the human place in nature.

We urgently need a shared vision of basic values to provide an ethical foundation for the emerging world community. Therefore, together in hope we affirm the following interdependent principles for a sustainable way of life as a common standard by which the conduct of all individuals, organizations, businesses, governments, and transnational institutions is to be guided and assessed.

PRINCIPLES

I. RESPECT AND CARE FOR THE COMMUNITY OF LIFE

1. *Respect Earth and life in all its diversity.*

- a. Recognize that all beings are interdependent and every form of life has value regardless of its worth to human beings.*
- b. Affirm faith in the inherent dignity of all human beings and in the intellectual, artistic, ethical, and spiritual potential of humanity.*

2. *Care for the community of life with understanding, compassion, and love.*

- a. Accept that with the right to own, manage, and use natural resources comes the duty to prevent environmental harm and to protect the rights of people.*
- b. Affirm that with increased freedom, knowledge, and power comes increased responsibility to promote the common good.*

3. *Build democratic societies that are just, participatory, sustainable, and peaceful.*

- a. Ensure that communities at all levels guarantee human rights and fundamental freedoms and provide everyone an opportunity to realize his or her full potential.*

b. Promote social and economic justice, enabling all to achieve a secure and meaningful livelihood that is ecologically responsible.

4. Secure Earth's bounty and beauty for present and future generations.

- a. Recognize that the freedom of action of each generation is qualified by the needs of future generations.*
- b. Transmit to future generations values, traditions, and institutions that support the long-term flourishing of Earth's human and ecological communities.*

In order to fulfill these four broad commitments, it is necessary to:

II. ECOLOGICAL INTEGRITY

5. Protect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain life.

- a. Adopt at all levels sustainable development plans and regulations that make environmental conservation and rehabilitation integral to all development initiatives.*
- b. Establish and safeguard viable nature and biosphere reserves, including wild lands and marine areas, to protect Earth's life support systems, maintain biodiversity, and preserve our natural heritage.*
- c. Promote the recovery of endangered species and ecosystems.*
- d. Control and eradicate non-native or genetically modified organisms harmful to native species and the environment, and prevent introduction of such harmful organisms.*
- e. Manage the use of renewable resources such as water, soil, forest products, and marine life in ways that do not exceed rates of regeneration and that protect the health of ecosystems.*
- f. Manage the extraction and use of non-renewable resources such as minerals and fossil fuels in ways that minimize depletion and cause no serious environmental damage.*

6. Prevent harm as the best method of environmental protection and, when knowledge is limited, apply a precautionary approach.

- a. Take action to avoid the possibility of serious or irreversible environmental harm even when scientific knowledge is incomplete or inconclusive.*

- b. Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm.*
- c. Ensure that decision making addresses the cumulative, long -term, indirect, long distance, and global consequences of human activities.*
- d. Prevent pollution of any part of the environment and allow no build -up of radioactive, toxic, or other hazardous substances.*
- e. Avoid military activities damaging to the environment.*

7. Adopt patterns of production, consumption, and reproduction that safeguard Earth's regenerative capacities, human rights, and community well-being.

- a. Reduce, reuse, and recycle the materials used in production and consumption systems, and ensure that residual waste can be assimilated by ecological systems.*
- b. Act with restraint and efficiency when using energy , and rely increasingly on renewable energy sources such as solar and wind.*
- c. Promote the development, adoption, and equitable transfer of environmentally sound technologies.*
- d. Internalize the full environmental and social costs of goods and services in the selling price, and enable consumers to identify products that meet the highest social and environmental standards.*
- e. Ensure universal access to health care that fosters reproductive health and responsible reproduction.*
- f. Adopt lifestyles that emphasize the quality of life and material sufficiency in a finite world.*

8. Advance the study of ecological sustainability and promote the open exchange and wide application of the knowledge acquired.

- a. Support international scientific and technical cooperation on sustainability, with special attention to the needs of developing nations.*
- b. Recognize and preserve the traditional knowledge and spiritual wisdom in all cultures that contribute to environmental protection and human well-being.*

- c. Ensure that information of vital importance to human health and environmental protection, including genetic information, remains available in the public domain.*

III. SOCIAL AND ECONOMIC JUSTICE

9. Eradicate poverty as an ethical, social, and environmental imperative.

- a. Guarantee the right to potable water, clean air, food security, uncontaminated soil, shelter, and safe sanitation, allocating the national and international resources required.*
- b. Empower every human being with the education and resources to secure a sustainable livelihood, and provide social security and safety nets for those who are unable to support themselves.*
- c. Recognize the ignored, protect the vulnerable, serve those who suffer, and enable them to develop their capacities and to pursue their aspirations.*

10. Ensure that economic activities and institutions at all levels promote human development in an equitable and sustainable manner.

- a. Promote the equitable distribution of wealth within nations and among nations.*
- b. Enhance the intellectual, financial, technical, and social resources of developing nations, and relieve them of onerous international debt.*
- c. Ensure that all trade supports sustainable resource use, environmental protection, and progressive labor standards.*
- d. Require multinational corporations and international financial organizations to act transparently in the public good, and hold them accountable for the consequences of their activities.*

11. Affirm gender equality and equity as prerequisites to sustainable development and ensure universal access to education, health care, and economic opportunity.

- a. Secure the human rights of women and girls and end all violence against them.*

- b. Promote the active participation of women in all aspects of economic , political, civil, social, and cultural life as full and equal partners, decision makers, leaders, and beneficiaries.*
- c. Strengthen families and ensure the safety and loving nurture of all family members.*

12. Uphold the right of all, without discrimination, to a natural and social environment supportive of human dignity, bodily health, and spiritual well-being, with special attention to the rights of indigenous peoples and minorities.

- a. Eliminate discrimination in all its forms, such as that based on race, color, sex, sexual orientation, religion, language, and national, ethnic or social origin.*
- b. Affirm the right of indigenous peoples to their spirituality, knowledge, lands and resources and to their related practice of sustainable livelihoods.*
- c. Honor and support the young people of our communities, enabling them to fulfill their essential role in creating sustainable societies.*
- d. Protect and restore outstanding places of cultural and spiritual significance.*

IV. DEMOCRACY, NONVIOLENCE, AND PEACE

13. Strengthen democratic institutions at all levels, and provide transparency and accountability in governance, inclusive participation in decision making, and access to justice.

- a. Uphold the right of everyone to receive clear and timely information on environmental matters and all development plans and activities which are likely to affect them or in which they have an interest.*
- b. Support local, regional and global civil society, and promote the meaningful participation of all interested individuals and organizations in decision making.*
- c. Protect the rights to freedom of opinion, expression, peaceful assembly, association, and dissent.*
- d. Institute effective and efficient access to administrative and independent judicial procedures, including remedies and redress for environmental harm and the threat of such harm.*
- e. Eliminate corruption in all public and private institutions.*

- f. Strengthen local communities, enabling them to care for their environments, and assign environmental responsibilities to the levels of government where they can be carried out most effectively.*

14. Integrate into formal education and life-long learning the knowledge, values, and skills needed for a sustainable way of life.

- a. Provide all, especially children and youth, with educational opportunities that empower them to contribute actively to sustainable development.*
- b. Promote the contribution of the arts and humanities as well as the sciences in sustainability education.*
- c. Enhance the role of the mass media in raising awareness of ecological and social challenges.*
- d. Recognize the importance of moral and spiritual education for sustainable living.*

15. Treat all living beings with respect and consideration.

- a. Prevent cruelty to animals kept in human societies and protect them from suffering.*
- b. Protect wild animals from methods of hunting, trapping, and fishing that cause extreme, prolonged, or avoidable suffering.*
- c. Avoid or eliminate to the full extent possible the taking or destruction of non-targeted species.*

16. Promote a culture of tolerance, nonviolence, and peace.

- a. Encourage and support mutual understanding, solidarity, and cooperation among all peoples and within and among nations.*
- b. Implement comprehensive strategies to prevent violent conflict and use collaborative problem solving to manage and resolve environmental conflicts and other disputes.*
- c. Demilitarize national security systems to the level of a non-provocative defense posture, and convert military resources to peaceful purposes, including ecological restoration.*

- d. Eliminate nuclear, biological, and toxic weapons and other weapons of mass destruction.*
- e. Ensure that the use of orbital and outer space supports environmental protection and peace.*
- f. Recognize that peace is the wholeness created by right relationships with one self, other persons, other cultures, other life, Earth, and the larger whole of which all are a part.*

THE WAY FORWARD

As never before in history, common destiny beckons us to seek a new beginning. Such renewal is the promise of these Earth Charter principles. To fulfill this promise, we must commit ourselves to adopt and promote the values and objectives of the Charter.

This requires a change of mind and heart. It requires a new sense of global interdependence and universal responsibility. We must imaginatively develop and apply the vision of a sustainable way of life locally, nationally, regionally, and globally. Our cultural diversity is a precious heritage and different cultures will find their own distinctive ways to realize the vision. We must deepen and expand the global dialogue that generated the Earth Charter, for we have much to learn from the ongoing collaborative search for truth and wisdom.

Life often involves tensions between important values. This can mean difficult choices. However, we must find ways to harmonize diversity with unity, the exercise of freedom with the common good, short-term objectives with long-term goals. Every individual, family, organization, and community has a vital role to play. The arts, sciences, religions, educational institutions, media, businesses, nongovernmental organizations, and governments are all called to offer creative leadership. The partnership of government, civil society, and business is essential for effective governance.

In order to build a sustainable global community, the nations of the world must renew their commitment to the United Nations, fulfill their obligations under existing international agreements, and support the implementation of

Earth Charter principles with an international legally binding instrument on environment and development.

Let ours be a time remembered for the awakening of a new reverence for life, the firm resolve to achieve sustainability, the quickening of the struggle for justice and peace, and the joyful celebration of life.

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Appendix C

PASSIVE SOLAR DESIGN

A Simple Design Methodology for Passive Solar Architecture

By Dennis R. Holloway (*the die-hard solar architect!*)

For more information see:

www.dennishollowayarchitect.com

Author's Note : The following information is a precipitation of knowledge acquired through my practice and research in the 1970's regarding the use of solar energy to 'passively' heat and cool buildings. I believe that continuing dissemination of this information through the Internet is very important in a time when earth's bio-environment is so endangered by the continued combustion of fossil fuel into the atmosphere. Please copy this page and distribute it freely.

The ancient discovery that the shadow of a "gnomon"—an arrow stuck vertically into the ground—mirrored the perfectly symmetrical path of the sun across the sky is as important to the development of civilization as the discovery of the wheel. By studying the movements of this shadow people first conceived of the 90° (right) angle—the foundation of geometry, and ultimately of architecture. A result of this

"shadow science" origin is that most architecture and city street grids are related to the north-south east-west axes. The ancients also gained great insights into the potential of architecture to modify the sun's shadow and radiant heat.

Indeed, using the sun as a heat source is nothing new. In **XENOPHON'S MEMORABILIA**, written 2400 years ago, **Socrates** observed:

"Now in houses with a south aspect, the sun's rays penetrate into the porticos in winter, but in the summer, the path of the sun is right over our heads and above the roof, so that there is shade. If then this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the winter winds. To put it shortly, the house in which the owner can find a pleasant retreat at all seasons and can store his belongings safely is presumably at once the pleasantest and the most beautiful."

While the Greek house that Socrates described probably lost heat as fast as it was collected, due to convective and radiation losses, the Romans discovered that if the south-facing portico and windows were covered with glass, the solar energy would be trapped causing the internal temperature to stay constant into the night. This simple phenomenon called the "greenhouse effect" is illustrated by the experience of returning to your car on a sunny, cool day and finding it overheated. Today we call the house that uses the greenhouse effect for heating a "passive solar house."

It is a common rule-of-thumb that, compared to a conventionally designed house of the same square footage, a well-designed passive solar house can reduce energy bills by 75% with an added construction cost of only 5-10%. In many parts of the U.S. passive solar houses do not require any auxiliary energy for heating and cooling. Given current and future projected fuel costs, the additional construction cost is recovered quickly. Official surveys show 100,000 passive solar homes in the U.S.(1984), but informal estimates bring to one million the number of buildings that employ some aspects of passive solar design, often south-facing greenhouses.



Figure 1: Potential for passive solar heating in the United States.

Characteristics of a Passive Solar House

The Passive Solar House has some distinctive design features:

1. In the northern hemisphere most of its windows are facing the south (in the southern hemisphere its windows face north). Solar radiation, mostly the visible light spectrum, passes through the solar-oriented glass of windows or solar spaces, and is absorbed by surfaces of materials inside the insulated envelope of the building. As these heated surfaces re-radiate the energy into the interior of the house, the air temperature rises, but the heat is not efficiently re-radiated outside again through the glass, nor can the heated air escape, so the result is entrapped energy.
2. Ideally, the interior surfaces that the light strikes are high density materials, such as concrete, brick, stone, or adobe. These materials, because of the "flywheel" effect (the ability to absorb energy and re-radiate it over time), can store the energy for

constant slow re-radiation, resulting in a very smooth temperature swing curve for the building, and reducing the possibility of overheating the air in the house. In this way a large portion of the houses' heating requirements can be supported by the sun.

3. In the early passive solar houses of the 70's, architects and builders tended to reduce window areas on the east, west, and north sides of the house in favor of southern orientation. This is still the general rule-of-thumb, but the introduction of energy conserving and radiation-modifying films, available in several major window lines (see Chapter 6, p. 57f), enables designers and builders to relax this rule. This is good news on sites with attractive views other than to the south. West windows are a source of high heat gain during the summer, and should be shaded. Generally, the house plan with a long east-west axis and optimized south-facing wall will be the best passive solar house.

4. Passive solar homes tend to be well insulated and have reduced air leakage rates, to keep the solar heat within the building envelope.

5. Since auxiliary heat requirements are greatly reduced in a passive solar home compared to a conventional home, smaller, direct-vented units or a woodstove for extended cloudy periods are often the heaters of choice.

6. Passive solar homes often have "open floor plans" to facilitate the "thermo siphoning" movement of solar heat from the south side through the rest of the house. Sometimes small fans are used to aid in warm air distribution in houses with "closed floor plans".

Passive Solar Techniques 1: Direct Gain

There are two basic ways passive solar houses gain solar energy, direct and indirect gain. Direct gain houses, considered to be the simplest type, rely on south-facing windows, called solar windows. These can be conventionally manufactured operable or fixed windows on the south wall of the house or standard-dimension insulating glass panels in the wall of the sunspace or solarium. While some of the heat is used immediately, walls, floors, ceilings, and furniture store the excess heat, which radiates into the space throughout the day and night. In all cases the performance and comfort of the direct gain space will increase if the thermal mass (concrete, concrete block, brick, or adobe) within the space is increased.



Figure 2: A direct gain passive solar house (Design by Dennis Holloway, Architect, for Ellen and Matt Champion)

J. Douglas Balcomb and his research team at Los Alamos National Laboratory recommend that the mass be spread over the largest practical area in the direct gain space. It is preferable to locate the thermal mass in direct sunlight (heated by radiation) but the mass that is located out of the direct sunlight (heated by air convection) is also important for overall performance. Thermal mass storage is as much as four times as effective when the mass is located so that the sun shines directly on it and it is subject to convective heating from warmed air as compared to only being heated by convection. The recommended mass surface-to-glass area ratio is 6 : 1. In general, comfort and performance increase with increase of thermal mass, and there is no upper limit for the amount of thermal mass.

Remember, covering the mass with materials such as carpet, cork, wallboard, or other materials with R-values greater than 0.5 will effectively insulate the mass from the solar energy you're trying to collect. Materials such as ceramic floor tiles or brick make better choices for covering a direct gain slab. Tiles should be attached to the

slab with a mortar adhesive and grouted (with complete contact) to the slab.

In direct gain storage thin mass is more effective than thick mass. The most effective thickness in masonry materials is the first four inches—thickness beyond 6" is pointless. The most effective thickness in wood is the first inch.

Locating thermal mass in interior partitions is more effective than exterior partitions, assuming both have equal solar access, because on the internal wall heat can transfer on both surfaces. The most effective internal storage wall masses are those located between two direct gain spaces.

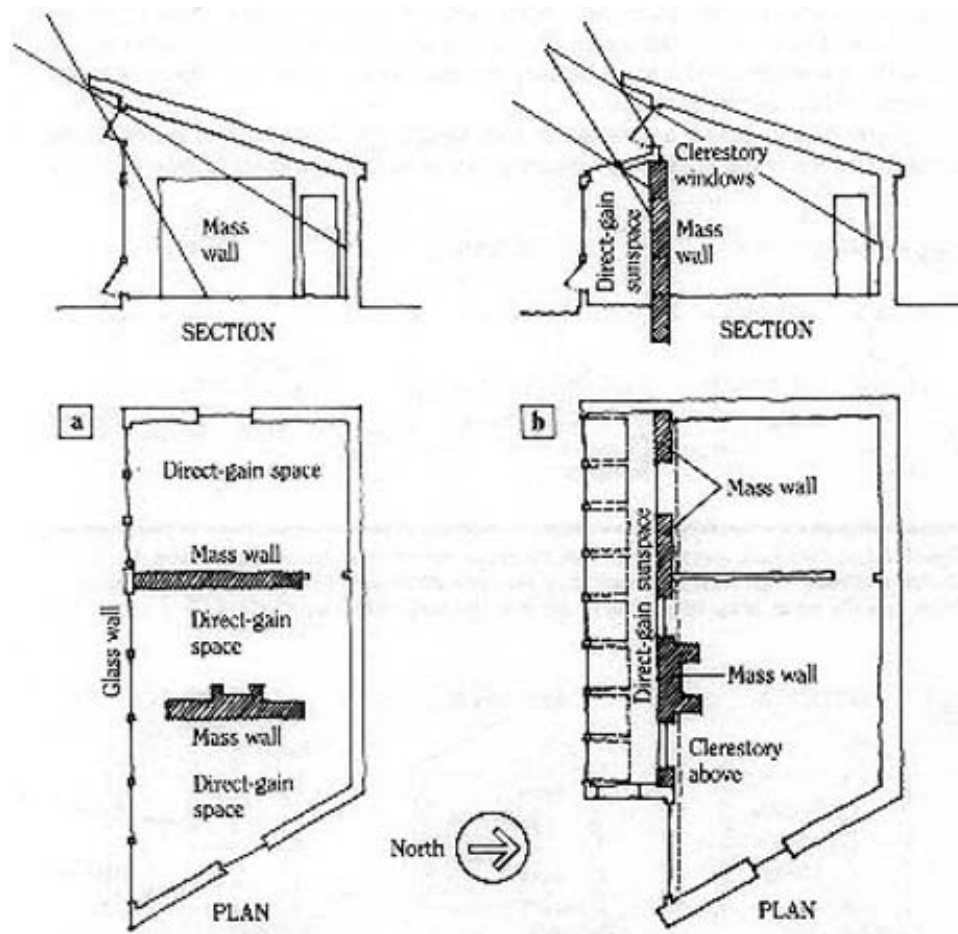


Figure 3: Internal mass storage walls serve as north-south partitions between direct-gain spaces (a) and as east-west partitions between direct-gain sunspaces and north clerestory space (b).

Lightweight objects and surfaces of low density materials should be light in color to reflect energy to high density materials. If more than one-half of the walls in a direct gain space are massive, then they should be light in color. If the mass is concentrated in a single wall, then its color should be dark—unless its surface is struck early in the day by sunlight, in which case its color should be light to diffuse the the light and heat into the rest of the space. Massive floors should be dark in

color to store the heat low. Clerestory windows should be located so that the sunlight strikes low into the space. If the sunlight from the clerestory first strikes high in the space, then the wall surface should be light in color to diffuse the light and heat downwards into the space.

In northern climates moveable insulation in the form of drapes, panels, shutters, and quilts often are used to cover the inside of the glass on winter nights to reduce heat loss. Because so much high-angle summer sun is reflected off vertical south-facing glass, heat gain is greatly reduced in the warm season, overhanging eaves for shading may not be as crucial as the early passive solar designers thought.

Since inhabitants will see out through the glass, this technique is good for the site with good southerly views. Some people object to the intense glare in direct gain rooms and fading of furniture fabrics can be a disadvantage. Privacy can also be a problem, since if the occupants can see out through the expanses of glass, the rest of the world can look in.

Besides providing warmth in the winter, a well-designed passive house should provide coolth and good ventilation in the summer. In some quarters there is a stubbornly persistent myth, a holdover from the news media coverage of some of the early passive houses, that overheating in summer is common in these houses.

Architects and builders have discovered that a two-storey solar space or greenhouse, adjoining the main house, with operable vent windows near the top and bottom of the space can be used to create natural ventilation for the house during summer. When the windows are open on a sunny day, the rising mass of warmed air is allowed to escape through the opened top vents which in turn draws in cooler air through the lower vents or through windows in the adjacent house. Called the chimney effect, this principle, employed to cool the Indian Tipi, can also keep your passive solar house cool in any U.S. summer climate without the use of powered fans or mechanical air-conditioning.

Shading devices used on the south side of the house can also help. Pull-down shades or canvas awnings on the outside of the glass of the south-facing windows, solarium, and trombe walls can greatly reduce house heat gain. Deciduous trees and shrubs planted to cast shadows on solar-oriented glazing can also create a micro -

climate that is several degrees cooler than surrounding areas. When the leaves drop, winter sun can shine into the house.

Direct-Gain Sunspaces

A popular direct gain heating strategy is the sunspace. Many homeowners claim this room becomes the favorite space in the house with its spacious outdoor feeling. The sunspace/greenhouse can, if properly designed and sited, provide as much as 50% of the house's heating requirements. In this situation, living spaces are better located on the south side with spaces (like bedrooms) not requiring as much heat to the north. Clerestory windows can be used in larger houses where it is important to get sunlight into the northside rooms.

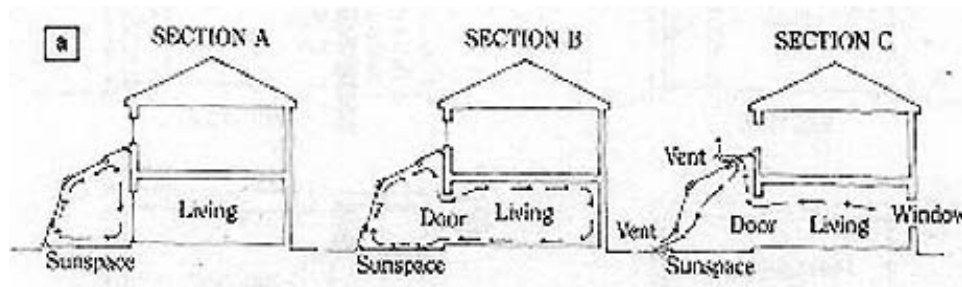


Figure 4a: One-story sunspaces: winter, sunspace cut off from the house (Section A); winter, sunspace helps the lower story via open doors (Section B); summer, sunspace helps cool the lower story by pulling in air from the north windows (Section C).

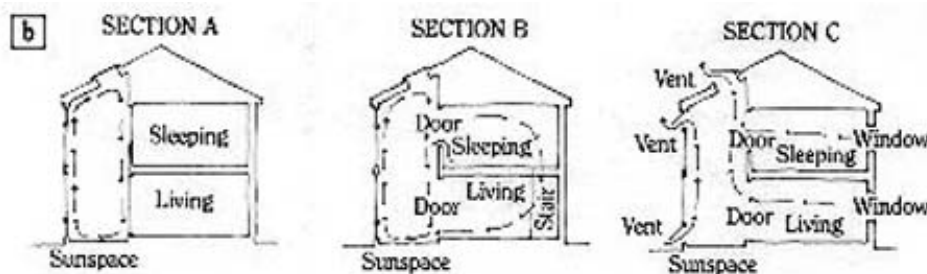


Figure 4b: Two-story sunspace: winter, sunspace cut off from the house (Section A); winter, sunspace helps heat both stories of the house (Section B); summer, sunspace helps cool both stories (Section C).

If you plan to include a sunspace in your design, you'll first need to decide on the primary function of the space. The design considerations for a food-growing greenhouse, a living space and a supplementary solar heater are very different, and although it is possible to build a sunspace that will serve all three functions, compromises will be necessary.

The Sunspace / Greenhouse

A greenhouse, for instance, should be a comfortable and healthy home for plants. Plants need fresh air, water, lots of light, and protection from extreme temperatures. Greenhouses consume considerable amounts of energy through evapotranspiration and the evaporation of water. One pound of evaporating water uses about 1,000 BTU's of energy that would otherwise be available as heat.

To stay healthy and free of insects and disease, plants need adequate ventilation, even in winter. There are air handling systems such as air-to-air heat exchangers that ventilate while retaining most of the heat in the air, but these add significantly to the cost of the project. The light requirements of a space for growing plants call for overhead glazing which complicates construction and maintenance, and glazed end walls, which are net heat losers.

There will be some economic gains from reduced grocery bills if you grow vegetables, and certainly there is much to be said for the sense of satisfaction that

comes with increased self-reliance and the aesthetics of a roomful of healthy plants attached to your house. The bottom line in terms of energy efficiency, however, is that a sunspace designed as an ideal horticultural environment is unlikely to have any energy left for supplementary space heating.

Solar Heat Collector

If the purpose of the sunspace is to collect solar heat and distribute it effectively to the adjacent living space, you're faced with a different set of design criteria. Maximum gain is achieved with sloped glazing, few plants, and insulated, unglazed end walls.

Remember that you'll get more usable heat into your living space if there aren't plants and lots of mass soaking it up in the sunspace. Sun-warmed air can be moved into the house through doors or operable windows in the common wall, as well as blown through ductwork to more remote areas.

Living Space

If your sunspace will be a living space, you'll need to consider comfort, convenience, and space in addition to energy efficiency. A room you plan to live in must stay warm in the winter, cool in the summer, have minimum glare levels, and moderate humidity.

Vertical glazing is the choice of increasing numbers of designers for a variety of reasons. First of all, although sloped glazing collects more heat in the winter, it also loses significantly more heat at night, which offsets the daytime gains. Sloped glazing can also overheat in warmer weather, usually the spring and fall, when you don't want the gain.

The performance of a vertical glazed south wall more closely follows the demands of heating degree days, heating effectively in winter when the angle of the sun is low and allowing less solar gain as the sun rises toward its summer zenith. A well-designed overhang may be all that's necessary to keep the sun out when it's not needed. Vertical glazing is also cheaper and easier to install and insulate, and is not as prone to leaking, fogging, breakage and other glazing failures.

A sunspace designed for living requires carefully sized thermal mass, and, as we

mentioned earlier, special care must be taken to assure that the sun can get to the mass. A masonry floor covered with carpets and furniture is obviously not as effective a thermal mass as masonry sitting in direct sunlight.

Once the sun goes down, the same windows that collected heat all day begin to reradiate heat to the outdoors. To minimize nighttime losses and maximize comfort (the human body also radiates heat to a cool surface), you may want to include movable window insulation in your design or investigate some of the new high tech glazings now commercially available

Design Guidelines

Regardless of the design strategy you choose, there are some other criteria that are important to consider. Much of the following information is taken from *The Sunspace Primer: A Guide to Passive Solar Heating*, by Robert W. Jones and Robert D. McFarland, (Van Nostrand Reinhold Co., New York, New York, 1984).

Glazing:

The ideal orientation for the glazing in your sunspace is due solar south, although an orientation within 30° east or west of due south is acceptable. For maximum solar gain, the glass should be tilted 50-60° from the horizon. Many designers, depending on their design strategy, prefer vertical glazing, or a combination of vertical and sloped glazing.

Vertical south-facing glass has advantages over angled glazing in not having to be sealed against water leakage and in its capacity to reflect unwanted (high angle) summer sun, but its winter performance is 10-30% lower than tilted glass of the same area. (Vertically glazed space, can be used like most other rooms in the house, whereas tilted glazing results in head height problems sometimes). The efficiency of a sunspace that combines vertical and some angled roof glazing will be higher than the vertically glazed sunspace, while retaining the advantages of vertical glazing. Rain and snow will clean the outside of the tilted glass pretty well, whereas vertical glass has the same maintenance problems as house windows. A two-to-three foot wide edging of pea gravel below sunspace glazing that is close to the ground, will prevent soil from splashing onto the glass, which can reduce efficiency.

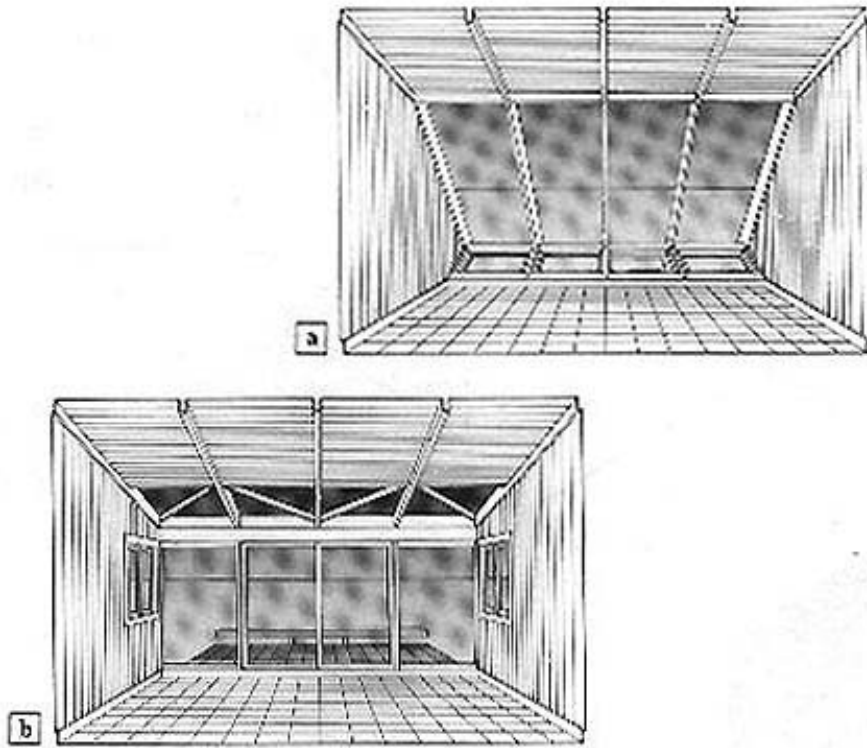


Figure 5: Sunspace with sloped south-wall glazing over reverse-slope vent windows (a). Sunspace with vertical south-wall glazing (sliding door), side venting windows, and sloped roof glazing (b). (Design by Dennis Holloway, Architect)

Heat Storage:

If the sunspace is deeper than it is high, the space itself will trap the radiation, so lighter surface colors are acceptable. Otherwise, the surfaces of heat storage materials (thermal mass) should be dark colors of at least 70 percent absorptance. To give you some perspective on the relative absorptance of various colors, black has an absorptance of about 95 percent, a deep blue about 90 percent, and deep red

about 86 percent. Non-storage materials should be lighter colors, so they will reflect light to the thermal mass that isn't in the sun.

The floor, north wall, and east and west side walls are good locations for mass walls, which should be materials with a high thermal conductivity such as concrete, water, brick, adobe, or rammed earth. "Light weight" concrete is not acceptable as a thermal mass material, and concrete is most effective in 4 to 6 inch thicknesses. If concrete blocks are used, the cores must be grouted solid.

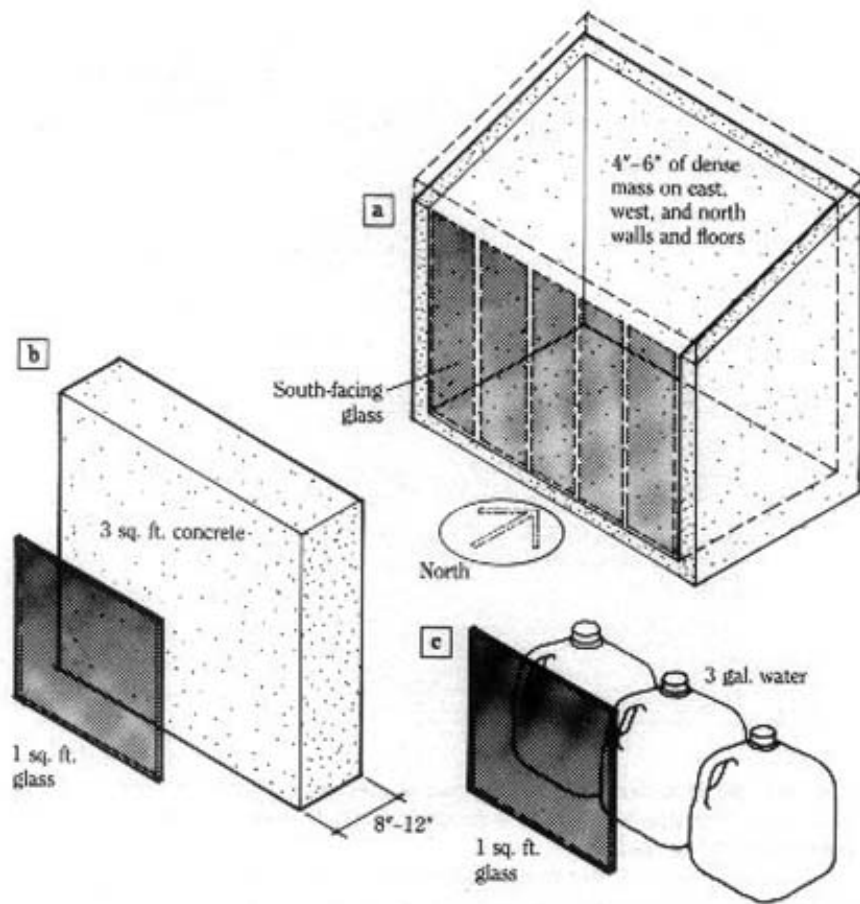


Figure 6: Sunspace thermal storage (a) Provide 3 square feet of concrete (b) or 3 gallons of water (c) for each square foot of glazing.

If the masonry floor and wall mass are the only thermal storage materials in the space, three square feet of masonry surface per square foot of south glazing is the

recommended ratio. If water in containers is the only heat storage medium used, the recommended ratio is three gallons per square foot of glazing.

Increasing the amount of mass will stabilize the internal temperatures, making the space more comfortable for people and plants. A common strategy is to use an 8 to 12 inch uninsulated masonry wall as the north wall of the sunspace. The wall is left uninsulated so that the heat from the sunspace can be conducted through to the interior of the house.

Conservation

If the sunspace is to be used for growing plants or as a living space, a minimum of double glazing is recommended. Single glazing loses a great deal of heat at night, and will make the space uncomfortable for plants and people. Movable insulation or a higher-R glazing system will greatly improve the performance of the glazing.

Either of these options add to the cost of the project, and the obvious disadvantage of movable insulation is that someone has to move it every day, and some designers refuse to use it because of an "objectionable appearance"—something this industry has not been creative about. On the other hand, it is possible to have the insulation controlled automatically with motors and thermostats, and insulation can provide privacy, summer shading, and increased comfort on cold winter nights.

Distribution

To distribute the warmed air from the sunspace to the rest of the house, openings are strategically placed in the common wall between the sunspace and the interior living space. Heat is transferred by the "thermosiphoning" circulation of the air. Warm air rises in the sunspace, passes into the adjoining space through the opening and cool air from the adjoining space is drawn into the sunspace to be heated as the cycle repeats.

If the openings are 6'8" doors, the minimum recommended opening is 8 square feet of opening per 100 square feet of glazing area. If two openings are used—one high in the sunspace, one low—with 8 vertical feet of separation, the recommended minimum area for each opening is 2.5 square feet per 100 square feet of glazing.

Controls

Sunspaces can radically overheat resulting in dead plants and unusable living spaces if operable vents are not included in the overall design. As we mentioned, overheating is most likely to occur in the late summer and early fall, when the sun is lower in the sky and the outside air temperature is still warm during the day.

Vents are placed at the top of the sunspace where the temperature is the highest, and at the bottom of the space where temperatures are the lowest to induce the chimney effect. Thermostatically controlled motors can be installed to open the vents automatically if no one will be home to operate them.

These paired vents should be sized according to the following specified fraction of the sunspace glazing area. The required vent area is a function of the glass slope, the vertical distance between the top and bottom vents (stack height), and the rise in internal temperature over outdoor temperature that can be tolerated in the sunspace. The last column in the chart gives fan sizes that will provide the same ventilation.

Few design strategies offer the aesthetic appeal and practical paybacks that a carefully thought out and constructed sunspace does. In our view, it is money well spent to take your preliminary design to a solar engineer or architect for feedback and a computer analysis. It is much less expensive to make changes on paper than to alter a design once it's built.

Passive Solar Techniques 2: Indirect Gain

The second passive solar house type, indirect gain, collects and stores energy in one part of the house and uses natural heat movement to warm the rest of the house. One of the more ingenious indirect gain designs employs the thermal storage wall, or Trombe wall placed three or four inches inside an expanse of south facing glass. Named after its French inventor, Felix Trombe, the wall is constructed of high density materials—masonry, stone, brick, adobe, or water-filled containers—and is painted a dark color (like black, deep red, brown, purple or green) to more efficiently absorb the solar radiation.

Some designers use "selective surface" materials, chrome-anodized copper or aluminum foils with adhesive backing that can increase the absorptive efficiency of

the wall to 90%, compared to 60% for a painted surface. These materials allow the wall to absorb radiant heat, but drastically reduce the amount of heat that is lost by radiation to the outdoors at night.

Some builders have had difficulty getting good adhesion between commercially available selective surface foils and the Trombe wall. According to the July 1, 1985 Solar Energy Intelligence Report, Los Alamos National Laboratory is testing a selective surface paint that may hold promise. If you would like to know more about it, contact the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703)487-4600, and ask for the report on "Thickness Insensitive Selective Surface Paint." The paint can be brushed or sprayed on, and performs in range of 10-20 percent better than flat black paint.

Heat collected and stored in the wall during the day, slowly radiates into the house even up to 24 hours later. The Trombe wall allows efficient solar heating without the glare and ultra-violet light damage to fabrics and wood trim that is common in direct gain solar homes. Trombe walls also afford privacy in situations where that is an issue.

Perhaps the most useful book on passive solar design for owner-builders is **THE PASSIVE SOLAR ENERGY BOOK**, by **Edward Mazria**, who makes the following recommendations for sizing the Trombe Wall: "In cold climates (average winter temperatures 20o to 30o F) use between 0.43 and 1.0 square feet of south-facing, double-glazed, masonry thermal storage wall (0.31 and 0.65 square feet for a water wall) for each one square foot of floor space area. In temperate climates (average winter temperatures 35o to 45o F) use between 0.22 and 0.6 square feet of thermal wall (0.16 and 0.43 square feet for a water wall) for each one square foot of space floor area."

Trombe Wall Vents:

In several of the earliest published Trombe wall houses, small vents were used in the top and bottom of the wall; heated air in the wall air space would rise and pass through the upper vent into the high space of the room, while cooler air from low in the room would be drawn into the wall air space through the low wall vent to form a convective heating loop. This is particularly effective in a building where heat is required quickly. The convective movement of air in the wall results in a

significant decrease in efficiency over time. Vented Trombe walls are known to be only about 5% more efficient, overall, than non-vented Trombe walls. Therefore, for residences, non-vented Trombe walls are recommended.

Designing the Passive Solar House

When the term, "passive solar" was introduced into the language of professional solar researchers in the 1970's, most people didn't have a vague notion what it meant. Later, as the term was popularized by the media and through a large number of public educational conferences, people probably thought that if they wanted to build a passive solar house they would have to hire not only an architect, but a professional solar engineer capable of manipulating very complex mathematical equations on a computer.

Today, thanks primarily to knowledge gained from government-funded research and a large number of completed "pioneer" passive solar houses that we've collected data from, we are at the stage where even a high school student can design a passive solar structure. Following is a composite of recently published information to get the owner-builder on the path to owner-designing the passive solar house.

Passive Solar Preliminary Design Rules of Thumb

Orientation:

Remember that "solar south" is different from "magnetic south." The longest wall of the house should ideally be facing due (solar) south to receive the maximum winter and minimum summer heat gains. However, the south wall can be as much as 30° east or west of solar south with only a 15% decrease in efficiency from the optimum.

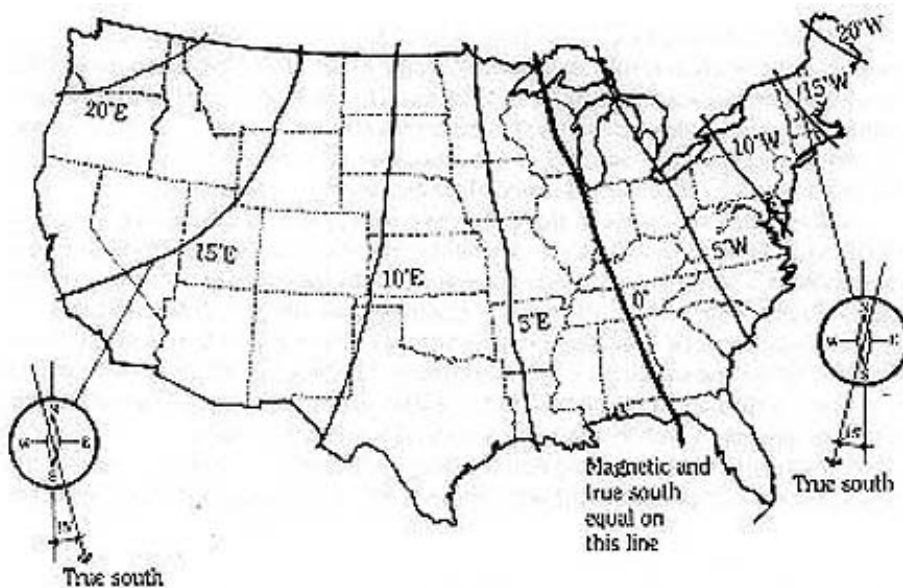


Figure 7: When designing a solar home, you must locate true (solar) south, not magnetic south. This map shows how magnetic south varies from true south in different parts of the United States.

Buffer Zone:

Design your house so that rooms with relatively low heat and light requirements, those that get infrequent use (storage, utility room, garage, e.g.), and those rooms that generate high internal heat (kitchen) are located on the north side of the house to reduce winter heat load.

In 1983 J. Douglas Balcomb and the research team at Los Alamos National Laboratory issued a set of direct gain and indirect gain design guidelines for heating passive solar houses located in the U.S. They included information on infiltration rates and selecting R-values for the walls, ceiling, perimeter, and basement. They also made suggestions about what kinds of glazings to use for east, west and north windows, as well as about how to size the solar collection area.

The technique is not a substitute for more rigorous computer-simulated thermal analysis by a professional engineer, but it gives owner-builders a solid basis for the

schematic design decisions. It is an elegant if oversimplified tool for deciding on a good mix of conservation and passive solar strategies based on geographical location. The five-step technique has been distilled from theoretical analysis and from data collected at actual passive solar houses.

STEP 1: Conservation Levels

Locate your building site on the map (Figure 8) to select the Conservation Factor (CF) to be used in your house design. Note that for each geographic zone the CF is expressed as a range. If your fuel costs are high (and whose aren't nowadays!), select the highest number.

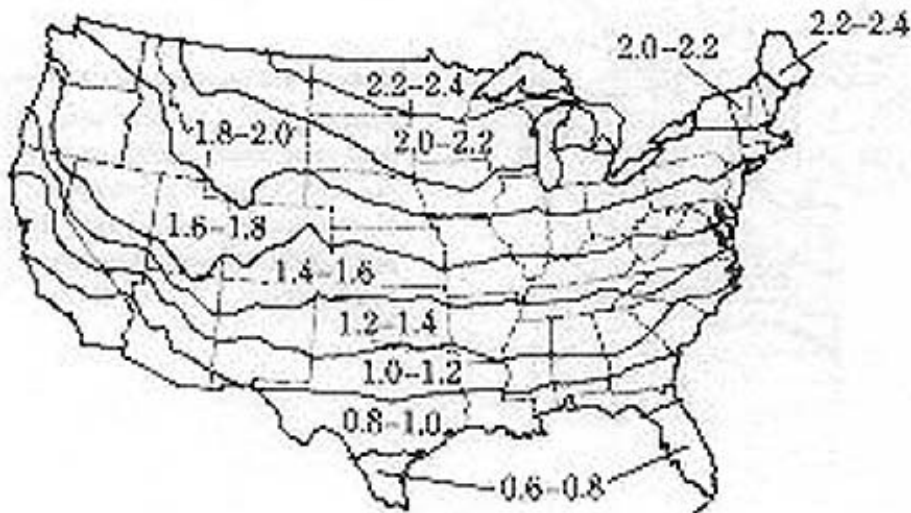


Figure 8: Use this map to find your conservation factor (CF). (Source: J. Douglas Balcolm, et al.)

STEP 2: Recommended Insulation Values and Infiltration Rates

Use the following formulas to determine insulation values and recommended infiltration rates. (CF is the conservation factor you selected in the first step.)

Wall R values: Multiply the CF by 14. This is the R-value for the entire wall, including insulation, siding, interior sheathing, etc.

Ceiling R-values: Multiply the CF by 22. This is the R-value for the entire ceiling, including insulation, finish surface, etc.

R-value of rigid insulation placed on the perimeter of a slab foundation: Multiply CF by 13. Subtract 5 from this number. Use the same value for the insulation of the floor above a crawl space or for the perimeter insulation outside an exposed stem wall.

R-value of rigid insulation applied to the outside of the wall of a heated basement or bermed wall: Multiply CF by 16. Subtract 8 from this number. Use this value for insulation extending to 4 feet below grade. Use half this R-value from 4 feet below grade down to the footing.

Target ACH (Air Changes/Hour): Divide .42 by the CF. If the result is lower than 0.5ACH, choose tight superinsulation techniques with controlled ventilation to maintain indoor air quality.

Layers of glazing on east, west, and north windows: Multiply the CF by 1.7, then choose the closest whole number. (If the number is 2.3, choose windows with three layers.) If the number exceeds 3, explore insulating glass and/or movable insulation.

Based on guidance from results of these formulas, select your conservation levels, trying to stay within 20% of the results. Your budget will be your best guide, but remember that conservation pays in the short and long run, so when in doubt, opt for higher conservation levels.

STEP 3: Net Load Coefficient

We next compute a Net Load Coefficient (NLC) . To do this, look up your home's geometry factor (GF) in Table 1 (below). For example, if the house will have a total floor area of nearly 3000 square feet on three stories, the GF will be 5.7.

Now multiply the GF by your house's floor area. Thus, if the floor area will be 2900 square feet and the GF is 5.7, you multiply these two values to get 16,530. Finally, divide this result by the CF. If your CF is 2.0, for example you would divide 16,530 by 2 to get 8265. This is your NLC.

Table 1: Geometry Factor, GF

GEOMETRY FACTOR (GF)				
Floor Area (sq. ft.)	Number of Stories			
	1	2	3	4
1,000	7.3	-	-	-
1,500	6.5	6.7	-	-
3,000	5.4	5.4	5.7	-
5,000	4.9	4.7	4.9	5.1
10,000	4.3	4.0	4.0	4.2

STEP 4: Load Collector Ratio

Locate your building site on the following Load Collector Ratio (LCR) map (Figure 9). This will give you the load collector ratio (LCR) for your home. Note that for each geographic zone, the LCR is expressed as a range. If your fuel costs are high, select the *lowest* number.

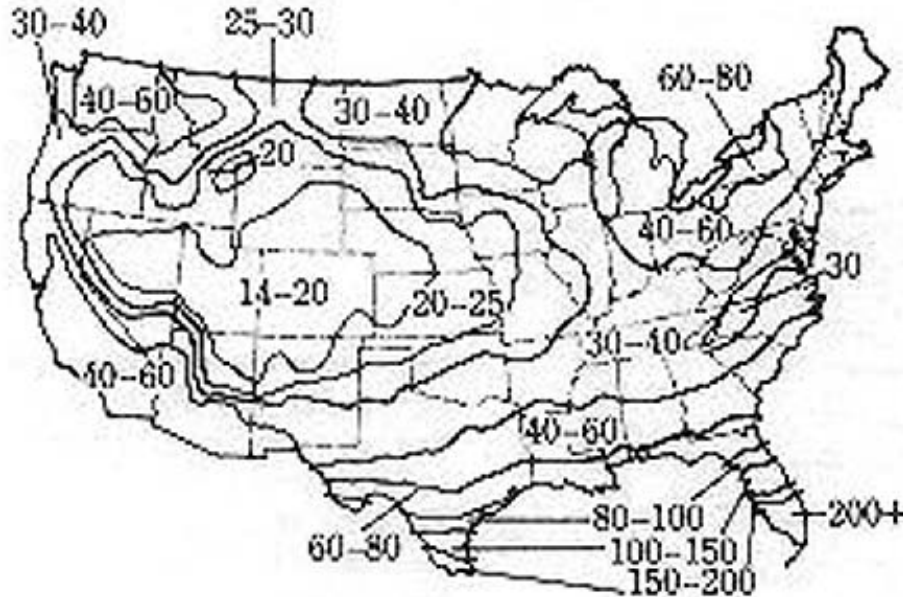


Figure 9: Use this map to find your load collector ratio (LCR). (Source: J. Douglas Balcomb, et. al.)

STEP 5: Passive Solar Glazing Area

To determine the area of the passive solar collector (Trombe wall, sunspace, etc.) for your home, divide the NLC (the number you got in step 3) by the LCR (the number you got in Step 4). For example, if your NLC is 8.265 and your LCR is 20, then your passive solar collector should have 423 square feet of south-facing glazing. You can round this number up or down by 10 percent (so the area could be as small as 370 square feet or as large as 450 square feet.) In hot climates, the areas should be adjusted downward by 20 to 30 percent.

Passive Solar Concepts

Elements most commonly used in passive solar homes to make maximum use of the sun's heat include direct-gain windows, direct gain glazed solariums, and

indirect-gain Trombe walls and mass wall. Each of these elements will influence the design because they have specific requirements.

"Direct-Gain" windows allow sunlight to enter the home directly. Much of the heat from the sunlight should be absorbed by some type of high-density material such as masonry; after sunset, the heat will flow out of this "thermal mass", helping to keep the house warm. Direct-gain windows should be oriented due south, although the orientation may be varied by as much as 30 degrees east or west of south without losing much efficiency. Southerly views from the building site become an important criterion in site selection—you don't want huge southern windows showing you unattractive views. Because many furniture fabrics and carpets are susceptible to fading in sunlight, and because these materials tend to prevent the light from reaching masonry floors where its warmth can be stored, you should keep such fabrics out of direct sunlight.

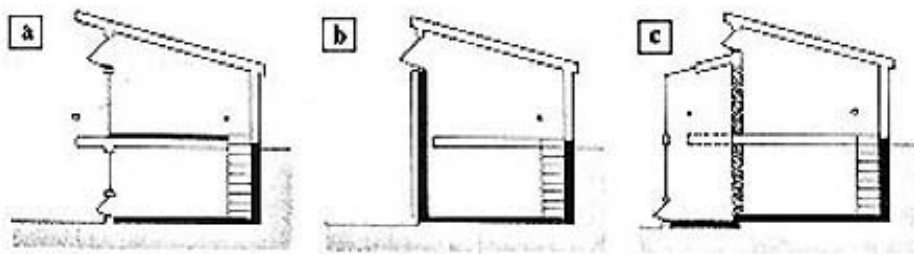


Figure 10: A large south-oriented glass wall and high vents (a); A Trombe wall (b); A two-story sunspace (c). Thermal mass is shown as solid black and speckled areas.

The direct gain solarium (otherwise known as a solar greenhouse or sunspace) is similar in concept to the direct-gain window, and the same orientation rules of thumb apply. The typical early solarium of the 1970s projected out from the house, like an addition, and was glazed on the south, east, and west sides as well as the roof. The south wall was typically sloped. Today's solarium has been modified for greater efficiency and typically is flush with the south wall of the house, thereby eliminating the loss of energy from the east and west walls. Surrounded by other spaces, the solarium space can be an effective focus for the house, functioning like a solar "hearth". To minimize the overheating common in the early style solarium, the

roof is not glazed and the south wall is vertical rather than sloped. The state-of-the-art solarium is sometimes a two-storey space, with French doors opening to rooms on both levels, allowing better circulation of solar-heated air throughout the house.

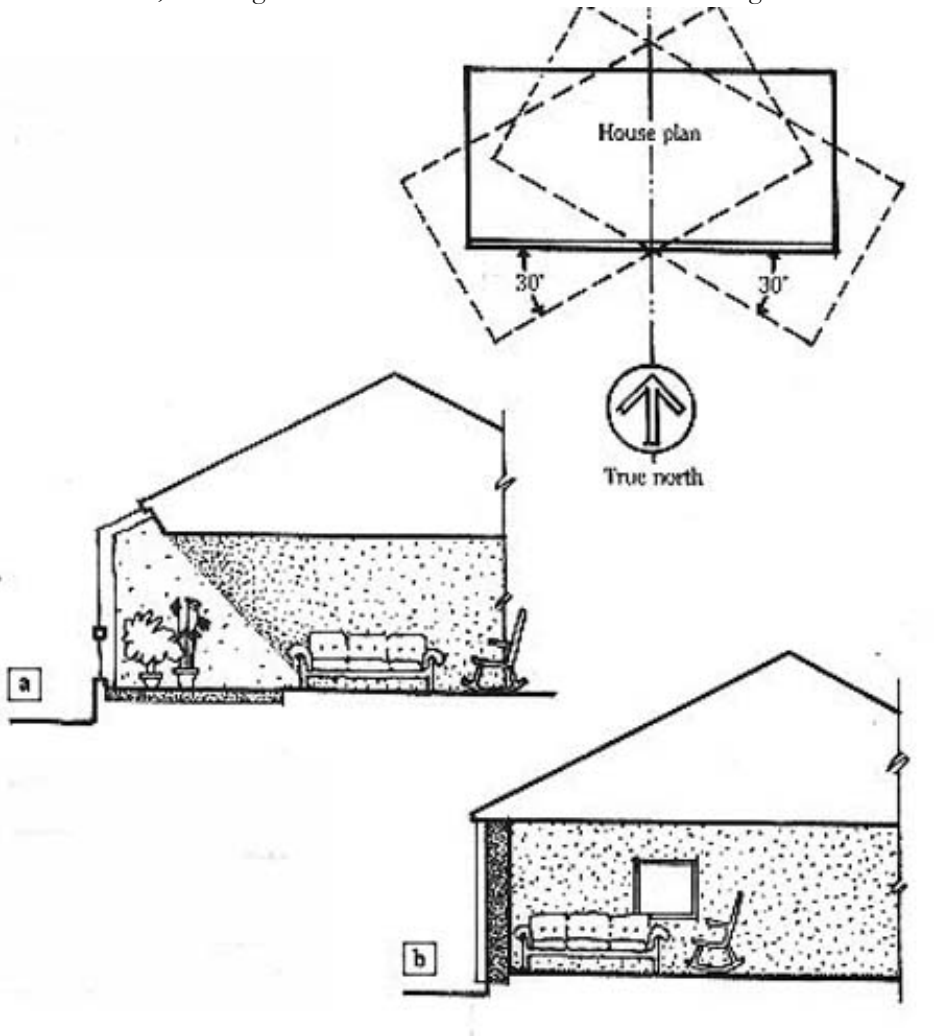


Figure 11: Orientation to true south in a passive solar house may vary by as much as 30 degrees east or west of south with relatively little loss of overall efficiency (top); A direct-gain system, such as

a sunspace (a), floods a space with light, which may cause fabrics to fade. An indirect-gain system, such as a Trombe wall (b), provides heat while blocking the light.

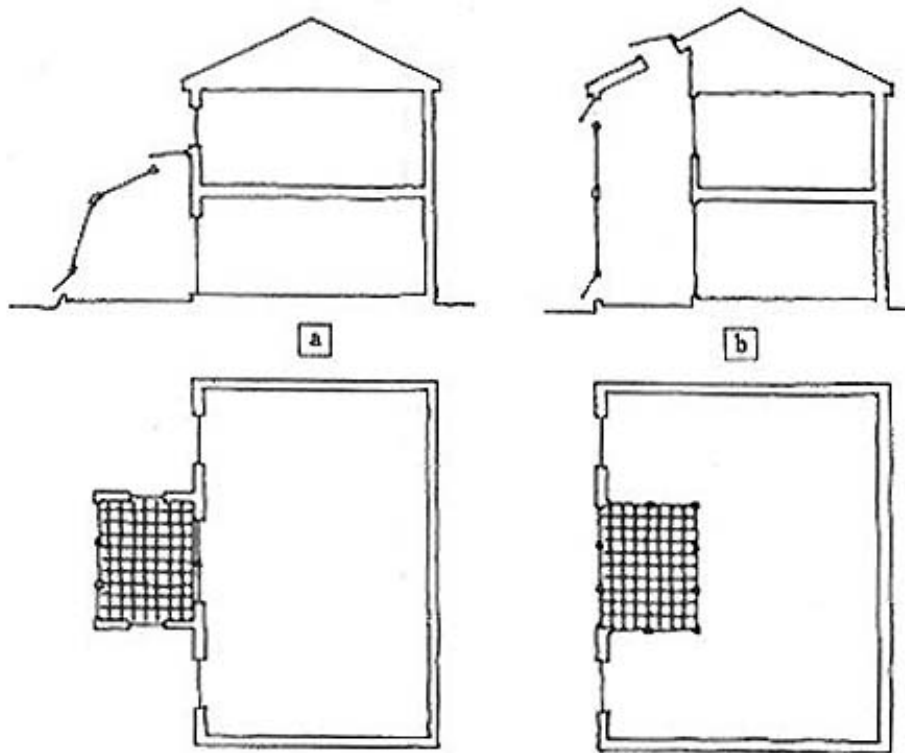


Figure 12: First generation sunspaces (a) usually protruded from the house. New sunspaces (b) are often two story designs set into a house's south wall.

A Trombe wall is a masonry wall with glazing spaced a few inches outside it. Solar heat is trapped between the masonry and the glass; it enters the house by migrating through the masonry. Whereas the direct-gain window and solarium are virtually transparent, creating strong spatial connections between indoors and outdoors, the Trombe wall obstructs views to the outdoors, so it works well on a site where a southern view is not desirable. If you do want a south view, however, you can place windows in a Trombe wall. Variations on the Trombe wall include half-Trombe

walls with direct-gain windows above, and Trombe walls with integral fireplaces. A Trombe wall can also be "bent" or shaped to fit the internal requirements of the floor plan.

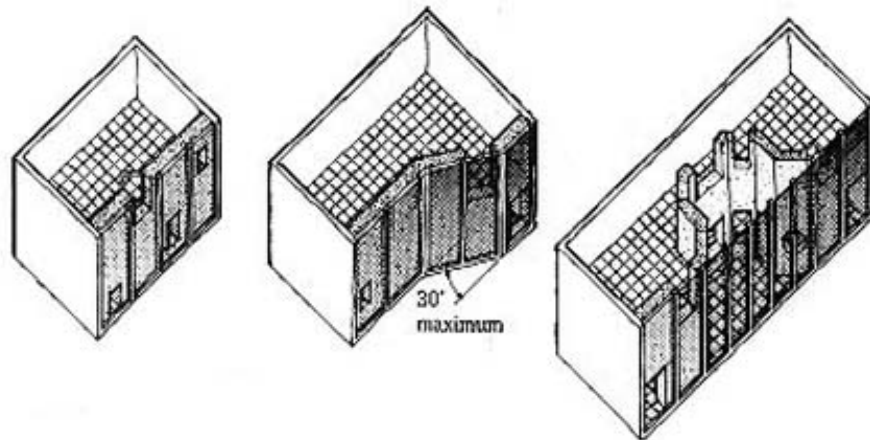


Figure 13: Trombe walls can be designed to fit virtually any south-facing wall.

The design of a multilevel passive solar house should take into account the fact that there will be some degree of heat stratification, with warmer upper level spaces and cooler lower level spaces. Thus the spaces on the upper level might include the living, cooking, and family activity areas where most of the waking hours are spent, and the lower level spaces could be used for sleeping. Although this "upstairs / downstairs" relationship seems unconventional to us, it offers a better view from the living space and is ideal for a hillside house with entry on the north side of the house and the north walls of the lower level sheltered by the hill.

The Future of Passive Solar Houses

The emergence in the 70's of the passive solar house, in all its variations, was a dramatic display of Yankee ingenuity applied to the national energy crisis, and our knowledge about the solar-thermal performance of buildings was extended by a quantum leap. But at this writing, the political pendulum and its news media has swung away from passive solar architecture, as the Federal solar tax credits quietly are put to bed.

With all the current talk of an emerging energy-glutted decade, the potential owner builder may wonder if making an energy efficiency statement in a new home makes any sense. We surely have to see through this cloud to know that energy shortfall in the 70's will pale by comparison to what lies ahead in the 90's. The growing movement of clear-sighted owner builders will continue to show the rest of the population that our living room comfort can, by connecting to our abundant ambient solar energy, release us from the tyranny of tenuous foreign energy supplies.

In a recent interview, Douglas Balcomb, our foremost passive solar researcher-spokesperson, said that the viability of passive solar has become an established fact, and the use of direct-gain spaces, sunspaces, and Trombe walls (in that order) will be with us for a long time.

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