BigPictureSmallWorld and the Buckminster Fuller Institute in collaboration with Global Education Motivators present

DESIGN SCIENCE LAB

Designing strategies for reaching the United Nation's Millennium Development Goals

A Report on the work of the Summer 2006 Design Science Lab
held at the United Nations and United Nations International School





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DESIGN SCIENCE LAB

Strategies for Reaching the Millennium Development Goals

Design Science Lab 2006, Volume I

A report on the work held at the United Nations and United Nations International School New York, New York, June 21–30, 2006

The Design Science Lab 2006 was presented by

BigPictureSmallWorld Inc., Media, PA, www.BigPictureSmallWorld.com
and the Buckminister Fuller Institute, Brooklyn, NY, www.bfi.org
in collaboration with Global Educational Motivators, Philadelphia, PA, www.gem-ngo.org
The New York Design Science Lab was directed by Medard Gabel of BigPictureSmallWorld Inc. and facilitated by David Heeney and Victoria Farmer of IndEco Strategic Consulting Inc., Eric Fedus and Chuck Michelson. The New York Lab was produced by Elizabeth Thompson of the Buckminster Fuller Institute with on-site coordination and assistance by Angela Molenaar.

New York Participants—June 2006

Bamini Balaji, Jean-Baptiste Bassene, Akeem Bello, Jennifer Bodenstab, Jon Brett, Yoshimi Brett, Ross Brockwell, Melissa Callender, Fabiola Carrasco, Kasia Chmielinski, Natasha Cline-Thomas, Ben Cohen, Sergio Cordiero, Gonzague de Raulin, Douglas Diaz, Kevin Dye, Easy, Daniel Eida, Sharif Ezzart, Victoria Farmer, Eric Fedus , Medard Gabel, Alexandra Heeney, David Heeney, Florence Johnson, Erica Jain, Wayne Jocoby, Erica Kane, Zane Kripe, Gabriel Kennedy, Fiona Kinniburgh, Jai Lakhanpal, James Lual, Kristina Mader, Morgan Maher, Ryan Martin, Marty McCrea, Chuck Michelson, Alexandra Montes, Aiesha Morris, Priyanka Pandit, Xena Parsons, Lexi Quint, Elizabeth Ramaccai, Ignez Renault, Stephen Rowley, Ariel Ruvinsky, Zoë Richards, Eric Rimpel, William Sheehan, Charles Sheldon, Elizabeth Thompson, David Walczyk, Vera Zago, Gregory Zuccolotto

The New York Design Science Lab Report compiled by Medard Gabel, BigPictureSmallWorld Inc., www.bigpicturesmallworld.com
Edited by Medard Gabel, Matt Barron of the Buckminster Fuller Institute, www.bfi.org, and Mary Gabel
Design by Mary Gabel, Gabel Graphics, Media, PA, www.gabelgraphics.com
Cover design by Jochen Hartmann of the Buckminster Fuller Institute

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Arunabha Ghosh, Human Development Report, UN Development Programme
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Above: Participants check in at the 2006 Design Science Lab at the United Nations International School in New York.
Right: Medard Gabel at the day's agenda and goals session.

INTRODUCTION: DESIGN SCIENCE

Design science is a methodology for changing the world. It involves the application of the principles and latest findings of science to the creative design and implementation of solutions to the problems of society. It is a way of recognizing, defining, and solving complex problems that is based on innovation and thrives on transparency. It takes a whole systems, global, and anticipatory approach that fosters creative collaboration and synergy in the development of comprehensive solutions to both global and local problems. It was inspired by the work of Buckminster Fuller and other planners, scientists, and visionaries.

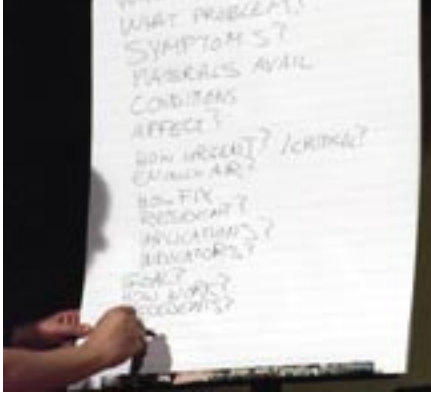
How is Design Science Different from Other Planning Processes?

Unlike many planning and political processes that compartmentalize issues and seek to develop solutions in a vacuum, Design Science stresses comprehenstive thinking based on a clear understanding of the state of the world, available resources, appropriate technology, culture, environmental constraints, and the interconnections between world problems and opportunities. The design science planning process provides a framework for devising solutions to current problems as well as anticipating future needs.

Design science is also different from other problem-solving and planning methodologies in its comprehensive, anticipatory, inclusive, and transparent approaches to the development of solutions. It takes a 'whole to particular' approach that is both global in perspective and in its examination of options. It seeks to build capacity rather than merely solve problems, and to develop solutions that are transformative rather than merely the reforming of already inadequate systems. It is informed by a moral vision that places a priority on designing ways of meeting unmet basic human needs in ways that are environmentally sustainable and socially just.

The core of this approach to problem solving and planning is both a concern with whole systems—the whole Earth, the entire history of the planet, the global economy, all of technology, and all of humanity; both those living now and those yet to be born—as well as a recognition that everything is implemented locally, and that the "whole" is merely the context for the local. Design science has both a global perspective and a local focus. It is the local upon which the success or failure of a particular design solution will thrive or die.

Design science is comprehensive in that it starts from the whole system and works back to the special case. It deals with all facets of a problem including the larger system of which the problem is a part; in this sense, design science seeks to build capacity, not just solve problems. It is anticipatory, in that it seeks to recognize the threats coming down the pike before they arrive full blown on an unsuspecting or ill-prepared society; and it deals with the way things are going to be when the solution is going to be implemented, not just the way things are in the present. It is a design strategy, in contradistinction to a political or 'let's pass-a-law-and-change-human-behavior' approach; it seeks to change the larger system of which the specific problem is a part through the introduction of innovative artifacts or policies.



This "comprehensive anticipatory design science" is at least as much a perspective on the problems of the world as it is a methodology for tackling those problems. When applied to contemporary problems, it can lead to strikingly fresh insights and solutions.

Design science is a tool that is based on a global perspective and a systems approach to the problems of the world. It assumes that globalization has made the world an ever more interconnected whole, and any successful problem solving of society's systemic ills needs to be an approach that is global, comprehensive, visionary, and based on science, not politics, ideology, or wishful thinking. The entire world is now the relevant unit of analysis, not the city, state, or nation. We are onboard, as Buckminster Fuller pointed out, "Spaceship Earth," and the illogic of 200+ nation state admirals all trying to steer the spaceship in different directions is made clear through this metaphor—as well in Fuller's more caustic assessment of nation states tending to act as "blood clots" in the world's global metabolism.

The design science process is augmented by vast quantities of statistical information about the state of the world, its resources, human trends, needs, and technology. With the advent of personal computers and the Internet this information became almost universally available—and with it, design science found its perfect complement. Coupled with the tools of the information age, design science gains the power to reach its potential. The Internet has not leveled the global playing field so much as expanded it, and the good-ol'-boy-status-quo-maintaining political process can now be subverted by a process that brings Thomas Jefferson into the twenty-first century.

In Fuller's words, design science is a process where individuals or teams of people can "make the world work, for 100% of humanity, in the shortest possible time, through spontaneous cooperation, without ecological offense or the disadvantage of anyone."

Making the world work for 100% of humanity reflects Fuller's global perspective as well as his values. We are not here just to make ourselves rich, famous, or top consumer of the day or decade, or here just for the 5% living in our part of the world; we are here for all humanity. The "spontaneous cooperation" is instructive in light of the previous discussion. The phrase does not read, "make the world work for 100% of humanity through a central government, or through enforced coercion by a strong military" but through a cooperation that arises from a fundamental transparency of society and its needs. If everyone knows what the situation is, has a clear vision of what should be and what needs to be done, we cooperate to get it done—as we do as a society in times of emergency.

Fuller said, "I am enthusiastic over humanity's extraordinary and sometimes very timely ingenuities. If you are in a shipwreck and all the boats are gone, a piano top buoyant enough to keep you afloat that comes along makes a fortuitous life preserver. But this is not to say that the best way to design a life preserver is

in the form of a piano top. I think that we are clinging to a great many piano tops in accepting yesterday's fortuitous contrivings as constituting the only means for solving a given problem."

Design science is a method for developing the life-preserving and enhancing solutions to society's problems.

—Medard Gabel,
BigPictureSmallWorld Inc.

Design Science Lab

The *Design Science Lab* is an intense, sometimes exciting, sometimes overwhelming workshop where the tools of design science are used by diverse groups to develop creative solutions to global and local problems and strategies for the implementation of those solutions. The Lab uses as its general frame of reference the United Nations Millennium Development Goals, a set of ambitious, but attainable milestones that, if implemented, will lead to a healthier, happier, more just, and more sustainable world by 2015.[1] It is our intention to hold at least one Design Science Lab each summer between now and 2015 that will focus on the development of strategies for achieving the UN Millennium Development Goals.

The first Design Science Lab took place in 2005 in New York City at the United Nations (UN) and the United Nations International School (UNIS). It included 25 high school and college students as well as working professionals ranging in age from 14 to 42. The participants in this Lab focused on addressing the UN Millennium Development Goal #1—to reduce by half those living in hunger and poverty by 2015. Their 11-part strategy for doing this can be downloaded free of charge or purchased in book form from www.designsciencelab.org. Eliminating Hunger, a short movie that presents the work of this Lab, can be seen at http://www.bigpicturesmallworld.com/movies/hunger/hunger1.html

The second year of the Design Science Lab replicated the global approach of the first lab, but also took the principles of the Lab to the local level. The Lab was conducted again in New York City, in the summer of 2006, at the United Nations and the United Nations International School. It had 55 participants ranging in age from 15 to 60. This group focused primarily on the Millennium Development Goals 2, 4, 5, 6 and 7 dealing with issues of global education, health, the environment, and energy. In addition to the New York program, the Design Science Lab was also held at the University of North Carolina in Asheville, from July 18 to 28. This Lab focused on the development of solutions to these "global" problems that can be implemented locally. Its 40 participants ranged in age from 14 to 73 and brought to the program their diverse interests and experiences. The written report of the bulk of their work is published in a separate document.[2]

Each of the 2006 labs lasted for ten very intense days, where the participants learned and applied the concepts and tools of design science to developing strategies to achieve the Millennium Development Goals (MDGs) and (in North Carolina) for achieving a more sustainable local community. Both programs had an orientation that took place at UN headquarters in New York (the North Carolina orientation took place via video conference). Lab participants were briefed by UN staff from the UN Development Programme, The Millennium Development Campaign, UNESCO, UNICEF, Department of Economic and Social Affairs, and others on the MDGs, their context, history, measurement, the progress made so far, and strategies in use for reaching them. The introduction to

design science and the Lab portion was conducted at the UN International School for the New York Lab and at the University of North Carolina for the North Carolina Lab. Lab participants in both programs typically worked ten to twelve hours a day.

On the last day of both Labs, participants returned to the UN (either in person or via video-conference) where they concluded the Lab with a presentation of their work to UN staff. An overview of this work is what is presented in this report.

Both Design Science Lab programs were put on by BigPictureSmallWorld and the Buckminster Fuller Institute, in collaboration with Global Education Motivators. Medard Gabel was responsible for the structure, content, and overall facilitation of the Labs. Elizabeth Thompson collaborated on overall structure and content. Other facilitators included David Heeney and Victoria Farmer from IndEco in Toronto Canada, plus Eric Fedua, Chuck Michelson, and Jeremy Bang.

The goals of the two Labs included:

- Learning about the Millennium Development Goals, their usefulness to the world, and how we can use them to make the world a better place
- Developing viable strategies for achieving one or more Millennium Development Goals
- Learning design science and how to apply it to global and local problems
- Increasing our understanding of global dynamics, world resources, human trends and needs, and options for humanity's success
- Increasing the public's understanding of these issues through disseminating the strategies as widely as possible
- Serve as an incubator and growing force for developing and disseminating design science techniques for complex problem solving and development of viable solutions to the world's problems
- Learning a methodology for changing the world.

Lab participant Akeem Bello, from Nigeria, takes the opportunity to sit in the seat of a UN delegate at the opening of the Design Science Lab.

In addition, the North Carolina Lab had as goals the following:

- Developing a new vision for the Asheville North Carolina region
- Generating a new way of addressing the problems and opportunities of the region, and to use the region as a model and test-bed for solutions that can be implemented throughout the world
- Bringing together a diverse group of elected officials, community activists, students, and citizens to focus on the region's sustainability and well-being
- Increasing the understanding of the Asheville North Carolina region's environment, resources, capacities and problems
- Increasing the involvement of local citizens in the development of solutions to local problems

DESIGN SCIENCE LAB SCHEDULE

Wednesday, June 21	5–7 P.M.	**Welcome and Introduction** **Ramu Damodaran,** Chief, Civil Society Section, UN Department of Public Information
Thursday, June 22	10 A.M.–1 P.M.	**State of the World: Energy and Environment** **Mandeep Baines**, Senior Policy Advisor, UN Millennium Campaign **Kathleen Abdala,** UN Department of Economic and Social Affairs: Energy and Transport Division **Karoly Kovacs**, UN Department of Economic and Social Affairs: Environment and Industrial Statistics Division **Marcia M. Brewster**, UN Department of Economic and Social Affairs: Sustainable Development Division **Elisabeth Clemens**, UN Development Programme
	2–5 P.M.	**State of the World: Environment** **Jim Sniffen,** Program Officer United Nations Environmental Programme **Vanessa Tobin**, United Nations Children's Fund **Aranubha Ghosh**, UN Development Programme: Human Development Report **Donna Goodman,** UNICEF, Program Advisor, Water, Environment and Sanitation Section
	6–8 P.M.	**Millennium Village Project** **Guido Schmidt–Taub,** UN Development Programme, Millennium Project: The Millennium Village
Friday, June 23	10 A.M.–1 P.M.	**State of the World: Health** **Margaret Carrington**, World Food Program **Dr. Richard Alderslade**, World Health Organization **Sergio Vieira,** UN Department of Economic and Social Affairs: Social Perspective Development Branch **Ellen Gustafson**, UN Food and Agriculture Organization, World Food Program

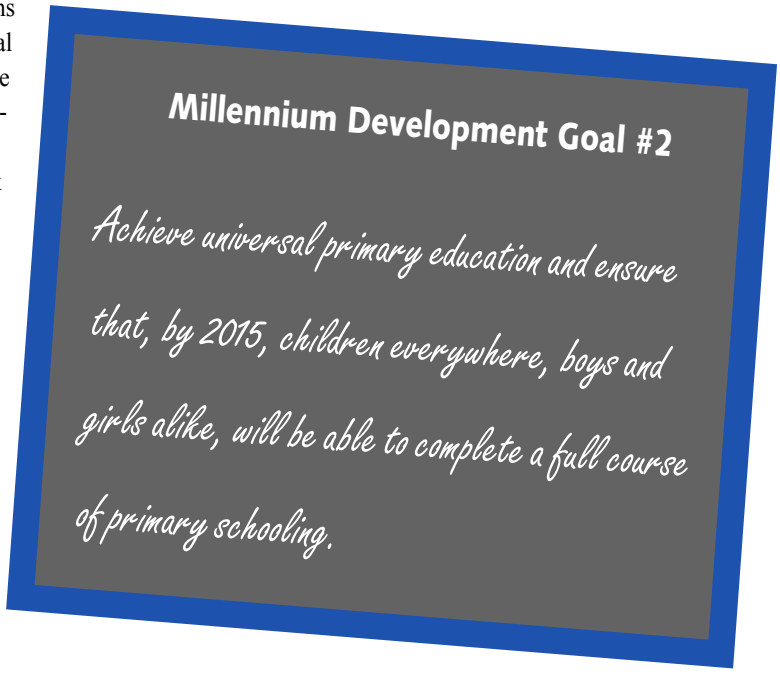
Friday, June 23	2–5 P.M.	**State of the World: Education** **Bill Yotive**, Global Teaching and Learning Project, UN Department of Public Information **Giorgia Passarelli**, Office of the United Nations High Commission for Human Rights **Suzanne Bilello**, UN Education, Science and Culture Organization **Changu Mannathoko**, UNICEF, Education Section
	6:30–8 P.M.	**Youth and Global Citizenship** **Julia Larson,** Millennium Development Campaign: Youth Movement
Saturday, June 24	10 A.M.–1 P.M.	**Design Science** **Medard Gabel,** Introduction to Design Science
	2–5 P.M.	**Design Science** **Medard Gabel,** Design Science Tools and Process
Sunday, June 25	9 A.M.–4 P.M.	Global/local design activity; Formation of design teams; Goal and success definitions
	4–5 P.M.	Day's summary
	7–9 P.M.	Evening program, *The World of Buckminster Fuller* film
Monday–Thursday, June 26–June 29		
	9–9:30 A.M.	Day's agenda and goals
	9 A.M.–4 P.M.	Design teams work
	4–5 P.M.	Day's summary/design teams' reports
	7–9 P.M.	Evening program
Friday, June 30	9–12 A.M.	Final preparation for presentations to the United Nations
	1–4 P.M.	Presentation to the United Nations
	6–6:30 P.M.	Closing ceremony

STRATEGIES FOR ACHIEVING THE MILLENNIUM DEVELOPMENT GOALS AND PREFERRED STATE

STRATEGIC AREA 1: EDUCATION/LITERACY

The Design Science Labs in both New York and North Carolina had teams that worked on strategies for reaching the Millennium Development Goal #2. This goal seeks to "Achieve universal primary education" and to "ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling."

The global education yeam in the North Carolina Lab built on the work of the earlier New York Lab. It did so in an integrative manner and so this report contains both Labs' work and is presented as one integrated whole, rather than as two separate chapters.



New York Design Science Lab Global Education Team
Fabiola Carrasco, Daniel Eida, Zane Kripe,
Kristina Mader, Priyanka Pandit, Xena Parsons, Lexi Quint,
Zoe Richards, Heath Robbins, David Walczyk

North Carolina Design Science Lab Global Education Team
Sarah Hausman, Reo Jones,
Alex Mackay, Patricia Major, Charvee Patel

EDUCATION FOR ALL FOR LIFE

> "If you think education is expensive, you should try ignorance."
>
> —Derek Bok

Strategic summary: Achieve universal primary education and 100% literacy by 2015, and provide affordable access to secondary, tertiary, and lifelong educational opportunities by 2026 through a combination of low-cost, mass produced "school-in-a-box" programs; community Internet hubs; mobile educational resource vehicles; wi-fi educational linkages and programs; sustainable technology for turning educational institutions into energy, food, and water producers; and a global coordinating agency that makes all the preceding available.

Introduction

The education work of the Design Science Lab 2006 was focused on demonstrating how, using present day technology, known resources, and limited financial wherewithal, illiteracy could be eliminated between now and 2015 (thereby achieving the Millennium Development Goal #2: Universal Primary Education), as well as providing affordable access to secondary, tertiary, and lifelong educational opportunities by 2026.

The overall strategy developed by the education teams in the Labs consisted of an interrelated six-part plan that, when aggressively implemented, would have a profound impact on the world. The results would include over 850 million people no longer suffering from illiteracy; as well as improved health, productivity, and longevity; higher employment and incomes for those in most need; and a world that is safer, more secure, stable, and immeasurably richer as more and more people become better and better educated and are able to participate in the creation of wealth.

The six parts of this strategic plan are:

- **School-In-A-Box 1.0, 2.0., and 3.0**
- **WE CAN: Worldwide Educational Cooperative for All Nations**
- **School Community eHub**
- **eMobile Educational Resources**
- **Wi-Fi for Education**
- **SEED: Synergetic Educational Experience and Development and Sustainable Schools**

The following pages describe these strategies.

Why Education?

The essence of education is empowerment. Without access to the global informational environment a person is denied access to many forms of power that can lead to self-, family-, community-, and global-

improvement. Literacy is the key to opening the doors needed for economic, social, and personal health and well-being. Although great strides have been made in the last 50 years, the global education situation is stained by the existence of 850 million people who are illiterate and over 100 million children who are not in primary school.

State of the World Education System

The work done by the education teams at the Design Science Lab in 2006 is embedded in a context of the global conditions surrounding the world's population and the global educational system that supplies that population with its education. The following basic facts lay out this context:

- World population in 2006: 6.5 billion
- 850 million people are illiterate; 95% of those people are in developing nations; 75% of these live in Sub-Saharan Africa and South and West Asia
- 70% of these people are women; they entered the twenty-first century unable to read a book or write their names[4]
- Over 1.5 billion adults are functionally illiterate
- Over 100 million children are not in primary school; 133 million young people cannot read or write (this is about 20% of the total number of children in this age group globally)
- There is a shortage of necessary school supplies, buildings, and teachers
- Girls make up 54% of the children without access to education, the majority being in Sub-Saharan Africa and South Asia; in those two regions alone, 87 million children are out of school.

> "Enlighten the people generally, and tyranny and oppressions of body and mind will vanish like evil spirits at the dawn of day."
>
> —*Thomas Jefferson*

- Failure to achieve gender equality in education by 2015 will contribute to over 10 million unnecessary child and maternal deaths over the next decade
- Many schools in the poorest regions of the world do not have separate toilet facilities for boys and girls. This situation is a serious impediment for young girls and their attendance at school
- 250 million children between the ages of five and fourteen work in developing countries—at least 120 million on a full time basis. 61% of these are in Asia, 32% in Africa, and 7% in Latin America. Most working children in rural areas are found in agriculture; urban children worked in trades and services, with fewer in manufacturing, construction, and domestic service. In extreme poverty situations, families lose money if their children go to school instead of working.[5]
- 4 to 5 billion people are without access to secondary, tertiary, and continuing education
- There are approximately 1.3 billion students enrolled in some form of school around the world (683 million students in primary education; 503 million students in secondary education; 132 million students in tertiary education)

- There are approximately 54 million teachers in primary, secondary, and tertiary schools around the world
- Teachers in parts of Africa are being paid the same now as they were 1975 (and given inflation, the net amount is considerably less than they were receiving in 1975), and cannot support their families
- About 70% of the poor live in rural areas. Education is an essential prerequisite for reducing poverty, improving agriculture and the living conditions of rural people, and building a food-secure world. Children's access to education in rural areas is still much lower than in urban areas, adult illiteracy is much higher, and the quality of education is poorer.
- There is prejudice and hate embedded in some curriculums around the world. In many countries where international tensions are present, extreme political opinions are expressed in curriculums
- A small proportion of nations currently include environmental awareness in their curriculum
- Existing school buildings are energy inefficient or lacking energy resources entirely.

Why This Needs To Change

- HIV/AIDS infection rates are double among young people who do not finish primary school. If every girl and boy received a complete primary education, at least 7 million new cases of HIV could be prevented in a decade (given current relationships between education and HIV infection rates).
- Education is a key economic asset for individuals and for nations. Every year of schooling lost represents a 10 to 20% reduction in girls' future incomes. Countries could raise per capita economic growth by about 0.3% per year—or 3% in the next decade—if they simply attained parity in girls' and boys' enrollments.
- Failure to educate girls and women perpetuates needless hunger. Gains in women's education contributed most to reducing malnutrition between 1970-1995, playing a more important role than increased food availability.[6]
- Achieving universal primary education will not only reduce the spread of AIDS and of other preventable diseases, but also contribute to reducing environmental damage, empowering girls, reducing child mortality, and improving mental health, as well as help lift people out of poverty by providing children "with choices and opportunities to create a better life for themselves."
- Enrollment in school is directly proportional to life expectancy at birth. Years spent in school and literacy rate is also directly proportional to life expectancy at birth. Therefore, increasing enrollment and years in school will lead to increased life expectancy.
- Education is for life. The purpose of education is for life, liberty, and the pursuit of happiness—as well as economic well-being, health, democracy, and the empowerment of people. One of the primary elements of a true, functioning, representative democratic republic is that its citizens are well informed.

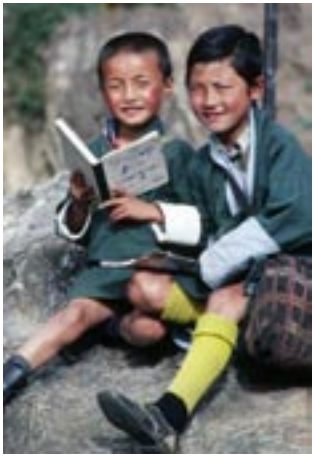
> *"As literacy increases, the need for leaders decreases."*
>
> *—Buckminster Fuller*

World Education System Preferred State

By 2015, 100% of humanity will have access to primary education and there will be 100% literacy in all nations. This includes not only literacy in one's own native tongue but also in at least one major language enabling people to communicate on an international basis.

By 2026, 100% of humanity will receive a full primary education for free and have affordable access to secondary, tertiary, and lifelong education; in addition, they will have:

- Universal Internet access
- Affordable access to study internationally and to study other cultures from their own location
- Affordable transportation to attend the schools of their choice
- Schools within a close proximity to students
- Schools that play a vital part in the community; that provide essential services where needed; that are suppliers of energy, water, and food to the community (rather than just consumers)
- Schools that are built with and powered by renewable resources
- Access to sports and the equipment needed to participate in sports
- Affordable access to educational resources and materials such as books, textbooks, computers, and advanced global library systems
- Access to cultural institutions
- Access to international press
- A peaceful and secure environment
- Gender appropriateness (different bathroom facilities for boys and girls)
- Access to healthcare facilities on campus
- Teachers who are well paid and respected members of the community
- Teachers and administrators who have global access to all educational resources; and who exchange education information readily
- Curriculum that:
  - o Is hate-free, unbiased, and contains opposing viewpoints
  - o Is interactive and relevant to community and cultural needs (things learned can be applied in real life to benefit the community in such areas as health, environment, food production, energy use)
  - o Accommodates different styles of learning
  - o Is globally centric (students learn about their region in the context of the entire world); contains environmental education in a global context
  - o Promotes creative exploration in arts and music
  - o Promotes compassion for oneself and others
  - o Promotes critical thinking skills
  - o Contains vocational training
  - o Is universal; culturally appropriate yet contains globally adhered to standards
  - o Promotes physical as well as mental growth
  - o Promotes extracurricular activities relevant to the community
  - o Helps children come out of school responsible and aware citizens with skills that will allow them to secure meaningful jobs and to be fully included and engaged in society.



Two school children of Bhutan. *UN Photo/John Isaac*

Strategic Vision: Education For Life

As documented above, there are many things wrong with the current educational systems of the world—as well as important directions to move that system towards. How can we get from the present to the preferred future? What needs to be done to eliminate illiteracy and make the advantages and prerogatives of life-long access to education available to everyone in the world?

In short, how can we increase the health, longevity, productivity, economic well-being, and political enfranchisement of all the people of the world by increasing the world's access to education?

The following is one strategy for doing this that was developed by the participants of the Design Science Labs in 2006.

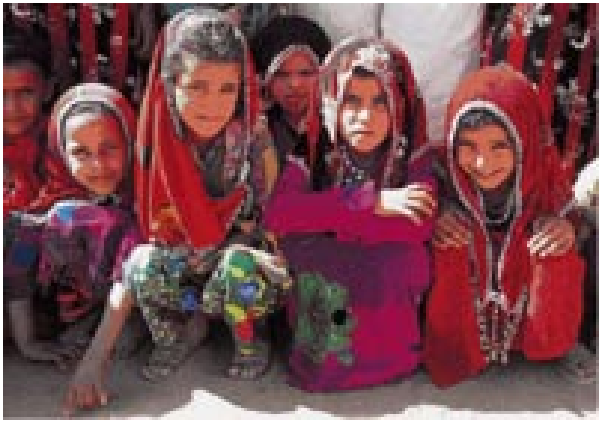
Children at school in Srifa, Lebanon
UN Photo/John Isaac

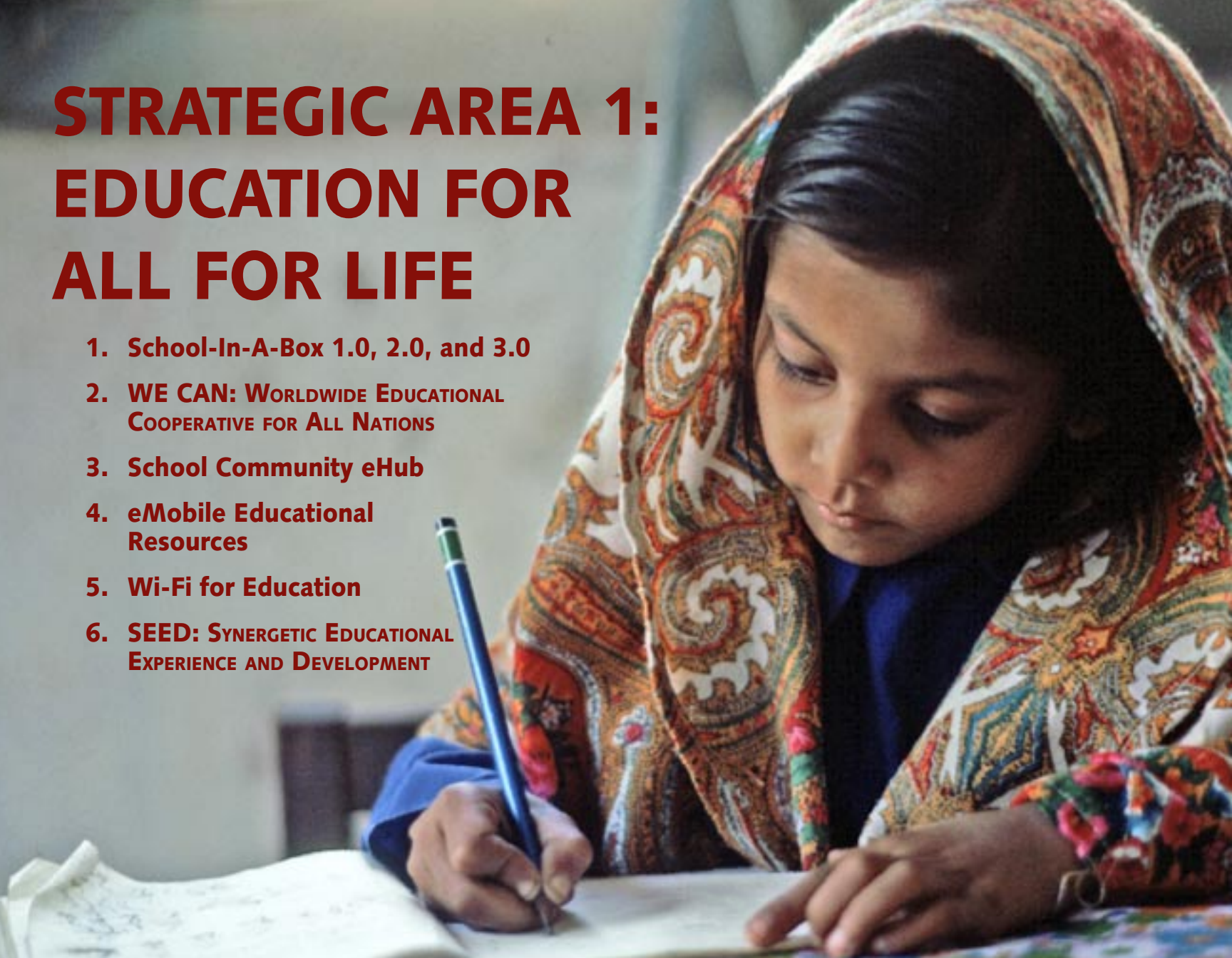
World Education System Preferred State Timeline

2006

2016
100% literacy

2026
100% access to secondary & tertiary education





STRATEGIC AREA 1: EDUCATION FOR ALL FOR LIFE

1. School-In-A-Box 1.0, 2.0, and 3.0
2. WE CAN: Worldwide Educational Cooperative for All Nations
3. School Community eHub
4. eMobile Educational Resources
5. Wi-Fi for Education
6. SEED: Synergetic Educational Experience and Development

1. SIB: SCHOOL-IN-A-BOX

By Kristina Mader, Fabiola Carrasco, Daniel Eida, Zane Kripe, Priyanka Pandit, Xena Parsons, Lexi Quint, Zoe Richards, Heath Robbins, David Walczyk, *(New York Design Science Lab Global Education Team participants)*

The core of this strategy[7] is an enhanced version of an artifact developed by UNICEF called "School-In-A-Box." UNICEF's basic School-In-A-Box was developed for disaster relief situations where a community's school was destroyed. The box was packed with school supplies, laminated lesson plans, and teacher materials. The lid of its packing case transforms into a blackboard. In the hands of a local teacher, it enables a school to re-open or to be opened.

Such a box, as is and in our more enhanced versions, would provide one of the key ingredients needed to eliminate illiteracy throughout the world.

Purpose

The purpose of the SIB is to provide universal access to education for all 100+ million primary aged children not in school. The distribution of such a "quick fix" solution, while simultaneously paying special attention to the educational needs of girls and the community, as well as providing a framework of support to teachers, and the inter-linking of communities, will go a long way towards eliminating illiteracy and providing universal access to primary education.

Mastering the art of writing, Karachi, Pakistan.
UN Photo/John Isaac

School-In-A-Box 1.0 Contents:

- Basic Essential Learning Tools (B.E.L.T.)
  - o Laminated student packets (for basic reading and math)
  - o Rulers, protractors, pencils, paper, multiplication tables
  - o Blackboard (lid of box turns into blackboard)

School-In-A-Box 2.0 Contents:

- All the above, plus
- Girls Education Tools (G.E.T.)
  - o *Gender Focused Learning Methods*
  - o *Peer-to-Peer Tutoring Program*
  - o *Leadership Development*
  - o *Financial Empowerment*
- Health & Sanitation Awareness Materials
- Malaria Deterrence Tools
- Practical & Community Learning Materials
- Laptop computer/Cell phone
- Teacher/Facilitator Instruction Manual

School-In-A-Box 3.0 Contents:

- All the above, plus
- Internet access
- Ongoing training and access to educational materials, provided by WE CAN

The more advanced versions of the SIB (versions 2.0 and 3.0) are intended for immediate use in some areas that are ready for them, and for later use in areas that first receive SIB 1.0.

Schools-In-Boxes

Because every locality is different it is assumed that a one-size-fits-all School-In-A-Box approach will not be an efficient, effective, or sustainable solution. Therefore our strategy calls for a series of Schools in a Box approaches.

The first SIB is almost identical to UNICEF's model. It is the bare minimum that a school needs to get started. It is intended to address the literacy needs of the 100+ million children, living mostly in Sub-Saharan Africa and Southeast Asia who are out of and/or do not have access to school. The most important function of the box is to serve as a quick fix in a rural village or urban setting, filling in as a short-term primary educational system. It directly addresses access to primary education, but not in a permanent manner.

SIB 1.0 is the first step in capacity building within a village, allowing it to move on to more permanent facilities, mobile options, and technological solutions, which are decided upon by the community and fill their specific needs.

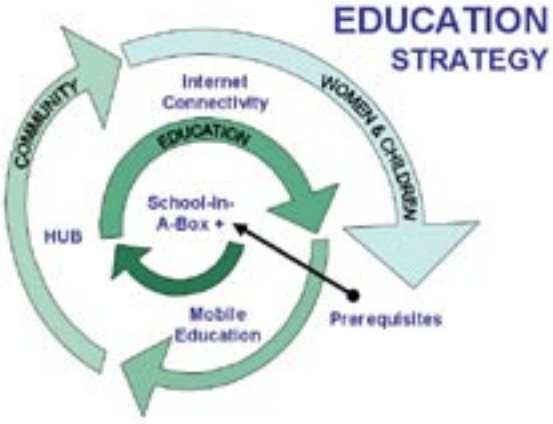
SIB 2.0 has more components, including supplemental modules that address girls' education and environmental literacy. SIB 2.0 provides instructions on how to deal with different learning styles, leadership development, application of practical skills, and girls' empowerment.

SIB 3.0 contains further educational modules plus a personal computer. This SIB also emphasizes community participation, enabling community leaders to dictate their own development priorities.

Schools-In-Boxes Programs

Community involvement has proven to be crucial in any development program, and that is central to the SIB strategy. In order for the SIB Program to be successful, the community needs to dictate the direction of the education within the community, and specifically address the basic needs of children in the area. To assist in this some important programs to include are parent-teacher conferences, community centoring, as well as curriculum development workshops.

The SIB strategy combines aspects of UNICEF's School-In-A-Box program, the UN Girls Education Initiative (UNGEI), models of peer coaching, global volunteer programs, HIV/AIDS awareness campaigns, the latest mobile education technology, and basic development assistance into a comprehensive "quick fix" for villages who have satisfied their basic hierarchy of needs (food, water, shelter), but are still without sufficient primary education.



SIB Costs and Funding

Cost

The current standard UNICEF SIB (SIB 1.0) costs $476 per unit. Each unit will meet the educational needs of 80 children. To reach 100 million children currently out of school in the developing world would take roughly 1.25 million of these units for a retail cost (mass production will result in considerably lower costs) of about $600 million.

Adding to the basic SIB 1.0 to create the SIB 2.0 and SIB 3.0 programs will add the following additional costs:

- $50 for HIV/AIDS, gender empowerment, environmental and other subject information/instruction curriculum materials
- $200 for laptop or cell phone with solar charger
- $8.60 for mosquito nets
- $125 for teacher training

for a total cost of $860 per SIB 2.0 and 3.0 units. To reach 100 million children with this program will cost $1.07 billion.

Funding

Funding for the SIB Program would come from a variety of sources. In addition to funding from national governments, UNICEF, UNESCO, and UNDP, SIB programs would be funded by grants and innovative private sector contributions.

An example of the later is an arrangement with UPS and/or other package delivery companies wherein they would deliver the SIB package to the appropriate village or urban school in the developing world and in return they would offer the rest of their customers the option of donating a small percentage of their shipping fees to the SIB Program. For example, UPS ships 14.8 million packages daily. An optional donation of 50 cents per package would generate over $2.7 billion per year (assuming a 50% participation rate).

School-In-A-Box Curriculum

2. WE CAN: World Educational Cooperative for All Nations

By Patricia Major, Sarah Hausman, Reo Jones, Alex Mackay, Charvee Patel *(NC Design Science Lab Global Education Team participants)*

WE CAN[1]

WE CAN seeks to provide an education hub for teachers, students, administrators, policymakers, and others from around the world to work together to achieve universal literacy, enhanced educational opportunities, and greater international collaboration and cooperation. WE CAN's comprehensive website will serve as the organization's 'base of operations,' providing intellectual and physical resources to individuals and other organizations.

In addition, the SIB Program is delivered, administrated, and improved by WE CAN. This global coordinating organization performs a number of tasks in addition to overseeing the SIB Programs.

WE CAN's purpose is to make the world's vast educational resources available to the teachers and students of the entire world.[2] They will do this by providing regular mail, telephone, and website access to all educational resources, including those of all existing agencies, providers of supplies, and information. (It will also include SEED catalogue information and ordering links. See Strategy 6, page 28.)

WE CAN's website will provide increasingly more services, including an equipment and supplies exchange, a supplies/tools/technology store that offers sliding-scale discounts, a teleconferencing link, downloadable software, and links to online classes.

WE CAN will also offer free telephone support for educators, providing information about available resources. All available information will be accessible on the WE CAN website, for those with access to the Internet. (The telephone network will include native-language-speaking operators who will have access to the website, and who can then assist callers by conveying information that the operator locates through the website.)

WE CAN services will include the following:

- Coordination and delivery of SIB Programs
- Customizable and adjusted SIB solutions for regional education efforts
- Distribution of SIB and other educational supplies and information
- Internet (and other), portals to educators, students, administrators, media
- Thematic entry points for topics such as school sustainability, curriculum, educational tools, educational programs, etc.
- Methods for cooperation between existing agencies, countries, school districts, teachers, and students
- A website in several languages that provides:
  - Teleconferencing communication between agencies, school districts, teachers, and students
  - Online meetings, classes, and training sessions
  - Funding and scholarship information

- o New tools and technologies information
- o Downloading of free software and publications
- o Ordering of supplies
- o Global and regional announcements of educational events
- o Crisis reporting and coordinated requests for assistance
- o Job postings
- o Links to other resources
- o Contact directory by agency/country/region/subject area/topic and any other subsets that may be useful

WE CAN Funding

WE CAN startup funding will be provided by philanthropic organizations, universities, sister cities cooperation, and private sector investment. Private sector revenue from fees for services will provide overhead and operating costs. School supply companies (including textbook providers, Staples, Microsoft, Apple, etc.) will provide revenue as a percentage of sales they receive as a result of WE CAN's global marketing efforts.

3. SCHOOL/COMMUNITY eHUB

By Fabiola Carrasco, Daniel Eida, Zane Kripe, Priyanka Pandit, Xena Parsons, Lexi Quint, Zoe Richards, Heath Robbins, David Walczyk, *(New York Design Science Lab Global Education Team participants)*

eHub[3]

Another part of the overall *Education for All for Life* strategy is the use of schools as community education hubs. The goal of this strategy is to extend the educational process from just school-age children to the entire community. The School/Community eHub would bring education to people, formally and informally, throughout the life span and regardless of location (urban to rural) and development level.

Part of the process of the eHub would be an educational needs assessment that would determine what subjects were wanted and needed by the community. The primary delivery of educational content of the eHub would be via the Internet.

The School/Community eHub would be a "permanent" or fixed part of a community. For communities that could not be reached with this strategy, there would be the traveling educational resource center described below.

Advantages and Effects

Reach small and dispersed communities
Continuous education
Accessibility
Community involvement
Community development
Relevance
Training for local needs
Flexibility
Up to date resource sharing
Cost effective
People driven design

4. eMOBILE EDUCATIONAL RESOURCES

By Fabiola Carrasco, Daniel Eida, Zane Kripe, Priyanka Pandit, Xena Parsons, Lexi Quint, Zoe Richards, Heath Robbins, David Walczyk *(New York Design Science Lab Global Education Team participants)*

Mobile Access to Education[4]

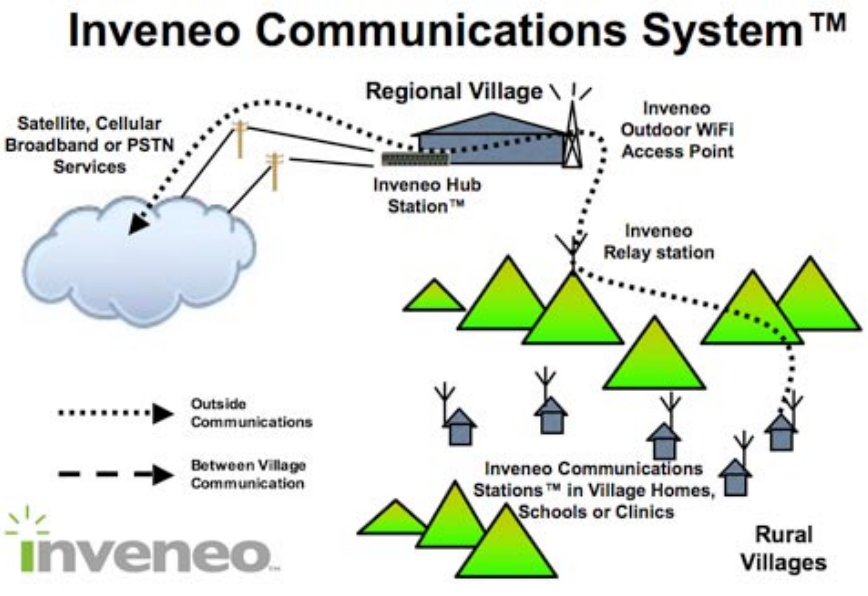
Yet another part of the overall education strategy is the use of mobile schools and training facilities. If people cannot get to conventional educational facilities, a mobile form of those facilities can go to the people. In Curitiba, Brazil, retired buses are used as mobile training centers. Curitibans pay $1.00 to take courses in auto mechanics, electricity, typing, hairdressing, artisan work, etc., in these mobile classrooms. At the end of these courses students are placed in jobs throughout the city or they often start their own businesses.

Right: Pedal-powered mobile libraries bring books to neighborhoods without libraries.

5. WI-FI FOR EDUCATION

By Priyanka Pandit, Fabiola Carrasco, Daniel Eida, Zane Kripe, Xena Parsons, Lexi Quint, Zoe Richards, Heath Robbins, David Walczyk, *(New York Design Science Lab Global Education Team participants)*

A key component of the *Education for All for LIfe* strategy is getting universal Internet access. One current technology for doing this is Wi-Fi, a wireless Internet access system. The *Wi-Fi for Education* strategy is intended to provide Internet access for everyone in the world. Its goals include providing Internet access (email plus phone service) to 4 billion people, living in the developing world, for $1/month—and to use the Internet as a medium for education as well as commerce, telemedicine, communication, etc.



Global Wi-Fi Costs[5]

There are a variety of technologies and associated costs for achieving universal Internet access. Costs range from $500 per village[6] to $1,000 per village to set up a wi-fi infrastructure ($341 million to $638 million for all of India's rural villages), to $2,000 for a village-wide solar powered communications station.

6. SEED: Synergetic Educational Experience and Development

By Reo Jones, Sarah Hausman, Alex Mackay, Patricia Major, Charvee Patel *(NC Design Science Lab Global Education Team participants)*

Sustainable Schools[7]

One of the goals of the SEED program is to increase the sustainability of the schools of the world. This includes the efficient use of energy, water, food, and other resources. It would provide a *SEED catalogue* to schools throughout the world (distributed with the help of WE CAN—see Strategy #2, page 23). This catalogue would enable schools to learn of and to obtain energy conservtion and production equipment, water catchment systems, food production systems, and other tools, equipment and facilities that will increase the school's use of sustainable technologies, decrease the school's ecological footprint, and increase its role as a net producer of energy, water, and food in its community.

SEED is designed to enhance existing science and environmental science curricula and provide curricula in places where none currently exists by encouraging hands-on learning experiences for students around the world. The basis of the SEED program is the SEED catalogue, a kit consisting of educational tools and resources designed to allow teachers and their students to create school and community gardens, design and build sustainable classrooms and school buildings from locally available materials, and involve the broader community in efforts to bring about a more sustainable world through education and action. This kit and the resources it includes will allow students and teachers to learn by doing.

The SEED catalogue makes environmental science curricula, green building, renewable energy, and other projects accessible and available to primary and secondary students globally at any level of need. SEED will work in partnership with WE CAN, ensuring that materials are available via the WE CAN website and telephone services.

Example of what the SEED catalogue includes:

- Horticultural kits with a list of necessary tools and instructions for gardening and growing herbs, fruits, vegetables, and trees
- Greenhouse construction templates and materials
- Green-school building design strategies and materials
- Energy-saving and energy-creating strategies and materials
- Cogeneration and district heating and cooling systems
- Local educational project opportunities with a SEED supporting organization
- Biofuels kits, tools, and instructions
- Green buildings blueprints
- Building energy management systems
- Recyclable materials use
- Environmentally friendly cleaners
- Environmentally friendly refrigerants
- Energy efficient cooling systems
- Water efficient systems, including composting toilets, grey water systems, rainwater collection

Possible collaborators with SEED include:

- WE CAN
- Individual city, state, and national governments
- UNEP, UNDP
- Alliance to Save Energy—green-school construction plans
- Architecture for Humanity—school plans
- The Collaborative for High-Performance Schools (CHPS)—green-school construction
- Energy Foundation—funding for sustainable-energy technologies and local projects
- Energy Star—renewable and energy saving products
- Green Building Supply—building materials, environmentally friendly cleaning materials
- The Green Engineer—sustainable design consulting
- Green House Mega Store—international greenhouse building supplies and templates for school projects, horticulture tools
- Potential collaborations and projects with universities and colleges

Results:

- Schools become local producers of food and promote energy efficiency as a way of saving both energy and money
- Students and teachers collaborate in environmental education and community building
- Encourages a global network of educational cooperation

One of the goals of the SEED Program is to have schools become sources of food, energy, and water rather than just large consumers of these resources.

The SEED Program will assist schools in rural areas to outfit a small farm (one to two hectares) adjacent or nearby the school for students to help farm. Part of the curriculum will be the teaching of the latest resource-efficient farming techniques to students.

In malaria-infested areas, one crop could be chrysanthemums, (which could be sold as feed stock for the production of the anti-malaria pesticide pyrethrum; see Health Strategy #3, page 41). In all areas, vegetables and fruit will be produced to provide children (and in some food-short areas, their families) with fresh produce.

Urban schools would use the same principle as the rural schools but would use solar panels to produce energy, rather than farms that produce food. Any energy produced that is above that needed by the school will be sold to nearby residences and businesses.

Example of hands-on environmental educational experience.

Solar energy facilities powering a school in Nigeria.

EDUCATION FOR ALL FOR LIFE RECAP

Cost

To implement all the strategies outlined above will cost $10 to $15 billion per year for ten years. The variable costs are a function of varying costs of implementation according to location and chosen strategies.

- The School–In-A-Box program costs are approximately $1 billion per year for 10 years.
- The WE CAN: World Educational Cooperative for All Nations program costs are approximately $500 million per year for 10 years.
- The School Community eHub program costs are approximately $200 million per year for 10 years.
- The eMobile Educational Resources program costs are approximately $500 million per year for 10 years.
- The Wi-Fi for Education program costs are approximately $1 billion per year for 10 years.
- The SEED: Synergetic Educational Experience and Development program costs are approximately $50 million per year for 10 years.

The total costs of all these programs are $3.25 billion per year for ten years. The additional costs of achieving universal primary education by 2015 can also be inferred by examining the average (per-pupil) costs of primary education today, and multiplying this cost by the number of primary school-age children not in school (100 million). Since this unit cost varies substantially across regions (and across countries within regions), the resulting global estimate varies between $10 billion and $15 billion, depending on whether regional, national or global averages are used.[8]

Funding

In addition to the UPS partnership program described above in the SIB strategy that could bring in over $2.7 billion per year, there are other sources of funding for the educational initiatives described here. Assuming that the amount needed is $3.25 billion per year, there is a need for less than $1 billion if the package delivery strategy is successfully implemented. This additional amount (or more) could come from government, philanthropic, and additional private enterprise sources.

The incentives for increasing educational funding from these sources are substantial. There is a direct and strong correlation between increased literacy and elevated worker productivity and higher GNP.[9] Along with higher productivity comes higher incomes. One Organization for Economic Cooperation and Development (OECD) study points to a doubling of income for those who complete secondary education over those who do not finish.[10] Annual return on investments in education for successful students range from 6.5% to nearly 17% in developed countries.[11] Life expectancy, infant mortality, and income per capita are all improved by education.[12] Economic growth and lowered fertility rates also result from increased education.[13]

In addition, governments have other compelling and cost-effective incentives to increase educational funding as the following figures make clear: 47% of the dropouts (in U.S. schools) left school because classes were not interesting; more than 50% of those incarcerated are high school dropouts (in some regions this figure is as high as 85%); it costs $23,200 to jail one inmate per year; it costs $10,000 per school student. If students can be kept from dropping out of school the odds

of their staying out of jail increases. Given the relative costs of jailing someone versus educating them, it is clear that the socially, morally, and economically wiser strategy is to invest more in education.

Summary

In summary, the educational strategies outlined above, if implemented aggressively, will enable the world to eliminate illiteracy, achieve universal primary education for all (thereby achieving the Millennium Development Goal #2), provide access for everyone in the world to secondary, tertiary, and lifelong educational opportunities—thereby increasing economic productivity; overall health and longevity; personal, community, and country-wide well-being; as well as increasing participation in local, regional, and global problem solving, governance, and democracy.

The return on investment for such a series of global and local strategies, in the short and long term, would be huge. The total cost for the educational strategies is less than the cost of two B2 bombers,[14] or what citizens of the U.S. spend on t-shirts each year.[15]

A student at the Dheisheh Preparatory Boys School run by the United Nations Relief and Works Agency for the Palestine Refugees in the Near East. *UN Photo/Evan Schneider*

School-girls in a reading class, Karachi, Pakistan. *UN Photo/John Isaac*

STRATEGIC AREA 2: HEALTH

The New York Design Science Lab's global health team worked on strategies for reaching Millennium Development Goals #4 (reduce child mortality), #5 (improve maternal health), and #6 (combat HIV/AIDS, malaria, and other diseases). These goals seek to "reduce by two-thirds the mortality rate among children under five;" "reduce by three-quarters the maternal mortality ratio;" and to "halt and begin to reverse the spread of HIV/AIDS, and the incidence of malaria and other major diseases."

New York Design Science Lab Goblas Health Team
Dan Bigg, Ben Cohen, Kevin Dye, Eric Fedus, Jareb Gleckel, Erica Jain, Erica Kane, Jai Lakhanpal, James Lual, Chuck Michelson, Ali Montes, Taylor Zuccolotto

HEALTH FOR ALL FOR LIFE

Strategic summary: Achieve universal health care coverage for everyone in the world by 2026, through a combination of ubiquitous low-cost Internet-connected "HealthHuts;" plus, reduce infection and mortality of malaria and other insect-borne diseases through the use of locally produced pyrethrum insecticides (thereby also providing increased revenue and employment opportunities to small scale farmers).

Introduction

The work of the Design Science Lab 2006 in the area of health was focused on demonstrating how, using present day technology, known resources, and limited financial wherewithal, basic health care could be provided to everyone in the world between now and 2015.

The overall strategy developed by the participants of the Lab consisted of an interrelated three-part plan that, when aggressively implemented, would have a profound impact on the health of the world's population.

The three parts of this strategic plan are:

- Hooked-Up HealthHuts
- Eradication of Malaria: Flower Power
- Cambodia Water Network

The following pages describe these strategies.

State of the World Health System

The global health system is characterized by the following problems. It:

- Does not provide full medical coverage to everyone in the world
- Lacks good disease prevention education and has inadequate delivery of preventative medicine (vaccines, vitamins, medications)
- Lacks adequate hygiene
- Is overly-reliant on treating illness/disease rather than the prevention of disease
- Does not provide maternal health care and information to all
- Does not deal with inadequate sanitation, which leads to water-borne disease

Global Health Preferred State

By the year 2026, 100% of humanity will have access to basic health resources, health education, and a healthy social environment. In addition, known curable diseases will be eradicated, and everyone will have access to the following resources and services: potable water, sanitation, food supplies adequate to maintain good health, pre- and post-natal care, medical facilities, and medicines.

STRATEGIC AREA 2: HEALTH FOR ALL FOR LIFE

1. Hooked-Up HealthHuts
2. Cambodia Water Network
3. Eradication of Malaria: Flower Power

1. HOOKED-UP HEALTHHUTS

By Erica Kane, Erica Jain, James Lual, Kevin Dye, Eric Fedus, Chuck Michelson *(New York Design Science Lab participants)*

There is a large global population that does not have access to accurate and reliable health information or care. This is the case in developed countries as well as developing, but is more extreme in developing parts of the world.

Hooked-Up HealthHuts are designed to deal with two fundamental problems of the health system:

- Lack of access to accurate medical information and health education, and
- Lack of communication between healthcare centers, providers, and contributors

HealthHuts are designed to provide access to an almost unlimited amount of health information and create a nationwide (and eventually global) network of clinics, hospitals, and other forms of patient care.

HealthHuts are interlinked kiosk-type computer terminals where people can access health related information in an easy to use and intuitive manner. They are designed to address the lack of health information, and other health related problems. One use of HealthHuts would help users learn what might be wrong with them and how their health problem could be treated. Users would describe their symptoms and receive possible health remedies that are available locally and non-locally. They would be advised how to prevent their malady as well as how to treat it. They would be advised to seek treatment at the nearest clinic if the malady was beyond self-medication. Emergency medical information would also be available.

> *Every year the world's poorest children are robbed of an estimated 130 million years of healthy life.*
>
> *—WHO, The World Health Report*

HealthHuts will be part of a network connecting HealthHut kiosks to clinics and hospitals that can provide for more through patient care for serious afflictions.

HealthHuts will help adults and children in rural villages learn about health in general, their health in particular, and health care options. One of the goals is that people will learn how to take better care of themselves. Entire villages will have access to health information that will lead to decreased mortality rates, better health, and increased productivity. A global network of HealthHuts and more advanced health care delivery units will enable HealthHuts to communicate with clinics and hospitals for efficient service. They will also allow for patient-to-patient communication so that people with similar health problems can communicate with each other.

The primary manifestation of the Hooked-Up HealthHuts strategy is the use of computer stations at public central kiosks, as in the picture on page 36.

Baby in Sudan. *WFP/Peter Smerdon*

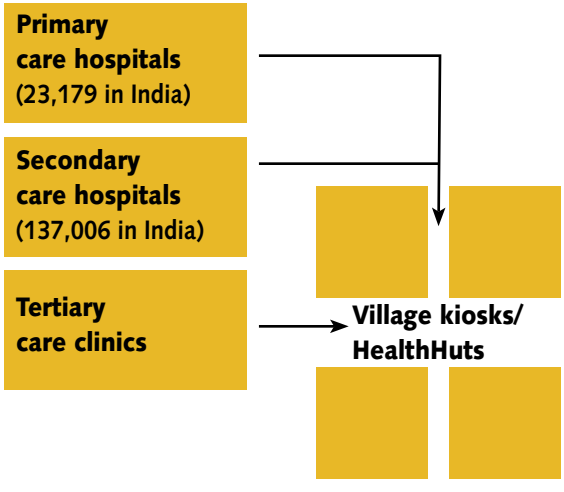
HealthHut Costs

To install two million HealthHuts in villages and urban neighborhoods around the world where health care coverage is sparse to nonexistent would cost the following:

1 HealthHut Kiosk unit: $400
2 million HealthHut units: $800 million
Annual maintenance: $50 million
Network maintenance: $50 million
HealthHut content maintenance: $300 million
Total start up costs: $1.15 billion
Annual costs (for maintenance, additional kiosks, and expansion of services): $500 million

HealthHut in Sengal

Countrywide Healthcare System Schematic



Each quaternary care kiosk is no more than a few-hour walk to secondary or tertiary care health centers.

> *"A state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity."*
>
> *—WHO definition of health*

These so-called 'hole-in-the-wall' HealthHuts are run off of solar power. They provide children and others the opportunity to learn computer skills without training, while obtaining valuable health related information.[1]

Young and old alike access health information and instructions and summon mobile emergency units. Information is illustrated, animated, and interactive. There are spoken instructions. visual maps, and directions to nearest clinic.

Another design is this earth brick building made from local ground. The cost is about $2,000 per hut and comes with educational multimedia software, Internet connection, and a direct line to the nearest health clinic. Local companies have donated computers for this setup.

2. CAMBODIA WATER NETWORK: BRINGING CAMBODIA CLEAN WATER

By Jareb Gleckel, Ali Montes, Ben Cohen, Kevin Dye, Eric Fedus, Chuck Michelson *(New York Design Science Lab Global Health Team participants)*

There are over one billion people in the world without access to clean drinking water. Cambodia is one of the worst areas when it comes to such access. The percent of Cambodians with access to potable water and improved sources of drinking water remains startlingly low despite the presence of abundant supplies of water, most notably Lake Tonle Sap (The Great Lake of Cambodia).

Many people are getting drinking water from unsanitary rice paddies, ponds, and similar sites. The contamination of these sites is due to insecticides and fertilizers, plus animal and human feces. Lack of proper sanitation facilities impacts the cleanliness of the water supply and is a main contributor to the high rates of infant mortality and morbidity.[2]

According to UNICEF, 70% of Cambodians (or 9.7 million people) do not have a reliable source of clean drinking water. In rural areas 26% have access to safe drinking water; in urban communities, it is 54%. As would be expected, this lack of access to safe water results in a high infant mortality rate as well as acute respiratory infections like pneumonia, malaria, measles, and dengue fever. In addition, the most common ailment that afflicts tourists is diarrhea, directly stemming from the polluted water. This impacts the economy by lowering the amount of money the country can earn through tourism.

Preferred State

The goals of the Cambodian Water Network include achieving the following by 2015:

- Provide all Cambodians with a clean, safe supply of water
- Assist in establishment of sanitation infrastructure
- Purify the abundant sources of polluted water present in Cambodia
- Create additional employment
- Increase environmental awareness in Cambodia
- Facilitate a stronger, more independent economy
- Build a self-sufficient government/private enterprise initiative that generates economic development revenue from outside the country (and is a model for other countries)

Poverty and Hunger in Cambodia

Cambodian Water Network Plan

This three-stage strategy calls for 1) setting up a series of water purification plants (financed by the World Bank and private enterprise which will have a 50% equity stake in the new water company), that 2) sell 50% of the water from these plants to Singapore as bottled water (which is facing a serious bottled water shortage), and 3) using 50% of the revenue from these sales to finance the construction of additional water purification plants and sanitation facilities. The other half of the revenue will go to the private enterprise and its stockholders, to pay back the initial start-up costs and provide a fair return on their investment.

The first step is to set up filtration plants in three scattered areas in Cambodia: the tip of Lake Tonle Sap where three rivers branch off, and in two other cities at the intersections of rivers and roads that can be used for transport purposes (see map). A pump and filtration plant would also be set up in the capital Phnom Penh along the Mekong River. A bottling plant will be built and the water from this factory will be shipped by rail to a port on the Gulf of Thailand and then shipped by boat to Singapore.[3]

Polluted waters of lake Tonle Sap during the high water season

Other markets for Cambodian bottled water include Bangkok whose nearly 9 million people[4] and large tourist industry are in need of bottled water. Another market is more developed nations such as Australia, Japan, and the USA. By exporting bottled water, jobs are created and revenue is obtained to fund the provision of clean water and sanitation facilities to all of Cambodia—thereby improving the overall health of Cambodia.

Costs

Startup:

- Water pumping and filtration plant: $3.4 million[5]
- Bottling Factory: 5-gallon bottling facility; 1,200 bottles/hour 29,000 bottles/day; 10.5 million/year; 144,000 gallons/day = $2 million

Subtotal: $5.4 million

Ongoing:

- Labor: 500 workers at $2/hour, 8 hours/day, 340 days/year = $2.7 million/year
- Transportation: $3,000 per trip (1 trip/week) = $156,000/year

Subtotal: $2.85 million

Startup and first year operating costs total: $8.25 million

Revenue:

$4 per 5-gallon bottle

5 million bottles/year (50% of total output; other 50% goes to meet domestic water needs) = $20 million

Revenue total: $20 million/year

Funding Partners

- A major water distribution corporation such as Nestle
- The World Bank, Asian Development Bank
- Government

3. ERADICATION OF MALARIA: FLOWER POWER

By Jai Lakhanpal, Taylor Zuccolotto, Kevin Dye, Eric Fedus, Chuck Michelson *(New York Design Science Lab participants)*

Malaria is a life-threatening parasitic disease transmitted by mosquitoes. 41% of the world's population lives in areas where malaria is transmitted.[6] There are 300 million cases of malaria each year resulting in 1 million deaths. 90% of these deaths occur in Africa, mostly in young children (only 41% of children under 5 years of age have access to anti-malarial drugs).[7] Every 30 seconds a child dies of malaria. Malaria also impacts the economy. For example, in Africa, malaria causes an estimated loss of $12 billion per year.[8] The indirect costs of malaria include lost productivity or income associated with illness or death.[9]

The average cost for potentially life-saving treatments of malaria are estimated to be U.S.13¢ for chloroquine, U.S.14¢ for sulfadoxine-pyrimethamine, and U.S.$2.68 for a 7-day course of quinine.[10] Although these costs appear low, providing these treatments for 300 million people proves extremely costly ($39 million for chloroquine treatment, $42 million for sulfadoxine-pyrimethamine treatment, and $804 million for a 7-day course of quinine) and well beyond the means of the health care systems and resource-short governments in malaria-afflicted areas.

Preventing malaria through the control of the mosquito that delivers the disease is a more cost-effective means of reducing the negative impacts of malaria. The strategy outlined below will also result in additional benefits to local economic development and the reduction of poverty.

Flower Power Strategy

The Flower Power strategy is a four-stage effort that involves the widespread production of the natural malarial mosquito controlling pesticide pyrethrum (derived from chrysanthemum flowers, and a relatively safe, non-harmful to mammals pesticide) by small, village-based subsistence farmers in many African countries. This provides an additional market and income for one of the poorest segments of African society. Along with the use of pyrethrum-laced bed nets to keep mosquitoes from biting while asleep, this strategy is designed to eliminate the most devastating impacts of malaria in Africa.

The strategy starts off with a series of farmer education posters, pamphlets, and demonstration farms that teach the best practices for growing the chrysanthemum flowers needed for the production of pyrethrum. This will be accompanied by a government backed guaranteed market for the next ten years' annual harvests of chrysanthemum flowers. With government incentives, the SC Johnson Company (or other private companies) will invest in the building of two or more plants in Africa to process the flowers into pyrethrum. This public-private partnership will increase the revenue of small farmers throughout many countries of Africa, guarantee a steady and dependable supply of chrysanthemum flowers for pesticide production, generate employment opportunities, and increase the availability of pyrethrum for use in fighting malaria and other mosquito-borne diseases. Tax revenues from the production and sale of pyrethrum will be used to implement the use of the pyrethrum, malaria education, and the purchase of mosquito killing bed nets.

The goals of this strategy include:

- The complete eradication of malaria and other mosquito-borne diseases from Africa by 2026
- Promoting the use of pyrethrum and pyrethroids in areas where malaria and other mosquito-borne diseases are prevalent, in order to eradicate these diseases by 2026
- Promoting the learning of the proper ways of treating and preventing malaria and other mosquito-borne diseases
- Stimulating the industry of safe insecticide production in Africa thereby creating increased employment
- Promoting production of drought resistant chrysanthemum flowers, thereby providing increased economic security for small African farmers
- Promoting the use of insecticides for the protection of crops in order to increase food production, thereby reducing hunger
- Creating a partnership with private enterprise; specifically the pesticide producing company SC Johnson[11] in order to support the growth of insecticide production in Africa.

Cost

The costs of the Flower Power Malaria Eradication strategy include:

Seeds

Chrysanthemum seeds cost approximately $440 per hectare (52,000 seeds are used per hectare)

To cover 66,000 hectares will cost $29 million per year

Irrigation pumps

To irrigate the 66,000 hectares will take approximately 22,000 foot-powered micro-irrigation pumps at a one-time cost of $2.2 million.[12] Installation ($2 million) and annual maintenance ($2 million) will run another $4 million per year.

Total seed and pump cost: **$35.2 million**

Total annual costs, if seeds are paid for by government: **$33 million**

Total annual costs, if seeds are paid for by farmers: **$2 million**

HEALTH FOR ALL FOR LIFE RECAP

Cost

To implement all the strategies outlined above will cost $1.2 to $2 billion for start up and $536 million annually thereafter for maintenance and updating.

The variable costs are a function of varying costs of implementation according to location and chosen strategies.

- The HealthHut program start-up costs are approximately $1.2 billion, with annual costs at $500 million.
- The Cambodia Water Network start up cost is approximately $5.5 million, with annual costs at approximately $3 million
- The Flower Power program start up cost is approximately $35 million, with annual costs at approximately $2 to $33 million, depending on cost sharing with farmers

The total start up costs of all these programs is $1.25 billion. The annual costs are about $535 million.

An old lady at her window in a Nepalese village.
UN Photo/John Isaac

Funding

Possible funding for the Health for All strategies include public and private investments at the local, national, and international levels.

One business model, based on Google's use of ad revenue, could generate substantial income for HealthHuts. For example, on the right hand side of each screen on the computer in each of the HealthHuts could be short ads for medications available locally that treat the health concern of the person at the HealthHut. These revenues would go towards the maintenance, updating, and expansion of the HealthHut and their contents. An added expense would be the vetting of the ads placed on the HealthHut screens.

Summary

In summary, the health strategies outlined above, if implemented aggressively, will provide health care coverage to the millions of people throughout the world who currently have little to no access. It will increase the healthcare self-reliance of these people, make them better informed about health, health problem treatments, and health care. The strategies will also reduce the incidence and severity of malaria in the world, and provide a private/public model for clean water provision.

STRATEGIC AREA 3: ENERGY

The Design Science Labs in both New York and North Carolina had teams that worked on strategies for providing the world with sustainable energy systems. They did this under the general rubric of Millennium Development Goal #7—that of "ensuring environmental sustainability."

The global energy teams in the New York and North Carolina Labs worked independently of each other, but their work is integrated here into one energy related report. In addition, the North Carolina Lab had an additional energy team that worked on local energy initiatives. This work is summarized at the end of this section of the report, as its replication around the world will have global impacts.

New York Design Science Lab Global Energy Team
Bamini Balaji, Ross Brockwell, Kasia Chmielinski, Douglas Diaz, Victoria Farmer, Alexandra Heeney, Ryan Martin, Charles Sheldon

University of North Carolina Design Science Lab Global Energy Team
Paul Beaton, Neha Bhatt, Nick Consoletti, David Silverman, Harris Stewart

University of North Carolina Design Science Lab Local Energy Team
Jonah Butcher, Robin Cape, Julie Clark, Dee Eggers, Alan Glines, Peter Harrison, Nancy Hodges, Janet Lowe, Stephanie Monson, Ari Zitin

A SUSTAINABLE ENERGY FUTURE

Strategic summary: Achieve a sustainable energy supply and overall energy system for 100% of humanity by 2015, through the removal of all subsidies to the carbon-producing combustion of fossil fuels, the dissemination of consumer energy education and energy transforming devices through artifacts such as the "EmPower Book," energy labeling and metering, energy resource co-ops, the mass production of renewable energy harnessing technology in the developing world, networks of local agents that facilitate efficient energy use, the transformation of housing into net energy producers, and the implementation of a series of energy strategies on the local level—including utility rate restructuring that encourages the use of renewable energy, discourages the use of carbon-rich fuels, and sets in motion community education processes that encourage conservation.

Introduction

The energy work of the Design Science Lab 2006 was focused on demonstrating how, using present day technology, known resources, and limited financial wherewithal, energy shortages and non-sustainable energy systems could be largely eliminated between now and 2015 (thereby helping to achieve the Millennium Development Goal #7 and other MDGs goals), as well as providing affordable access to renewable energy supplies by 2026.

The overall strategy developed by the various energy teams in the Labs consisted of an interrelated eight-part plan that, when aggressively implemented, would have a profound impact on the world. The results would include over one billion people no longer suffering from lack of access to electricity and other forms of energy needed for the daily maintenance of their lives, as well as a major increase in the efficiency of the energy that is currently being used. Results of this shift would include increased economic productivity, better health as food production goes up, decreased indoor air pollution, and better access to more of the services of society.

The eight parts of this strategic plan are:

- Carbon Subsidy Removal
- EmPower Book
- Living Label
- Energy Resource Co-ops
- Manufacturing Renewable Technologies
- Sustainable Extension Network
- Green Mobile Homes

Plus local energy strategies:

- Utility Rate Restructuring
- Residential Home Efficiency: *Be a Hero* Campaign
- Energy-In-A-Box

The following pages describe these strategies.

State of the World Energy System

". . . a bad road leading to a dead end."

The global energy system is characterized by:

- Shortages and increasing costs of energy supply for transport, heating, industrial use (up to three billion people do not have access to enough affordable energy to meet their needs[1])
- 30% to 40% of energy use is wasted through inefficient consumption
- Geopolitical insecurity
- High cost to consumers, including global subsidies to fossil fuels ($230 billion annually)
- Health effects from processing, use, and pollution: 2.6 billion people burn biomass fuels for cooking resulting in indoor air pollution, deforestation, and significant loss of time for girls and women who must spend many hours gathering fuel wood
- Severe environmental impacts, including air pollution and greenhouse gases, plus land, crop, ground cover, and forest loss
- Electricity shortages: 1.6 billion people have no access to electricity (Sub-Saharan Africa is largely without household electricity—92% of rural residents; 49% of urban residents are without electricity); black- and brown-outs of electricity service where there is service.

Indoor Air Pollution

Preferred State

The preferred state for energy in the world is an abundant supply of affordable, clean, and safe energy. The energy systems of the world are based on renewable energy sources, efficient in the use of energy, with equitable access, and a well educated energy user community.

Two workers walking home from a vulcanizing plant in Copsa Mica, Romania. The plant gives its workers rations of milk to combat mineral deficiencies caused by the pollutants spewed by the plant. The tall structures in the background are cooling towers. *UN Photo/R Marklin*

STRATEGIC AREA 3: A SUSTAINABLE ENERGY FUTURE

Global Energy Strategies:

1. **Carbon Subsidy Removal**
2. **EmPower Book**
3. **Living Label**
4. **Energy Resource Co-ops**
5. **Manufacturing Renewable Technologies**
6. **Sustainable Extension Network**
7. **Green Mobile Homes**

Local Energy Strategies:

8. **Electricity Rates restructuring**
9. **Residential Home Efficiency: Be a Local Hero Campaign**
10. **Energy-In-A-Box**

1. CARBON SUBSIDY REMOVAL

By Ryan Martin, Bamini Balaji, Ross Brockwell, Kasia Chmielinski, Douglas Diaz, Victoria Farmer, Alexandra Heeney, Charles Sheldon
(New York Design Science Lab Global Energy Team participants)

> *"The removal of fossil fuel subsidies has been advocated as the first order of priority in instituting economic policies to protect local and global environments."*
>
> —*World Bank*

Fossil fuels receive many subsidies from governments around the world. These are in the form of price supports, tax breaks, low to no-cost licensing fees, publicly funded research and development, military expenditures in strategic locations to keep favorable governments in power and energy supplies secure, and unaccounted environmental and social costs. The amount of these subsidies is in the range of $250 billion per year.[2]

A key strategy in reaching the preferred energy state is the phasing out of subsidies to fossil fuels so that they more accurately reflect their real costs to society and the global economy. This would include:

- Five year graduated (from current levels to zero) removal of all government subsidies to coal, oil, and natural gas
- The reallocation of R&D funds from fossil fuel industries to renewable energy industries.
- Economic incentives that encourage investment in renewable energy and energy conservation

The results of these moves would be a savings to global society of over $200 billion in current expenditures on subsidies, plus, in just the U.S., a $30 billion utility bills savings, $6 billion in additional rural income, 90,000 new jobs (twice that from fossil fuels), plus less smog, acid rain, mercury contamination, and water use.[3] On top of this the U.S would have a burgeoning industry of the future that can sell its products worldwide.

2. EMPOWER BOOK

By Ross Brockwell, Bamini Balaji, Kasia Chmielinski, Douglas Diaz, Victoria Farmer, Alexandra Heeney, Ryan Martin, Charles Sheldon *(New York Design Science Lab Global Energy Team participants)*

The EmPower Book is a local energy development manual. Its goal is to make energy-saving and -producing technology available in the developing world. It is a comprehensive guide/resource catalogue/manual that helps individuals and communities obtain access to energy and the conservation of energy—in its many forms and technologies. The "book" comes in a variety of forms—an actual paper book or online website and search engine with appropriate links to micro-loans and other services.

Funding would come from manufacturers whose products are listed in the EmPower Book and from ad revenue generated at the website by energy product companies whose products might be sold through the site. Micro-financing for obtaining the needed energy products will be part of the services offered by the EmPower Book.

Recipients of loans could sell the energy they produce to surrounding communities, thereby making enough money to repay the loan and to earn a steady income.

3. LIVING LABEL

By Charles Sheldon, Alexandra Heeney, Kasia Chmielinski, Bamini Balaji, Douglas Diaz, Victoria Farmer, Ryan Martin, *(New York Design Science Lab Global Energy Team participants)*

The Living Label is a tool for conserving energy use, increasing transparency in energy transactions, and educating energy users. A primitive example can be seen in the home utility meter.

The primary targets of Living Meters are people in the developed world. This tool will help people learn about how much energy they are currently wasting and help them find the resources needed to become more efficient. It will provide real-time energy consumption feedback.

Such "smart meters" are currently being introduced in Canada and elsewhere.

Examples of logos that increase energy conservation awareness.

4. ENERGY RESOURCE CO-OPS

By Paul Beaton, Neha Bhatt, Harris Stewart *(North Carolina Design Science Lab Global Energy Team participants)*

Energy Resource Co-ops are locally based initiatives designed to increase energy, food, and water supply in developing countries. Community centers, powered by a renewable energy source, would be built (or an existing building would be retrofitted). These buildings would be demonstration sites for energy–efficiency and producing technology that the community could implement in their own homes. The community centers would be powered by solar, wind, geothermal or micro-hydro power, depending on the climatic, geographic, and topographic conditions.

The community center would have a communal kitchen where meals for many households (100-500) can be prepared daily. It would include a water pumping/filtration/purification system also powered by renewable energy technology.

The center would be managed as a cooperative in which area households can join in exchange for monthly sweat equity hours. Where appropriate and needed, households would receive daily meals cooked in the communal kitchen, as well as a ration of filtered drinking water.

Members of the community center would be responsible for the running of the center. A member of the community would play the role of coordinator and would be trained in operating and maintaining the building, equipment, and supervising communal cooking and filtration activities. This person would be a liaison to a regional coordinator who would monitor the Center's programs and equipment and help troubleshoot any problems.

The sweat equity paid by the energy co-op members could be used to develop a micro-industry such as the one started in Kibera, a large Kenyan slum. Here workers are trained to assemble portable solar panels that are then sold on a regional and international market. Revenues from the micro-industry are used to support the co-op. Workers can also earn money and get training. Under this system, energy from an abundant, clean, renewable source is collected, people are employed, and incomes are increased.

Clockwise from top right: Communal center powered by renewable energy source; Communal kitchen; Clean water source

5. MANUFACTURING RENEWABLE TECHNOLOGIES

By Paul Beaton, Neha Bhatt, Harris Stewart *(North Carolina Design Science Lab Global Energy Team participants)*

This strategy is designed to nurture a renewable energy manufacturing industry in Sub-Saharan Africa, and to diversify and spur economic activity and create jobs.

Sub-Saharan African countries can be attractive locations for renewable technology manufacturing plants. By removing some of the financial barriers, offering incentives, and providing reliable insurance and markets to companies that make such equipment, Sub-Saharan countries can become homes to a burgeoning renewable energy industry.

In developed, richer nations, renewable technology companies often have a tough time competing in the market of heavily subsidized industries such as oil, coal, gas, and nuclear power electricity. Manufacturing renewable energy technology in Sub-Saharan Africa could reduce capital and operating costs for some of these companies, and allow them to develop markets in places where the traditional coal/petroleum/nuclear powered grid has not already become the dominant system.

Just as the information technology field was nurtured and blossomed in India, it would be similarly feasible for the renewable energy industry to be nurtured and grow in Sub-Saharan Africa.

The renewable technologies that could be nurtured include wind, solar, geothermal, micro-hydro, and biomass. To begin this nurturing of the renewable energy manufacturing industry in Sub-Saharan Africa, governments would offer incentives to developed world manufacturers. These would come in the form of guaranteed orders for large quantities of renewable energy technology. The orders would be substantial and yearly, so that the risk to initial direct investments by the company would be so reduced as to make the investment compelling.

6. SUSTAINABLE EXTENSION NETWORK

By David Silverman *(North Carolina Design Science Lab Global Energy Team participants)*

One of the most successful economic development programs in history was the U.S.-based Agricultural Extension Service. This program trained educators/farmers that would teach other farmers about the latest agricultural techniques for increasing productivity, reducing soil erosion, and managing resources. Agricultural productivity and economic well-being of farm communities was greatly accelerated.

The Sustainable Extension Network would be modeled after the U.S. Agricultural Extension Service. "Sustainability agents" would be trained and offices established throughout a developing country. The number trained would be a function of the number needed to cover the entire country. (In the U.S., every county had an extension agent.)

Sustainability agents would be responsible for increasing the energy, water, and resource efficiency use throughout the area they were stationed in. They would maintain currency with all sustainability research, document local efforts, and communicate these to other sustainability agents, as well as link local sustainability related organizations and help new organizations to form. The agent would collect community sustainability indicators and publish these, foster collaborative sustainability research, and foster local economic development

7. GREEN MOBILE HOMES

By Nick Consoletti *(North Carolina Design Science Lab Global Energy Team participants)*

Green mobile homes would provide suitable, affordable, resource efficient housing that can be integrated into existing urban and rural environments. They would be a component in urban slum revitalization, rural housing needs, and new "eco-village" developments.

The current mobile and pre-fabricated housing industry, or new entrants into this business, could build the green mobile homes. In developing countries, local manufacturing networks could be used to manufacture these units. Using local materials and labor, the impact on the economy and housing quality would be large. The housing units would have solar panels, greenhouses, water catchments, composting toilets, and other resource conserving devices as standard features thereby providing a higher quality of life for those living in the units, as well as building a growing body of expertise in these technologies.

LOCAL ENERGY STRATEGY

By Jonah Butcher, Robin Cape, Julie Clark, Dee Eggers, Alan Glines, Peter Harrison, Nancy Hodges, Janet Lowe, Stephanie Monson, Ari Zitin
(North Carolina Design Science Lab Local Energy Team participants)

Energy consumption over time

The local energy team focused primarily on the energy consumption and production in North Carolina and the Asheville/Buncombe area. They addressed questions such as:

- What renewable energy sources are being used in the region?
- What renewable energy sources are available in the region?
- What are the ways that energy consumption can be cut down in private, commercial, and public buildings?

Local Energy System Preferred State

The ideal local energy system is one that:

- Is carbon negative and runs off of renewable energy sources
- Is designed so that its energy systems solve pollution problems rather than create them; where there is an ever decreasing amount of waste; where waste from one part of the system is used as input into other parts; and where new energy installations are used as a catalyst for sustainability
- Is able to export surplus local renewable energy production
- Encourages social understanding and community
- Has an energy accounting system that is transparent, understandable, and accessible
- Has its electricity supplied from local sources
- Has an efficient, effective, and accessible transportation system based on renewable fuel sources
- Has all new construction designed to optimize energy efficiency through site and orientation; and existing structures are retrofitted for energy efficiency.

8. ELECTRICITY RATES RESTRUCTURING

Local energy strategies that could be implemented throughout the developed and developing world are needed if the world is to meet its energy needs in ways that do not undermine the planet's environment and climate.

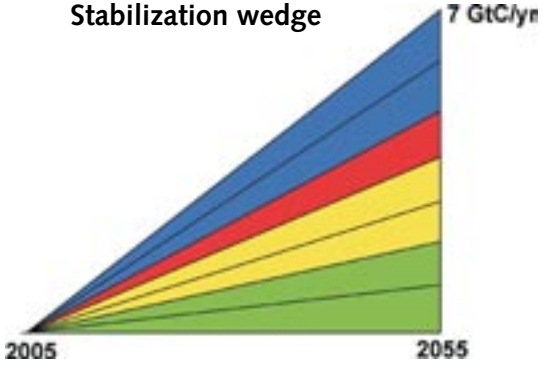
One approach that the Design Science Lab in North Carolina followed was that of the "stabilization wedges" described by Robert Socolow and S. Pacala of Princeton University.[4] This approach points out that "humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century. A portfolio of technologies now exists to meet the world's energy needs over the next 50 years and limit atmospheric CO_2 to a trajectory that avoids a doubling of the preindustrial concentration and climate problem over the next half-century." The North Carolina Lab developed a local plan that goes down this path.

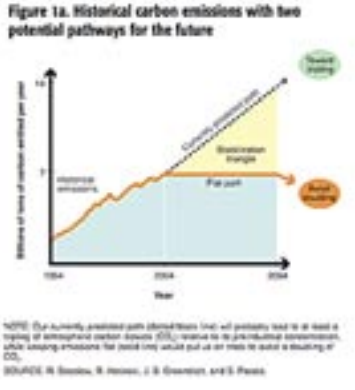
The wedge approach at the local level involved a series of actions. One was decreasing the reliance of electric utilities on fossil and nuclear fuels while increasing their use of renewable energy sources and energy conservation.

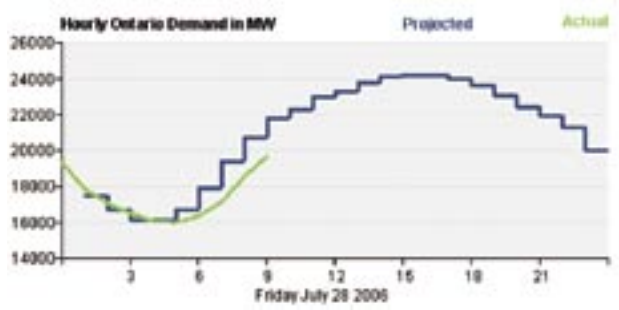
One way of doing this is to allow electric utilities to be in tune with undistorted market realities—rather than taking their cues from subsidized energy sources that lead to non-sustainable choices. One example of this is in Austin, Texas. Here, the local electric utility was allowed to offset new power plant construction by implementing energy conservation. It turned out to be far less expensive to save 1,000 MW of power through conservation and improvements in efficiency than it was to build a new power plant to meet peak load demands.

The utility implemented a rate structure that encouraged the driving down of peak use, and the use of conventional (fossil fuel) energy sources. New demand was, in effect, met with a "conservation power plant." The results of this electricity rate restructuring included the avoidance of constructing an additional 600+ MW of electrical generating capacity. The utility also avoided over 50% of the cost of constructing a 600 MW power plant, as well as the pollution, health, and environmental effects that would have gone with it.

Austin's utility was successful in doing this through a variety of actions and policies, including the encouragement of conservation, green buildings, district cooling, and education of the building trades (electricians, builders, plumbers, contractors).





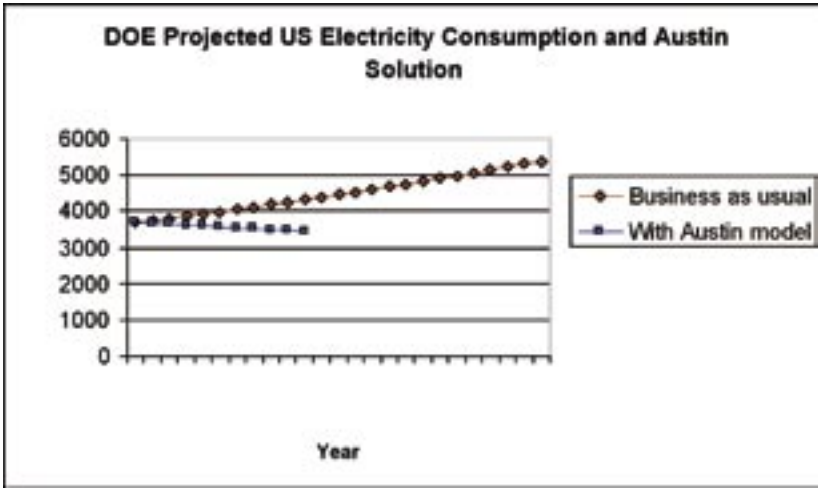


Note: Projected Ontario Demand uses a step graph to show the highest expected demand within the hour. Actual Demand uses a line graph to show average demand for that hour5.

energy projects paid back their initial costs in one to three years. Some of the projects took longer—but all were eight years or less. The return on investment in the form of decreased electricity costs makes these programs generate a net profit for the ratepayers quickly.

If the U.S. as a whole implemented the city of Austin's energy program, it would, in 10 years, save over $73 billion in electricity costs. Assuming half of this amount would run the conservation (and other) programs, there would be a net savings of approximately $36 billion. Additional savings from avoided health care costs, improved crop yield, materials damage, etc., would also accrue.

On a local level, for example in North Carolina, if the Austin energy program was implemented, it would result in the avoidance of building 9,000 MW of new power plants (about five coal and three nuclear plants) over the next ten years (saving over $5 billion in plant construction alone). The net savings to rate payers in North Carolina would be $2.5 billion. The return on investment for programs of this kind is substantial and rapid: most of Austin's



9. RESIDENTIAL HOME EFFICIENCY: BE A LOCAL HERO CAMPAIGN

Be a Hero is a community education and recognition campaign that encourages individual action that promotes climate protection and economic well-being through energy efficiency. The program honors community citizens who accomplish the greatest energy savings in the past year.

10. ENERGY-IN-A-BOX

Energy-In-A-Box is a community education campaign that assists in baseline energy efficiency audits through providing the core essentials for increasing energy efficiency in the average dwelling. The "Box" contains all the ingredients and tools needed to implement the easiest energy efficiency improvements into all homes. Local home improvement suppliers would be one of the primary sponsors.

A demonstration project in the Asheville area of North Carolina has a target of reaching 10,000 homes in two years. 125 volunteers from surrounding colleges and technical schools, in partnership with local home improvement stores, will lead the effort. Savings of close to $200/year per house ($2 million total/year) are projected. Implementing the *Energy-In-A-Box* program in half of the households in the state could offset the need for a new coal fired power plant.

The Energy-In-A-Box kit includes:

- Four compact fluorescent light bulbs (which last more than ten times longer than incandescent bulbs and use a quarter of the electricity)
- Two bottles of non-toxic caulk and 1 caulk gun for sealing openings in walls, doors, or ceilings. Caulking is one of the easiest and most cost-effective means of reducing energy waste, allowing people to save up to 10–15% on heating and cooling costs annually
- One roll of weather-stripping tape for securing windows and exterior door frames from the elements. Drafty windows and door frames are one of the leading causes of unnecessary heating and cooling, and repairing this problem is quick, easy, and economical
- One surge protector to reduce phantom load or "vampire" power. This is the energy that is drained by electronics like televisions and computers even when they are not turned on. Plugging these electronics into a surge protector allows users to switch them all off easily, with the potential to reduce energy consumption by as much as 10–15%.

STRATEGIC AREA 4: ENVIRONMENT

TThe North Carolina Design Science Lab Local Environment Team worked on strategies for transforming their local region's environment. (These strategies are summarized below. For a more detailed report, see *Volume 2* of the 2006 Design Science Lab Report.) It was assumed that the type of approach that could be taken in North Carolina could also be taken in most other parts of the world and, if aggressively implemented, would help reach Millennium Development Goal #7—that of "Ensuring environmental sustainability."

University of North Carolina Design Science Lab Local Environment Team
Michael Miller, Joel Fuller, Darcel Eddins, Cathy Holt, Gloria Howard Free, Molly Sprengelmeyer, George Reynolds,

The New York Design Science Lab Global Environment Team worked on strategies for building and strengthening sustainability into global environmental systems.

New York Design Science Lab Global Environment Team
Akeem Bello, Yoshimi Brett, Sergio Cordiero, Gonzague de Raulin, Easy, Sharif Ezzart, David Heeney, Florence Johnson, Morgan Maher, Marty McCrea, Aiesha Morris, Elizabeth Ramaccai, Ariel Ruvinsky

ENVIRONMENT FOR ALL FOR LIFE

Strategic summary: Reduce environmental impact, improve environmental sustainability, and strengthen the global and local economy through a needs and resources linking website, a tools and products package, and a series of local food, agriculture, and water system changes.

Introduction

The local environmental sustainability work of the Design Science Lab 2006 in North Carolina was focused on demonstrating how the use of sustainable urban agriculture and radical improvements in the use and conservation of the region's water resources could help provide a higher quality of food at a lower cost to both the consumer and the local, national, and global environment. It also developed strategies for the use of the region's water resources that leads to less erosion and flooding, better water quality, and improved all-around environmental quality.

The two parts of this strategic plan are:

- Regenerative Urban Agricultural Systems and
- Regenerating Water Systems.

The global environmental sustainability work of the Design Science Lab 2006 in New York was focused on demonstrating how the use of information technology and pre-packaged kits could make a large positive impact on local and global environmental problems.

The following pages describe these strategies.

Why the Environment?

> *"Nature does nothing uselessly."*
>
> —*Aristotle*

Every region of the world touched by modernity has suffered some forms of environmental degradation. Some of these environmental impacts are non-local in origin, such as acid rain, global warming, and loss of biodiversity. Many localities contribute to these global problems in ways that impact their local environment (such as producing their share of acid rain causing nitrous oxide). Many localities also do things that degrade "just" their local environment (or where the bulk of the visible and first order impacts are). These locally induced environmental impacts are a good place to begin the environmental healing and regeneration of the global environment.

State of the Local Environment

Every local environment has its problems, needs, and capacities. The local environment—whether in, for example, the Asheville, North Carolina, area of the United States or in Africa—is hampered by an agricultural system that is not sustainable. It has a heavy reliance on

subsidized fossil fuels that are used to grow, as well as import, food into the region.[1] Or, in the case of Africa, the amount of food produced is both inadequate and produced in ways that undermined the environment. This artificially maintained situation in the U.S. keeps local farmers from producing for the local market, raises prices for the consumer, and leads to agriculture practices that undermine local environmental resources.

In addition to the problems brought about through the long distance importation of food into different parts of the U.S., there are problems with local agriculture production and the processing of organic wastes. For example, only 20 tons out of 113 tons of Asheville's total organic waste is composted. If all organic wastes were composted the region would be in a stronger position to reduce the amount of fertilizers it uses and to regenerate its soil resource base. To deal with these and other problems facing areas of the U.S.—and as a model for other parts of the world—the following strategies have been developed:

- Sustainable Urban Agriculture
- Water Quality
- New Earth Exchange Website
- Community-In-A-Box

> "Ecosystems matter: Half of all jobs worldwide are in agriculture, forestry and fishing."
>
> —*World Resources Institute*

> "We will end up where we are headed if we do not change our direction."
>
> —*Ancient Chinese proverb*

Women working in a rice field in Palung, Nepal.
UN Photo/John Isaac

STRATEGIC AREA 4: ENVIRONMENT FOR ALL FOR LIFE

1. Sustainable Urban Agriculture
2. Water Quality
3. New Earth Exchange Website
4. Community-In-A-Box

1. SUSTAINABLE URBAN AGRICULTURE

The Sustainable Urban Agriculture program will establish community gardens in all neighborhoods and at all schools in the Asheville, North Carolina, region of the United States. These urban gardens/farms will produce fresh vegetables and fruits for the local market as well as teach students and adults the latest sustainable food production techniques.

In addition, the Sustainable Urban Agriculture program will plant greenways on the region's floodplains that contain diverse native plantings. Native animal species will also be reintroduced, where appropriate. The program will also institute a green-roofs and rooftop gardens program for all appropriate municipal buildings. This will decrease energy needs (cooling costs are reduced by 20% in green roof systems), collect and purify rainwater, decrease storm runoff, increase habitat for native species, and reduce urban heat island effect.

The Sustainable Urban Agriculture program will also implement a downtown "Edible Walkways" program, and establish compost systems in every garden. It will work with regional trash collectors to increase the amount of organic waste that is composted to 80% or more. It will also build cisterns for roof water catchments, and swales to water fruit trees.

In stage two of this strategy, the program will begin working on the production of mushrooms, and the cleaning up of brownfields. In some locations it will build greenhouses to extend the growing season. It will also forge linkages with Asheville Sister City programs in Mexico, Russia, and Greece to both share its programs, methods, and technology, and to learn from these cities what they are doing in these areas.

Benefits

Each 100 x 100 foot garden can produce up to $35,000 worth of food production each year under intense cultivation regimes. In addition to this revenue stream for local residents, this local food production will result in improved nutrition, increased local food security, green space for urban dwellers, waste recycling, pollution reduction, reduced environmental contamination from pesticides and fertilizers use, and increased employment.

2. WATER QUALITY

The Asheville region, like most every other region in the world, has water use problems. Streams and rivers are degraded from what they once were. Fertilizer, pesticide, industrial, and residential waste have all found their way into our water systems. In order to assure that our streams and rivers are biologically healthy for future generations, there is a need to deal with these problem in a comprehensive manner.

The primary cause of decline in water quality in the Asheville region is non-point source pollution from impervious surface (paved streets, parking lots, etc.) runoff. As impervious surfaces increase above 10%, water quality begins to decline proportionately. The impact of impervious ground cover includes higher volumes of storm water runoff, reduced groundwater recharge, higher peak flows and smaller low-water flows, increased pollutant load, and degradation of stream habitat.

There are 4,136 miles of streams and rivers in the Asheville region watershed. The amount of impaired stream miles in this region is 151.2 miles. This relatively low amount (3.6%) needs to be viewed in light of the fact that less than 25% of the streams and rivers are monitored for biological integrity. If the same proportion of the region's streams and rivers were impaired, the total would be over 600 miles.

Strategy: Floodplain Protection

In order to secure the quality of the regions rivers, streams, and water, local and regional planning organizations will implement a floodplain protection strategy. Part 1 of this strategy is a *Uniform Floodplain Ordinance.* This region-wide ordinance will call for and enforce a minimum of 50-foot streamside buffers utilizing native plant species. This will stabilize ground cover, reduce storm water runoff and erosion, and provide additional green spaces.

Part 2 of the strategy is the development and implementation of zoning of lands adjacent to streams and rivers for appropriate uses such as greenways, community gardens, parks, and recreation areas.

Part 3 of the strategy is the limiting of the total of impervious surfaces to10% within the 100-year floodplain, the protection of important natural areas, and reduction of sprawl. There will also be regional treatment areas that utilize biomimicry for removal of pollutants and low-impact development that utilizes clustering of development, and conservation areas for treatment of runoff.

Community Actions

There are numerous actions area residents can take to improve water quality by decreasing storm water run off. These actions include the

installation of storm water disconnects, rain barrels, rain gardens, wetlands, green roofs, and cistern collection of storm water. The primary monetary incentive for these actions will be the elimination of storm water utility fees.

Implementation

The key to the success of this strategy is education. Training for local governments, developers, and financial institutions will begin immediately. Education for municipal officials, residents (especially those living near streams and rivers), and the private sector is critical to success.

Non-point source pollution training for residents, modeled after the "Florida Yards and Neighborhood Program" will be implemented. Drought tolerant landscaping, composting, integrated pest management, and maintenance of septic systems will all be managed by a regional water quality board formed from communities within the watershed area.

Funding

Local funding sources include storm water utility fees and local impact fees for parks and open spaces. Other possible funding sources include land trusts, soil and water conservation districts, and the state Clean Water Management Trust Fund of the North Carolina Nonpoint Source Pollution Department. At the Federal level, the Natural Resource Conservation Service, EPA Region IV, and Tennessee Valley Authority all have funds for this type of strategy.

Timeline

- 2006—Educate stakeholders (local, state officials, developers, residents, schools and colleges, non-profit organizations such as environmental groups, land trusts, and Chamber of Commerce)
- 2010—Regional plan developed and implemented
- 2014—Prioritizing specific areas
- 2018—Property acquisition begins
- 2022—Develop greenways, parks, and recreation areas

REGENERATING THE GLOBAL ENVIRONMENT

By Akeem Bello, Yoshimi Brett, Sergio Cordiero, Gonzague de Raulin, Easy, Sharif Ezzart, David Heeney, Florence Johnson, Morgan Maher, Marty McCrea, Aiesha Morris, Elizabeth Ramaccai, Ariel Ruvinsky *(New York Design Science Lab Global Environment Team participants)*

Introduction

The global environmental sustainability work of the Design Science Lab 2006 in New York was focused on exploring the feasibility of a website that would link people from around the world in ways that allowed the listing of needs and resources, and a packaged set of tools and products that would meet the needs of people in remote developing areas.

The two parts of this strategic plan are:

- New Earth Exchange and
- Community-In-A-Box.

The following describe these strategies.

State of the Global Environment

- Non-sustainable agriculture and industrial practices undermine the ecological basis of global and local society
- Global air pollution; massive (7 billion ton[2]) release of CO_2 through the combustion of fossil fuels; in addition, N_2O, SO_2, mercury, and particulate matter are released causing widespread damage to crops, wildlife, and human health
- Massive loss of productive farmland through soil erosion and economic development of former farmland
- Loss of biodiversity through destruction of wildlife habitats
- Discharge of large quantities of toxic substances to groundwater, rivers, streams and oceans
- Thinning of ozone layer above southern and northern hemispheres; largest hole in the ozone layer over Antarctica ever in 2006
- Growing number of toxic waste sites throughout the world
- 2.6 billion people burn biomass fuels indoors for cooking are in danger of serious health risk
- Growing global population puts increasing strains on over-stressed ecosystems and resource use
- Increasing use of fossil fuels puts additional strains on global ecosystems
- Deforestation is rampant in many parts of the world, leading to soil erosion, decreased crop yields, and eventual desertification
- Mining for minerals and other economically productive materials has ravaged large parts of the world
- Deteriorating environmental systems cause people to migrate causing environmental refugees
- Environmental disasters, due to global warming, are on the increase

Preferred State for the Global Environment

- Sustainable agriculture produces society's food.
- Renewable energy supplies society's energy
- Regenerative practices renew, restore, strengthen, and maintain all environmental systems
- Global warming causes (i.e. atmospheric carbon dumping) are reversed

Environmental Sustainability Strategy

There are two primary components to the global environmental sustainability strategy:

- New Earth Exchange Website
- Community-In-A-Box

> "Quite clearly, our task is predominantly metaphysical, for it is how to get all of humanity to educate itself swiftly enough to generate spontaneous social behaviors that will avoid extinction."
>
> —*Buckminster Fuller*

3. NEW EARTH EXCHANGE WEBSITE

Strategy Goals

- Develop a regenerative flow of communication and collaboration between individuals, civil society, government, and the private sector throughout the world
- Share success stories, benefits, actions, and methods that achieve regenerative solutions to local problems in a transparent, inspiring and pro-active manner.

People at a local level already interact with others on a global scale via the Internet. The New Earth Exchange website will enable people to describe their needs, successes, and communicate with others who have had similar experiences. It will enable people to develop solutions together as well as to do research and gain access to products or services with which to improve the conditions or situations they face.

This website and service could be developed with funds from foundation, government, or private sector investments. It could be maintained through ad revenue, donations, or user fees.

The site could be linked with the SEED (see page 28) and Em-Power Book (see page 49) initiatives.

4. COMMUNITY-IN-A-BOX

Community-In-A-Box is a packaged collection of tools, artifacts, instruments, materials, how-to manuals, and educational devices. It is aimed at helping the developing world meet its needs for shelter, energy, food, water, and sanitation. It is sent to a community to help the community solve the problems they face. Its contents are based upon the community's self-described needs as articulated on the *New Earth Exchange* website.

For example, the package could include the following items to help ensure an environmental problem is solved:

- Building construction kit
  - o Materials, tools, and 'how-to' manuals for building and/or using the following:
    - Rainwater catchment systems
    - Water purification systems
    - Sanitation facilities
    - Irrigation pump
    - Food storage facility
- Energy systems
  - o Solar systems for electricity generation
  - o Small scale hydro system
- Communication Tools
  - o Cell phone
  - o Solar powered laptop computer with Internet access
- School-In-A-Box
- Health Education kit

Other *Community-In-A-Box* kits for meeting other community needs could be put together. Other needs include water, energy, sanitation, health, shelter, and employment.

Marketing, Finance, and Dissemination

Both strategies would need to partner with agencies already in underdeveloped areas to help people gain awareness of and access to these opportunities.

SUMMARY/CONCLUSIONS

The strategies described in this report outline a series of policies, programs, and action plans that, if implemented, would meet various Millennium Development Goals of the United Nations as well as move the world, in the years beyond 2015, to even higher levels of human well-being. Taken individually, each strategy can stand alone in making a significant contribution to improving some aspect of the human condition. Taken collectively, the strategies are more than the sum of their parts. They would, if implemented together, have a profound impact on our collective wealth, health, and potential.

The global and local strategies described help illustrate the creativity, values, vision, and commitment of the youth and concerned citizens of the world. They also represent what an interdisciplinary, multigenerational group of non-experts can do when provided an opportunity and methodology for tackling the critical and complex problems facing the world. Your feedback is most welcome—as is your ongoing participation in this evolving work. One way to do this is to visit the Design Science wiki (where the first drafts of much of the work in this report was developed). This can be found at http://www.dsl.bigpicturesmallworld.com

As indicated at the beginning of this document, this is the second year of the Design Science Lab. Those wishing to take part in coming Labs are urged to contact BigPictureSmallWorld at www.bigpicturesmallworld.com, the Buckminster Fuller Institute at www.bfi.org, or check in at www.designsciencelab.org.

Participants of teh Design Science Lab presenting to the United Nations at the conclusion of the Lab.

APPENDIX: THE UN MILLENNIUM DEVELOPMENT GOALS

Goal #1: Eradicate extreme poverty and hunger

- Reduce by half the proportion of people living on less than a dollar a day.
- Reduce by half the proportion of people who suffer from hunger.

Goal #2: Achieve universal primary education

- Ensure that all boys and girls complete a full course of primary schooling.

Goal #3: Promote gender equality and empower women

- Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015.

Goal #4: Reduce child mortality

- Reduce by two thirds the mortality rate among children under five.

Goal #5: Improve maternal health

- Reduce by three quarters the maternal mortality ratio.

Goal #6: Combat HIV/AIDS, malaria and other diseases

- Halt and begin to reverse the spread of HIV/AIDS.
- Halt and begin to reverse the incidence of malaria and other major diseases.

Goal #7: Ensure environmental sustainability

- Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources.
- Reduce by half the proportion of people without sustainable access to safe drinking water.
- Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020.

Goal #8: Develop a global partnership for development

- Develop further an open trading and financial system that is rule-based, predictable and non-discriminatory. Includes a commitment to good governance, development and poverty reduction—nationally and internationally.
- Address the least developed countries' special needs. This includes tariff- and quota-free access for their exports; enhanced debt relief for heavily indebted poor countries; cancellation of official bilateral debt; and more generous official development assistance for countries committed to poverty reduction.
- Address the special needs of landlocked and small island developing States.
- Deal comprehensively with developing countries' debt problems through national and international measures to make debt sustainable in the long term.
- In cooperation with the developing countries, develop decent and productive work for youth.
- In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries.
- In cooperation with the private sector, make available the benefits of new technologies—especially information and communications technologies.

ENDNOTES

Introduction: Design Science Lab

1 For more information on the Millennium Development Goals, see http://www.un.org/millenniumgoals/

2 Some of the work of the North Carolina Design Science Lab dealt with global problems and solutions. These have been interwoven in this document in places where their content compliments or builds on the work of the New York Lab.

Strategic Area 1: Education/Literacy

1 Details of this strategy can be found at http://www.dslnc.bigpicturesmallworld.com

2 A search in Google for "educational agencies" results in 1.1 million results. WE CAN's purpose would be to make as many of these resources available to the developing world as possible.

3 Additional details of this strategy can be found at http://www.dslnc.bigpicturesmallworld.com

4 Details of this strategy can be found at http://www.dslnc.bigpicturesmallworld.com

5 Further details of this strategy can be found at http://www.dslnc.bigpicturesmallworld.com

6 http://www.Firstmilesolutions.com

7 Further details of this strategy can be found at http://www.dslnc.bigpicturesmallworld.com

8 These figures are close to those obtained by UNICEF in their "minimum global estimate" of $9.1 billion

9 Literacy correlates with cereal yields: 0.653; literacy with GNP/capita: 0.584; literacy with calorie consumption: 0.672. Correlations were done in the software program Global Data Manager. Literacy rate is from Central Intelligence Agency, *World Factbook 1989* (Washington, D.C.: CIA, 1989). GNP/capita is from The World Bank, pp. 178-179.; cereal yield is from World Resources Institute, pp. 278-279.; calorie consumption is from FAO, pp. 291-292; infant mortality and life expectancy are from *World Population Data Sheet 1990*. Also see The World Bank, *The Contributions of Education to Economic Growth: International Comparisons*. World Bank Reprint Series, No. 320 (Washington, D.C.: The World Bank, 1985), where it is pointed out that four years of primary education is associated with an average increase in farm productivity of 10% or more.

10 "Income by educational attainment," (*The Economist,* June 23, 2001, p. 104).

11 "Returns to education," (*The Economist,* November 2, 2002, p. 96).

12 Literacy with infant mortality: -0.815 ; literacy with life expectancy: 0.822. Correlations were done in the software program Global Data Manager. On average, each additional year of schooling is associated with a decrease in infant mortality rate of approximately nine per 1,000; K. Hinchliffe, *The Monetary and Non-Monetary Returns to Education in Africa*. The World Bank Education and Training Series, Report EDT46 (Washington, D.C.: The World Bank, 1986).

13 "No school, no future," (*The Economist*, March 27, 1999, p. 45).

14 Center for Defense Information, http://www.cdi.org/issues/aviation/B296.html

15 *State of the World 2004*, (Washington D.C., Worldwatch Institute, 2004 p. 163).

Strategic Area 2: Health

1 Dr. Sugata Mitra, NIIT, World Bank
2 74 of 1,000 children die during infancy (one of the highest rates of infant mortality in the world).
3 By 2011, the bottled water supply to Singapore from the Malaysian government will be cut off if a price for bottled water is not agreed upon. Singapore is actively looking for alternative suppliers.
4 World's Largest Urban Areas [Ranked by Urban Area Population] http://www.mongabay.com/cities_urban_01.htm
5 Based on a prototype facility built in Georgia, USA
6 Malaria Facts. National Center for Infectious Diseases, Division of Parasitic Diseases. Atlanta: Center for Disease Control and Prevention, 2004. 26 June-July 2006. http://www.cdc.gov/Malaria/facts.htm
7 "Malaria in Africa." Roll Back Malaria. Roll Back Malaria, WHO. 26 June-July 2006. <http://www.rbm.who.int/cmc_upload/0/000/015/370/RBMInfosheet_3.htm>.
8 "Economic Costs of Malaria." Roll Back Malaria. Roll Back Malaria, WHO. 26 June-July 2006 <http://www.rbm.who.int/cmc_upload/0/000/015/363/RBMInfosheet_10.htm>.
9 ibid
10 ibid
11 The SC Johnson Company has been a producer of a commercial aerosol insecticide, Raid, since 1956. The active ingredient of this Raid is the natural insecticide pyrethrum.
12 Average size of small farm is 3 to 4 hectares, therefore 22,000 pumps are needed for 66,000 hectares; Each micro-pump costs $100, therefore total cost is $2.2 million

Strategic Area 3: Energy

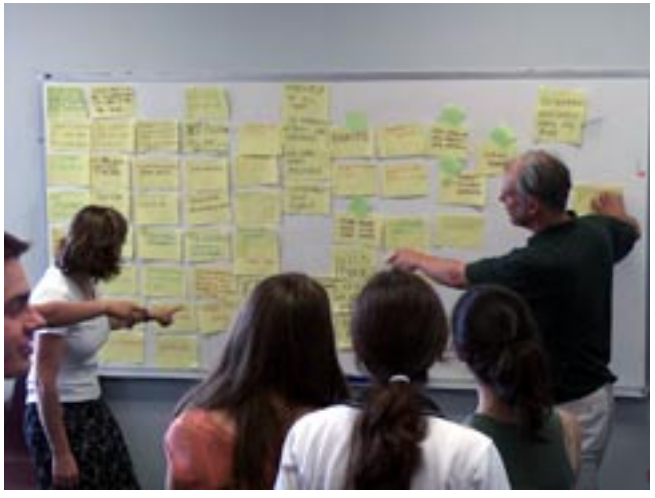
1 Energy Survey "A brighter future?" (*The Economist*, February 10, 2001, p.11).
2 *Wind Force 12*, (Greenpeace and European Wind Energy Association, p. 12, 2002) http://www.choose-positive-energy.org/html/content/news_prscntr.htm
3 Union of Concerned Scientists: Barriers to the Use of Renewable Energy Technologies, *Powerful Solutions: Seven ways to Switch America to Renewable Electricity,* UCS, 1999
4 S. Pacala1* and R. SocolowS. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." *Science*, August 13, 2004 Vol. 305.
5 IESO: http://www.theimo.com/imoweb/siteShared/demand_price.asp?sid=ic

Strategic Area 4: Environment

1 *Empty Breadbasket: The Coming Challenge to America's Food Supply and What We Can Do About It.* Rodale Press, 1985.
2 S. Pacala1 and R. Socolow. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." *Science*, August 13, 2004 Vol. 305.










“You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.”

—R. Buckminster Fuller