M2794.006900 DESIGN FOR MANUFACTURING

Week 6, October 10

Introduction to Appropriate Technology (AT)

Fall 2017

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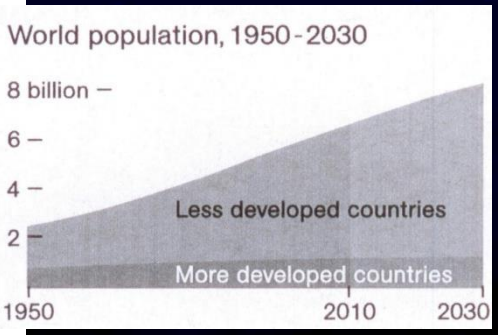
Seoul National University

Contents

- **Introduction to AT**
  - Background, definition and history of AT
- **Global importance and role of AT**
- **Examples of AT**

Urgent issues of the world



99% of Norway's power is from hydro, while 96% in the UK is fossil or nuclear power.

In Iceland, 100% of the energy comes from hydro and geothermal with excess to create hydrogen for fuel cells.

The lights in Canada are 58% hydropower, while in the United States, 91% of electricity comes from fossil and nuclear power.

98% of Chinese people have electricity access, however 82% is produced from fossil and nuclear fuels.

509 million people in Sub-Saharan Africa live in the dark, they have no access to electricity.

Even with these lights: 713 million out of 1.4 billion people in South Asia* still have no electrical services.

Brazil gets 83% of its energy from hydropower.

Australia is blessed with solar, geothermal and tidal resources, but is still using 92% fossil fuels. In contrast to New Zealand, which gets 68% of their electricity from hydro and geothermal.

Earth at Night
More information available at:
http://antwrp.gsfc.nasa.gov/apod/ap001127.html
Online Version of this Map: www.geni.org/globalenergy/multimedia/earth-at-night.shtml

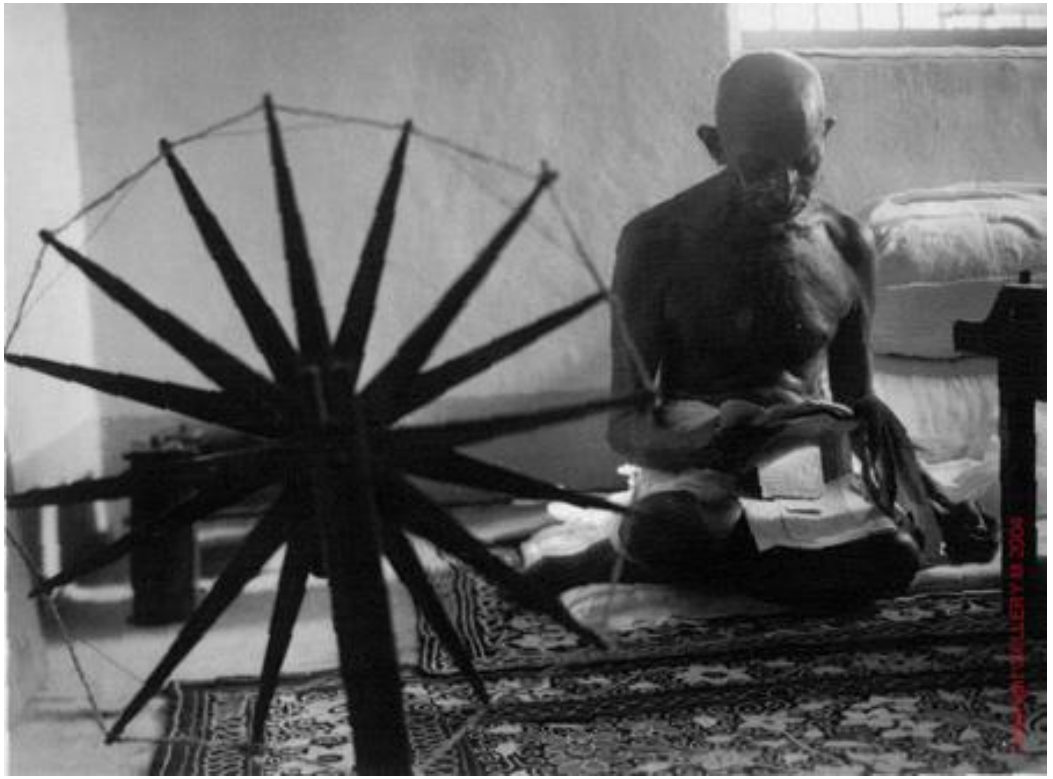
Sources: CIA World Factbook (www.cia.gov/cia/publications/factbook/)
IEA Energy Statistics (www.iea.org/Textbase/stats/)
World Energy Council (www.worldenergy.org)
* South Asia: Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka

Electricity is Essential for Development

The Earth at Night map from NASA shows areas of prosperity -- those people with access to electricity. 1.6 billion, 25% of humanity, remain in the dark -- with no access to running water, refrigeration or lighting. Nearly all the lights in this picture are supplied via high-voltage transmission lines, and 100 nations already exchange power across borders. To meet the UN Millennium Development Goals, a combination of grid-connected and stand-alone renewable electricity development will elevate a community out of basic poverty in an environmentally sustainable manner. While most nations use polluting fossil and nuclear fuels, abundant renewables -- hydro, geothermal, biomass, wind and solar -- exist on every continent. Linking the renewable electricity resources in Africa and South Asia will provide the foundation for ending hunger and poverty.

History of AT

- Mahatma Gandhi (Mohandas Karamchand Gandhi, India, 1869~1948)
- Gandhi advocated for small, local and predominantly village-based technology to help India's villages become self reliant
- Spread handlooms to Indian villages

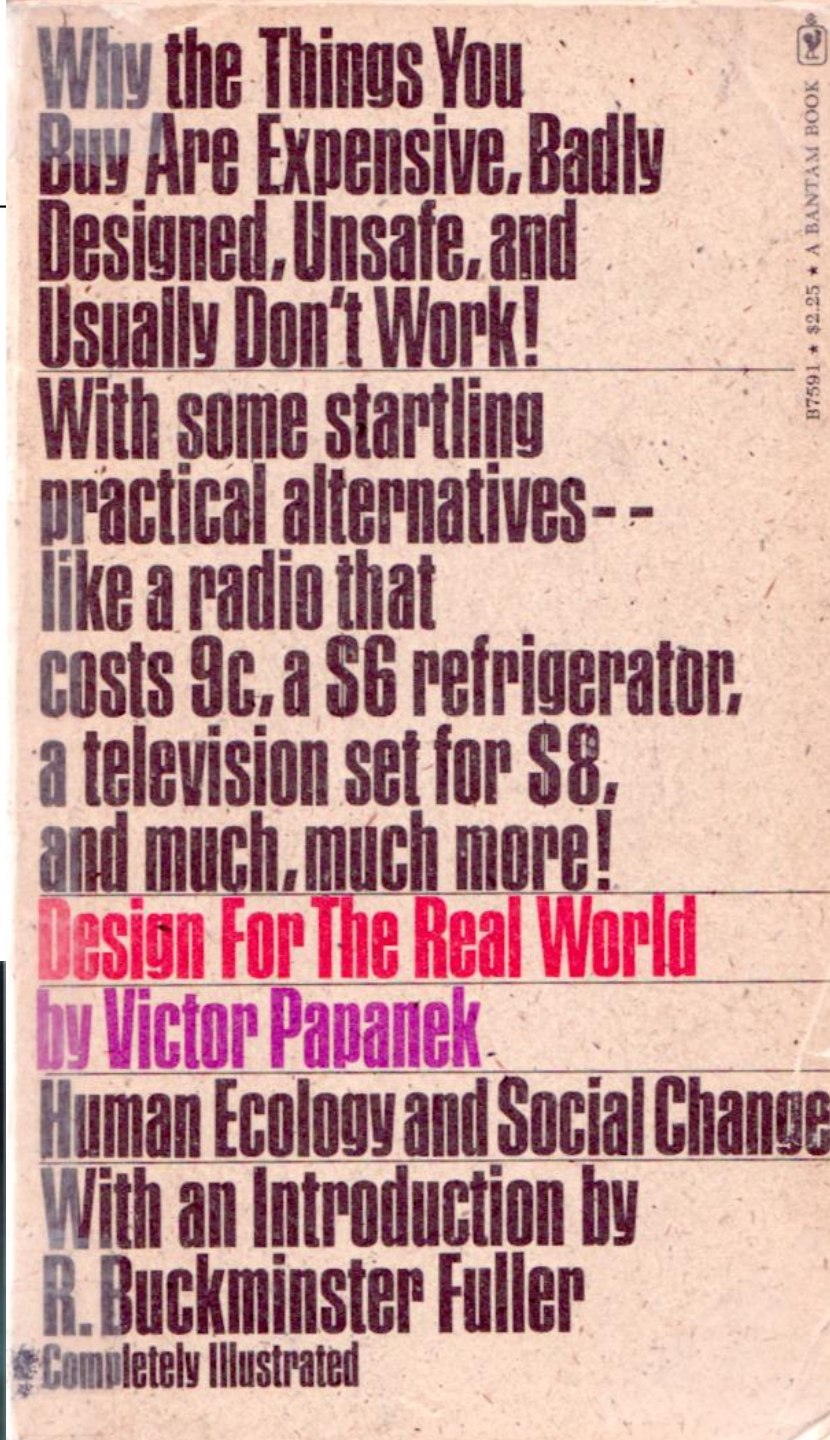


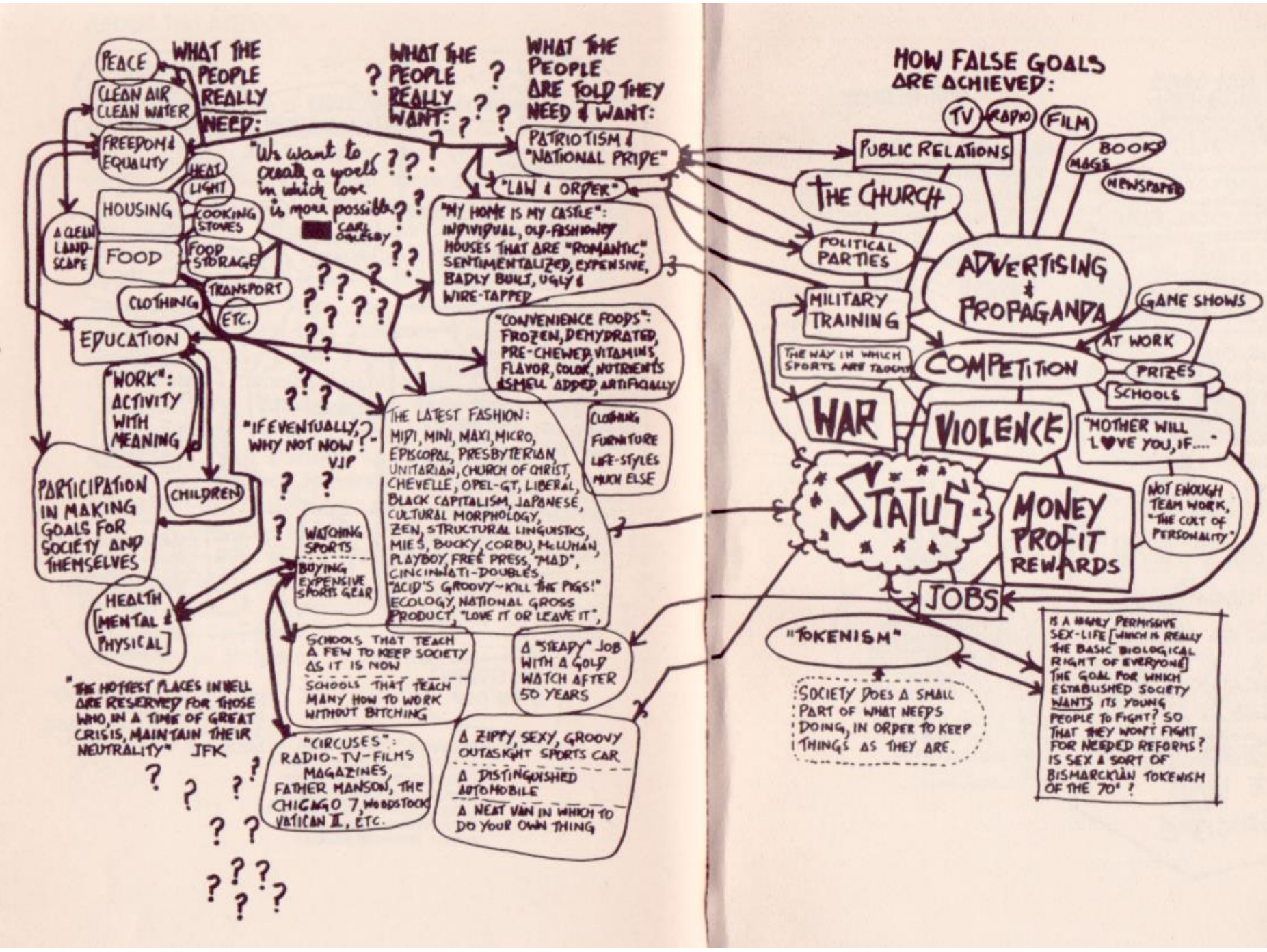
History of AT

- **E. F. Schumacher**, (August 16, 1911 – September 4, 1977, Bonn, German)
  - Ideological movement (and its manifestations) originally articulated as "**intermediate technology**" → developed to Appropriate Technology
  - Discussed in relationship to economic development and as an alternative to transfers of capital-intensive technology from industrialized nations to developing countries
- **Small is Beautiful, First published in 1973**
  - One of the fundamental books on ecological economics.
  - In *Small is Beautiful*, Schumacher also proposed "**Buddhist Economics**," which "**tries to maximize human satisfactions by the optimal pattern of consumption**," as opposed to mainstream Western economics, which "**tries to maximize consumption**".
  - The book is divided into four parts
    - PART I - THE MODERN WORLD
    - PART II - RESOURCES
    - PART III - THE THIRD WORLD
    - PART IV - ORGANISATION AND OWNERSHIP

History of AT

- Victor Papanek (Autria, 1927~1998)
  - **Design for Human Scale-** Papanek writes: "Much recent design has satisfied only evanescent wants and desires, while the genuine needs of man have often been neglected by the designer.“
  - **9 cent radio (1966)**
    - **For Indonesian people to prevent hazard from volcanos**
    - **Thermoelectric power – knowledge on engineering !**
    - **No profit for any stake holders**

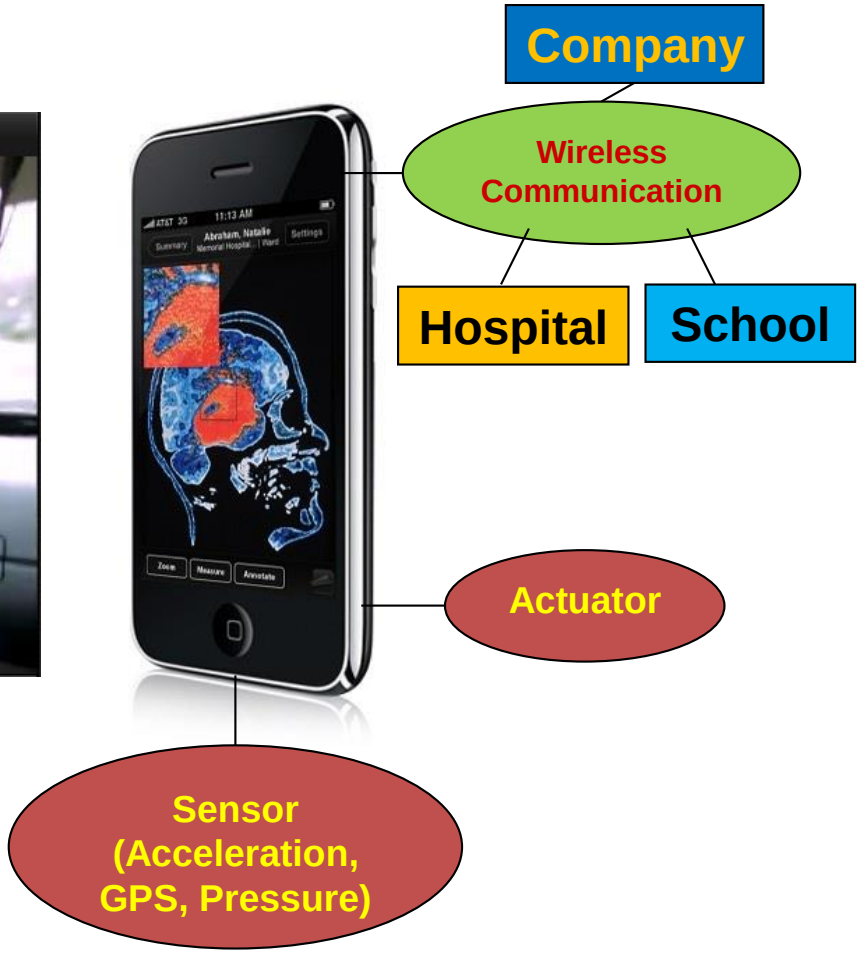



WHAT THE PEOPLE REALLY NEED:
PEACE
CLEAN AIR CLEAN WATER
FREEDOM & EQUALITY
HOUSING
HEAT
LIGHT
COOKING STOVES
A CLEAN LAND-SCAPE
FOOD
FOOD STORAGE
TRANSPORT
CLOTHING
ETC.
EDUCATION
"WORK": ACTIVITY WITH MEANING
PARTICIPATION IN MAKING GOALS FOR SOCIETY AND THEMSELVES
CHILDREN
HEALTH [MENTAL & PHYSICAL]
"THE HOTTEST PLACES IN HELL ARE RESERVED FOR THOSE WHO, IN A TIME OF GREAT CRISIS, MAINTAIN THEIR NEUTRALITY" JFK
WHAT THE PEOPLE REALLY WANT:
"We want to create a world in which love is more possible." CARL OGLESBY
"IF EVENTUALLY, WHY NOT NOW!" VJP
WHAT THE PEOPLE ARE TOLD THEY NEED & WANT:
PATRIOTISM & "NATIONAL PRIDE"
"LAW & ORDER"
"MY HOME IS MY CASTLE": INDIVIDUAL, OLD-FASHIONED HOUSES THAT ARE "ROMANTIC", SENTIMENTALIZED, EXPENSIVE, BADLY BUILT, UGLY & WIRE-TAPPED
"CONVENIENCE FOODS": FROZEN, DEHYDRATED, PRE-CHEWED, VITAMINS, FLAVOR, COLOR, NUTRIENTS & SMELL ADDED, ARTIFICIALLY
THE LATEST FASHION: MIDI, MINI, MAXI, MICRO, EPISCOPAL, PRESBYTERIAN, UNITARIAN, CHURCH OF CHRIST, CHEVELLE, OPEL-GT, LIBERAL, BLACK CAPITALISM, JAPANESE, CULTURAL MORPHOLOGY, ZEN, STRUCTURAL LINGUISTICS, MIES, BUCKY, CORBU, McLUHAN, PLAYBOY, FREE PRESS, "MAD", CINCINNATI-DOUBLES, "ACID'S GROOVY ~ KILL THE PIGS!" ECOLOGY, NATIONAL GROSS PRODUCT, "LOVE IT OR LEAVE IT",
CLOTHING FURNITURE LIFE-STYLES MUCH ELSE
WATCHING SPORTS
BUYING EXPENSIVE SPORTS GEAR
SCHOOLS THAT TEACH A FEW TO KEEP SOCIETY AS IT IS NOW
SCHOOLS THAT TEACH MANY HOW TO WORK WITHOUT BITCHING
A "STEADY" JOB WITH A GOLD WATCH AFTER 50 YEARS
"CIRCUSES": RADIO-TV-FILMS MAGAZINES, FATHER MANSON, THE CHICAGO 7, WOODSTOCK VATICAN II, ETC.
A ZIPPY, SEXY, GROOVY OUTASIGHT SPORTS CAR
A DISTINGUISHED AUTOMOBILE
A NEAT VAN IN WHICH TO DO YOUR OWN THING
HOW FALSE GOALS ARE ACHIEVED:
TV
RADIO
FILM
BOOKS
MAGS
NEWSPAPER
PUBLIC RELATIONS
THE CHURCH
POLITICAL PARTIES
ADVERTISING & PROPAGANDA
GAME SHOWS
MILITARY TRAINING
AT WORK
THE WAY IN WHICH SPORTS ARE TAUGHT
COMPETITION
PRIZES
SCHOOLS
WAR
VIOLENCE
"MOTHER WILL LOVE YOU, IF...."
STATUS
MONEY PROFIT REWARDS
NOT ENOUGH TEAM WORK, "THE CULT OF PERSONALITY"
JOBS
"TOKENISM"
SOCIETY DOES A SMALL PART OF WHAT NEEDS DOING, IN ORDER TO KEEP THINGS AS THEY ARE.
IS A HIGHLY PERMISSIVE SEX-LIFE [WHICH IS REALLY THE BASIC BIOLOGICAL RIGHT OF EVERYONE] THE GOAL FOR WHICH ESTABLISHED SOCIETY WANTS ITS YOUNG PEOPLE TO FIGHT? SO THAT THEY WON'T FIGHT FOR NEEDED REFORMS? IS SEX A SORT OF BISMARCKIAN TOKENISM OF THE 70's?

History of AT

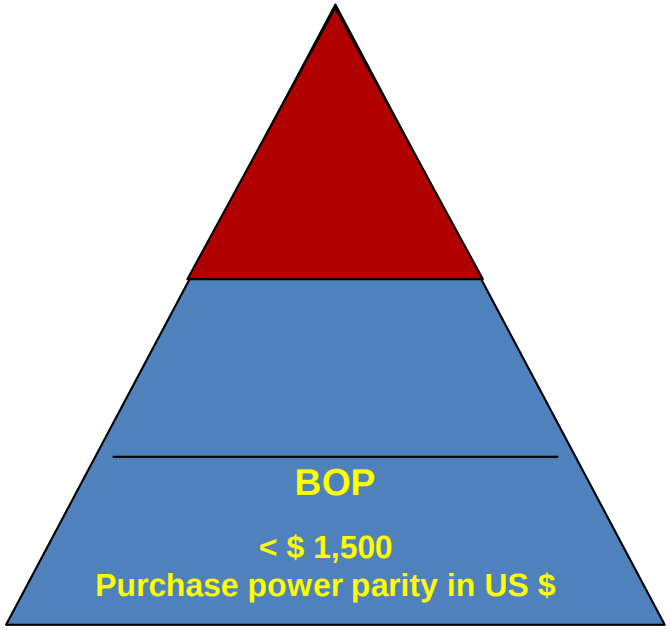
- **Paul Polak (Czech Republic / USA)**
  - He provocatively argues that the "**appropriate technology" movement has died** - by which he means that its flowering in decades past had no major impact on the poor, and many organizations devoted to appropriate technology have closed or scaled down.
  - **Founder of IDE, D-Rev and Windhorse International**
  - **He treats poor people as customers and emphasizes profit by business**

Technology for TOP



Appropriate Technology – broader view

- AT
- Quality of Life Technology
- Social Technology
- Welfare Technology
- Technology for BOP
- Universal Design



What is appropriate?

- Wage
- Technology
- Customer's needs
- Local resource

→ Global collaboration maximizing mutual benefits

AT++

- **Issue to consider – extreme affordability**

  10*30 << 300 ??

- **Beyond technology**

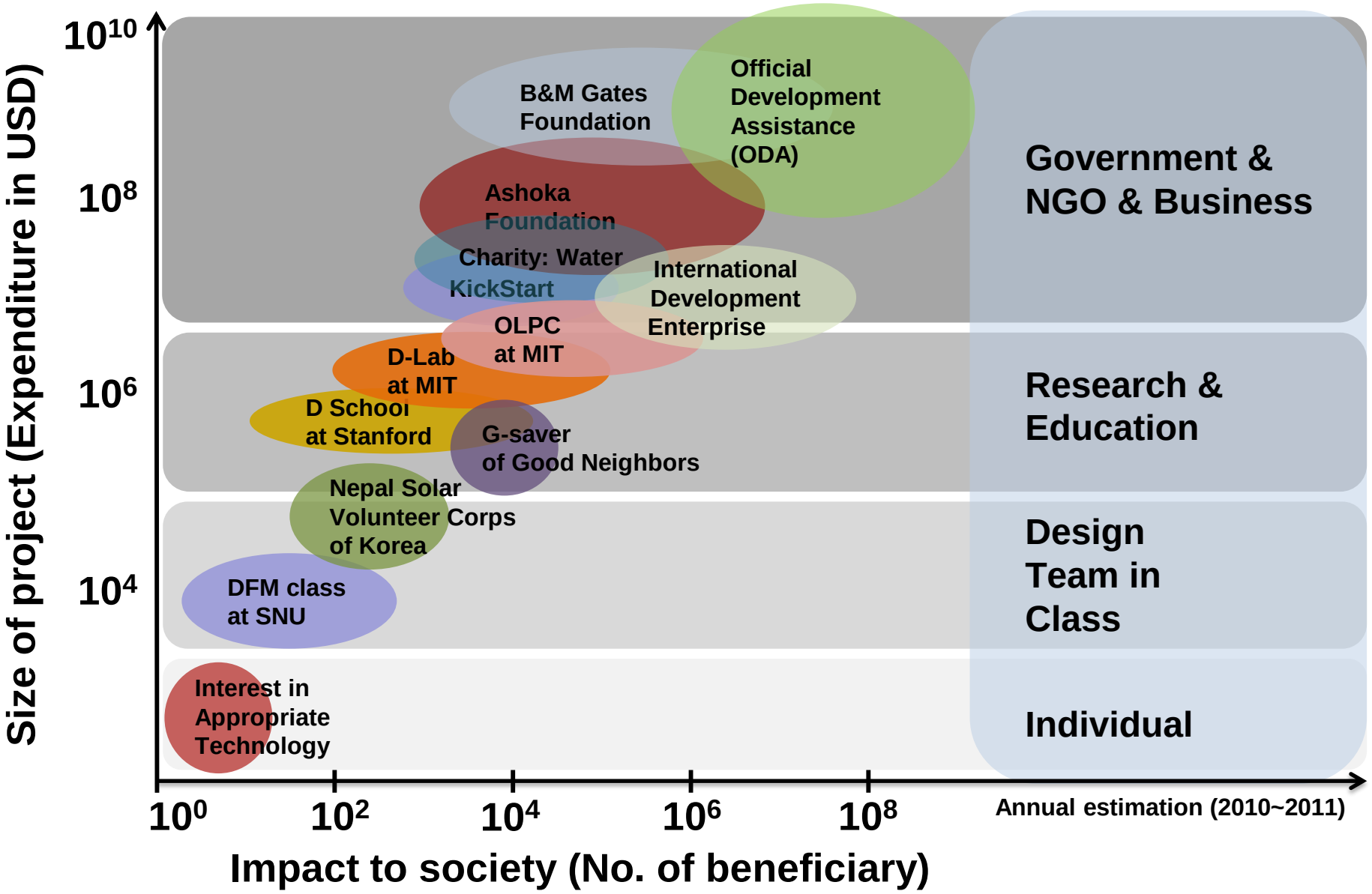
  - SELCO (Harish Hande)
    - -Solar plant + Micro finance → 500,000 units
  - D.light Design (Sam Goldman)
    - -Peace Corps, champion of GSVC → 2 million people
  - Dambisa Moyo – “Dead Aid”

  -Micro finance - Muhammad Yunus, 2006 Nobel Peace Prize, Grameen Bank

Harish Hande

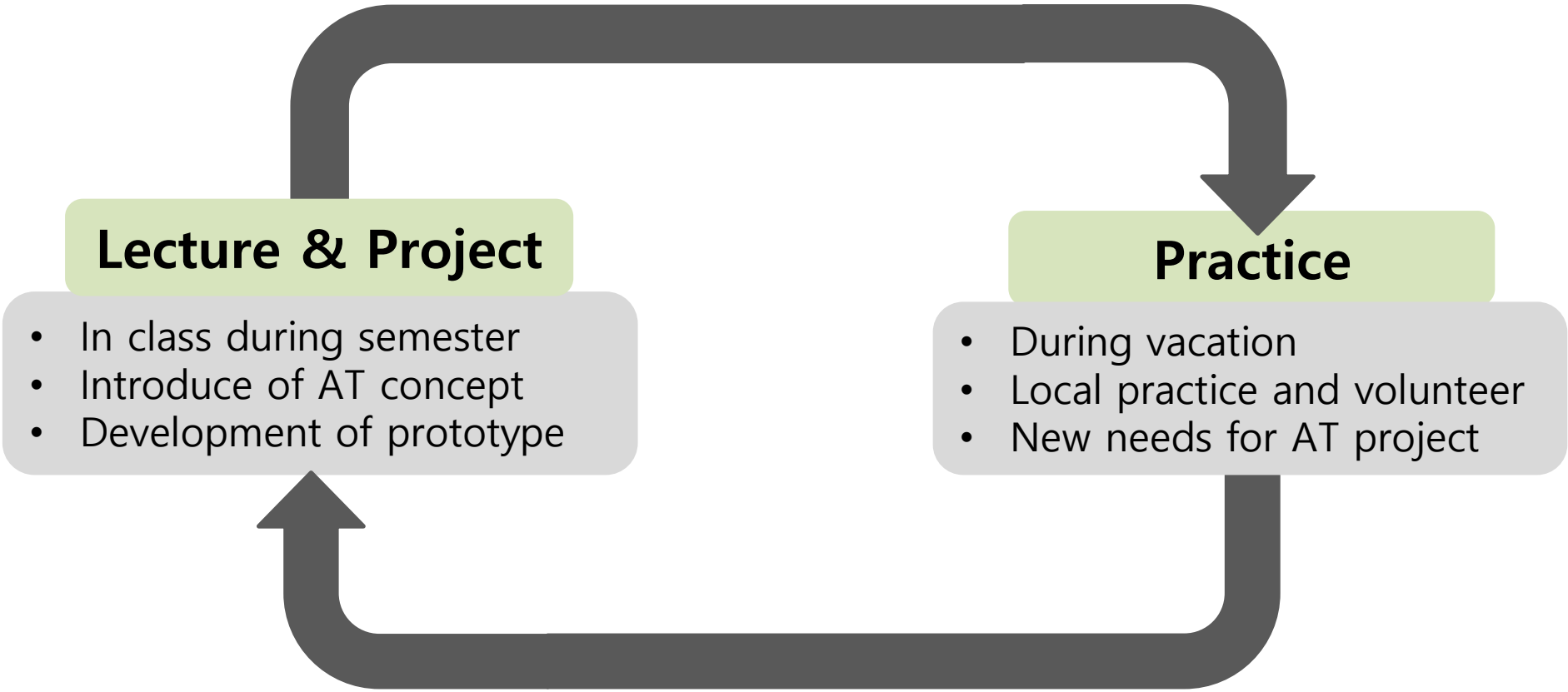
Sam Goldman

Impact of AT projects



Development & application model

- **Simple 2 step model of DFM class at SNU**



Global importance and role of AT

Public contribution
Benefit many people
in developing countries

Environmentally friendly
Decrease emission of pollutants
and minimize the consumption
of energy resources

Agenda of G20
Poverty reduction and economic
development of developing countries
Mitigation of the development
gap between countries

Appropriate technology

High technology
Available in high technology
combined with
appropriate technology

Social enterprise
Founding of social enterprise
and improve the ability
of the poor economy

Millennium development goal (MDG) by UN
Important in achieving
the Millennium Development Goals UN

Global importance and role of AT

- **Millennium Development Goals(MDG) of UN**
  - September 8th, 2000.
    All 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015.
  - Agenda
    - Eradicating extreme poverty
    - Reducing child mortality rates
    - Fighting disease epidemics such as AIDS
    - Developing a global partnership for development

Ref) http://www.who.int/topics/millennium_development_goals/en/

Global importance and role of AT

- **Millennium Development Goals**

MDG 1: Eradicate extreme poverty and hunger

MDG 2: Achieve universal primary education

MDG 3: Promote gender equality and empower woman

MDG 4: Reduce child mortality

MDG 5: Improve maternal health

MDG 6: Combat HIV/AIDS, malaria and other diseases

MDG 7: Ensure environmental sustainability

MDG 8: Develop a global partnership for development

MDG agenda can be effectively implemented via the "**appropriate technology**"

Global importance and role of AT

- **Sustainable Development Goals (SDGs)**

Global importance and role of AT

- **Major differences between MDG and SDG**

  Difference #1: Zero Goals

  Difference #2: Universal Goals

  Difference #3: More Comprehensive Goals

  Difference #4: Addressing THP Pillars

  Difference #5: Inclusive Goals Setting

  Difference #6:Distinguishing Hunger and Poverty

  Difference #7:Funding

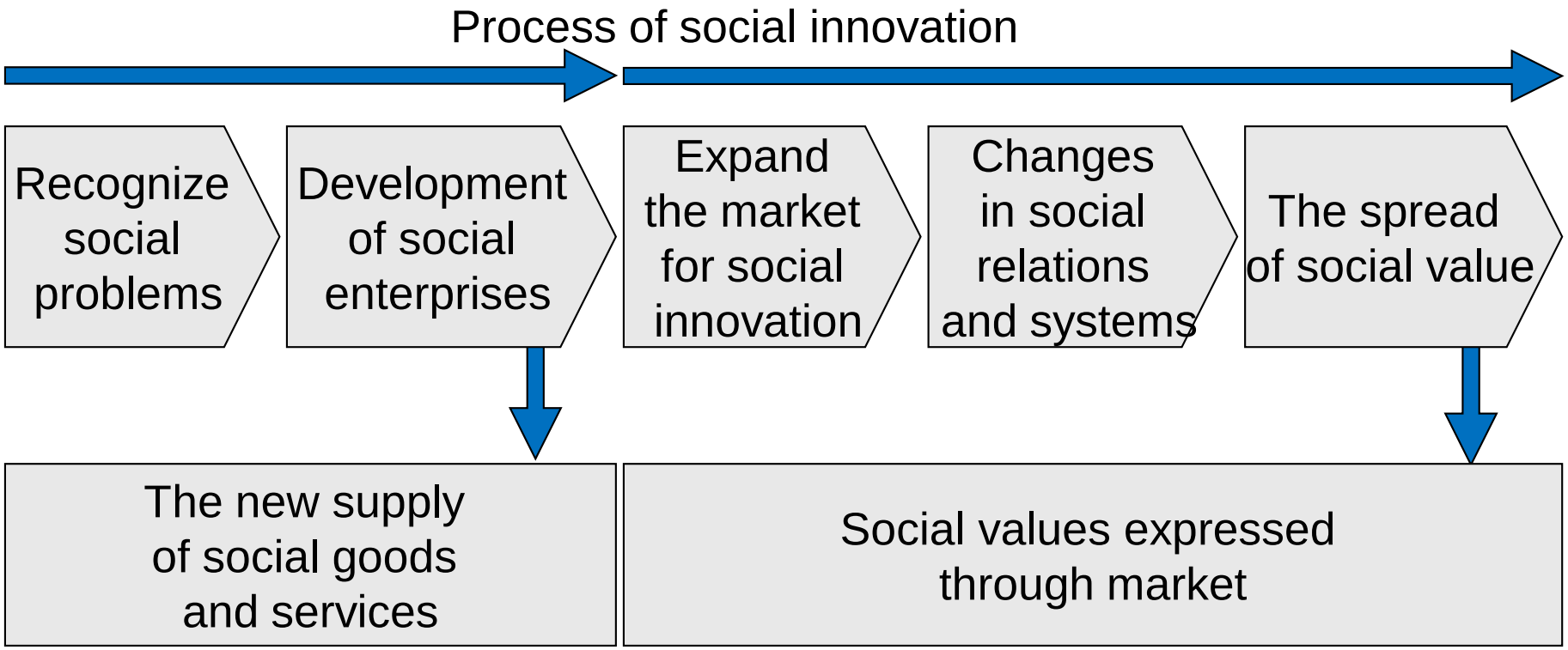
  Difference #8: Peace Building

  Difference #9: Data Revolution

  Difference #10: Quality Education

Social enterprise

- **Social enterprise :** Organization that applies business strategies to achieving philanthropic goals



Social enterprise

- Types of social enterprise
  - Advantages of social enterprise
    - Ability to raise capital at below market rates due to the ethical investment industry
    - Easier access to publicity
    - Labor costs below average
  - **For-profit**
    - Profits that are not re-invested in the organization are distributed to the owners of the corporation as cash
    - Ex) **John Lewis** : Share of annual profits with owner and employees
  - **Non-profit**
    - Uses surplus revenues to achieve its goals rather than to distribute them as profit or dividends
    - Ex) **The Big Issue** : Street newspaper published in eight countries offer homeless people the opportunity to earn a legitimate income

Global AT research institutions

- Outside research institutions
  - NGO, company, and institution
    - Vestergaard Frandsen
    - International development enterprise (IDE)
    - Solar cooker international
    - Kickstart international
  - University
    - Massachusetts institute of tech.(MIT)
    - Stanford University
    - Colorado State University
    - John Brown University
    - Barefoot College
  - Government
    - U.S. Agency for international development
    - U.S. Department of agriculture
    - U.S. Department of energy

VESTERGAARD FRANDSEN

IDE

KickStart

D-Lab

d. HASSO PLATTNER Institute of Design at Stanford

kopernik technology marketplace

Development & application

- **Kickstart**
  - 5 Step Process

1	**IDENTIFY OPPORTUNITIES** What business will be profitable for these people, in this place?
2	**DESIGN PRODUCTS** What new tools will make this possible?
3	**ESTABLISH A SUPPLY CHAIN** How can we produce these?
4	**DEVELOP THE MARKET** How do we convince someone with little money to make a big investment?
5	**MEASURE AND MOVE ALONG** Is this going as we planned?

Ref) Kick Start: *http://www.kickstart.org/*

Development & application

- **Products**
  - All KickStart products are designed with one purpose in mind:

to help a person make enough money to lift their family out of poverty.

Products In Development

At KickStart, our Technology Development department in Nairobi is constantly at work improving our current products and developing new money-making technology for people in the developing world.

Super MoneyMaker

The Super MoneyMaker Pump is KickStart's best-selling pump with over 150,375 sold to date.

MoneyMaker Hip Pump

The MoneyMaker Hip Pump is KickStart's newest, lightest, and most affordable pump. Already over 29,375 in use.

Ref) Kick Start: *http://www.kickstart.org/*

Education and promotion

- ABOUT DESIGN OTHER 90: NETWORK
  - The Design Other 90 Network is an open-network database
  - **Share** vital design resources for developing and emerging economies.
  - **Connect** with stakeholders in the fields of design, architecture, sustainability, humanitarian aid, and more.
  - **Engage** a broad international audience in developing solutions for those living in poverty.

Ref) Design for the Other 90%:*www.other90.cooperhewitt.org*

Education and promotion

- ABOUT DESIGN WITH THE OTHER 90%: CITIES
  - To formulate innovative approaches to urban planning, affordable housing, entrepreneurship, nonformal education, public health, and more.

EXCHANGE

View solutions that promote the exchange of design knowledge between informal settlements and formal cities.

REVEAL

View solutions that increase awareness of conditions in informal settlements, which often do not show up on official maps or in census rolls.

ADAPT

View solutions that help residents of informal settlements respond to challenges facing their communities.

INCLUDE

View solutions that seek to include those who have been marginalized by the established city, especially the poor, women, and youth.

PROSPER

View solutions that help create work opportunities in informal communities.

ACCESS

View solutions that improve access to water, sanitation, food security, electricity, health, transportation, and education.

Ref) http://www.designother90.org/cities/home

Education, promotion

DESIGN FOR THE OTHER 90%

- DESIGN FOR THE OTHER 90%
  - The exhibition features five main areas of interest:
    - **Water, Health, Energy, Education and Shelter**

  - A revolution in design
    - "The majority of the world's designers focus all their efforts on developing products and services exclusively for the richest 10% of the world's customers. Nothing less than a revolution in design is needed to reach the other 90%."
      —Dr. Paul Polak, International Development Enterprises

Ref) http://archive.cooperhewitt.org/other90/other90.cooperhewitt.org/

Financial support

- **Kopernik**
  - Kopernik website showcases the latest technologies
  - Local groups (NGOs) choose what is most needed in their area and apply online for funding.
  - After vetting, we post the project on our website so that you can choose what you want to fund.
  - The technology is shipped directly to the local NGO, avoiding middlemen, so more of your money (in the form of technology) reaches the end user.
  - You get feedback about how your donation has helped people's lives.

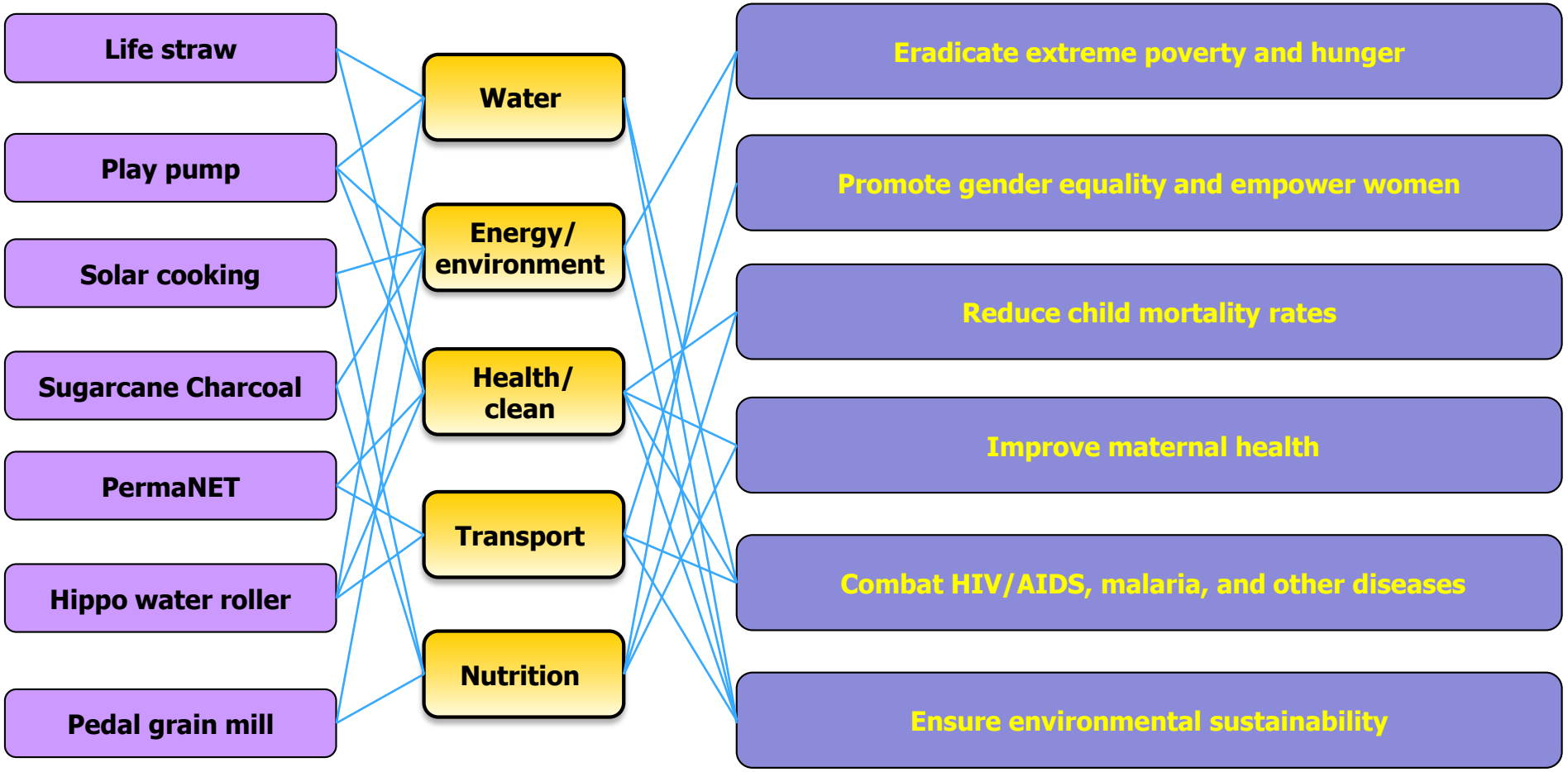
Ref) Kopernik: *www.thekopernik.org*

Examples of AT

- Water
- Energy
- Environment
- Cleanliness
- Residence
- Transport
- Nutrition
- Health
- Education

Problems and solutions

- Effectively implemented via the “appropriate technology”



Examples of AT – Water and sanitation

- **Drinking Water Crisis**

884 million

deprived of improved sources of drinking water

4 billion

annual cases of diarrheal illness

1.8 million

lives lost each year due to diarrheal disease

443 million

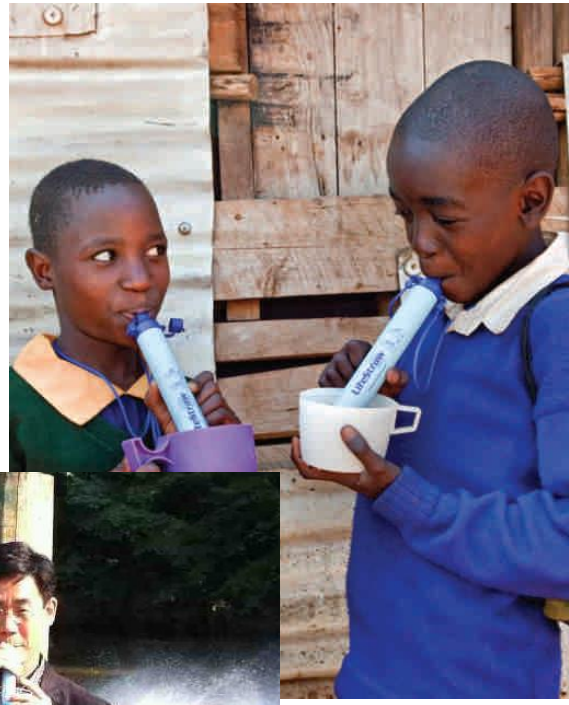
school days lost each year from water-related illness

117 million

disability adjusted life years (DALYs) lost annually due to diarrhea and intestinal worm infections

Examples of AT – Water and sanitation

- **Lifestraw**
  - Portable Water Filter
    - Offers easy access to clean and safe drinking water away from home
    - Filters at least 1000L of contaminated water
    - Removes minimum 99.9999% of waterborne bacteria (>LOG 6 reduction)
    - Removes minimum 99.9% of waterborne protozoan parasites (>LOG 3 reduction)
    - Reduces turbidity by filtering particles of approximately 0.2 microns
    - Contains no chemicals
    - Has a high flow rate
    - Requires no electrical power, batteries or replacement parts



Ref) www.lifestraw.com

Examples of AT – Water and sanitation

- **Lifestraw family**

1. Feed water bucket with pre-filter

2L capacity container for filling with unpurified water

2. Pre-filter

The 80 micron pre-filter removes coarser turbidity and easy to clean

3. Halogen chamber

Releases low-level chlorine to prevent membrane fouling

4. Plastic hose(one meter long)

Gravity creates sufficient pressure on the membrane cartridge in order to reach a high flow rate

5. Membrane cartridge

Ultra filtration takes place in the membrane cartridge – a pore size of 20 nanometer retains bacteria, viruses, parasites and fine dirt particles

6. Blue tap

Outlet for purified water

7. Cleaning bulb

Backwashing of the membranes is done by squeezing the bulb three times

8. Exit valve

Disposes the dirt and impurities

Ref) www.lifestraw.com

Examples of AT – Water and sanitation

- **Physical Performance**

Intervention	Water treatment capacity	Processing time /Flow rate	Factors affecting performance	Impact on water taste /appearance	Repeat intervention required
LifeStraw family	18,000 liters	Instant access Average 9 liters/hour	Safe storage if water not consumed directly	Neutral for taste; positive for appearance	No
LifeStraw	At least 1,000 liters	280mL/min at the beginning	Provides access to safe and clean drinking water away from home	Neutral for taste; positive for appearance	No
Boiling	Not applicable	20 minutes (includes heating water to 100 ˚C, 1min. Boiling, cooling)	Boiling temperature and safe storage	Neutral or negative for taste; neutral for appearance	Yes

Ref) www.lifestraw.com

Examples of AT – Water, Cleanliness

- **Microbiological performance**

Intervention	Bacteria	Virus	Protozoan Parasites	Meets Environmental Protection Agency protocol
LifeStraw family	Minimum 99.9999%	Minimum 99.99%	Minimum 99.9%	Yes
LifeStraw	Minimum 99.9999%	Minimum 99.99%	Minimum 99.9%	Yes
Boiling	99.9999%	99.99%	99.9%	Yes

Ref) www.lifestraw.com

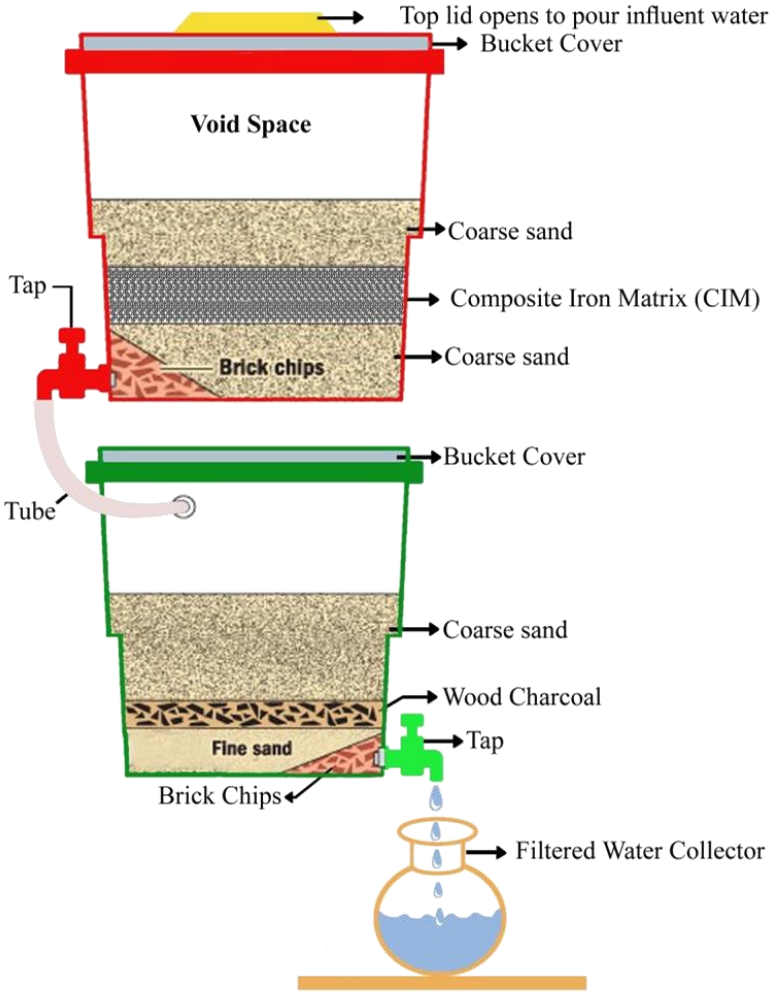
Examples of AT – Water and sanitation

- **Sono Water Filter**
  - Active material, a composite iron matrix (CIM) absorbant
  - The low-cost, two-bucket system
    - A cost of US$35
  - SONO can remove arsenic, manganese (a neurotoxin), iron, and all transition metal ions
  - Filters can last at least fourteen years at the present usage rate of one hundred liters per day
  - SONO has made larger filters to clean a hundred liters an hour

Ref) http://www.designother90.org/cities/solutions/sono-water-filter

Examples of AT – Water and sanitation

- **Sono Water Filter**



Schematic diagram of SONO Filter

Examples of AT – Water and sanitation

- **Gongali Model: Nano Filter**

Bone char filter(BCH)

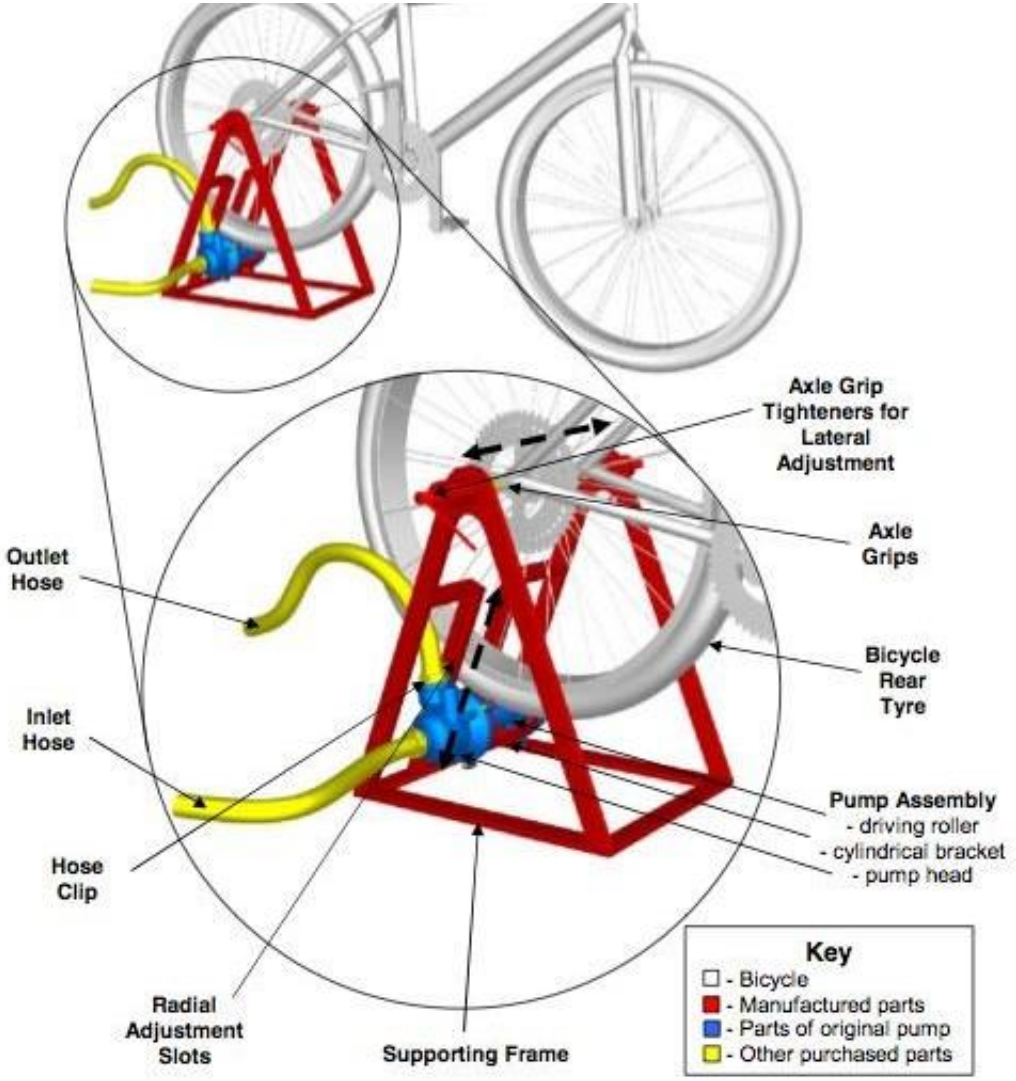
Membrane purifier(MP)

Examples of AT – Energy

- **Mobile bicycle powered water pump**
  - Bicycle-powered water pump for irrigation and water distribution in Guatemala
  - Goal is to improve the daily lives of locals without finicky (and expensive) fossil fuel machines
  - The machine can pump 40 liters of well water per minute
  - Portable

Ref) http://www.mayapedal.org/

Examples of AT – Energy



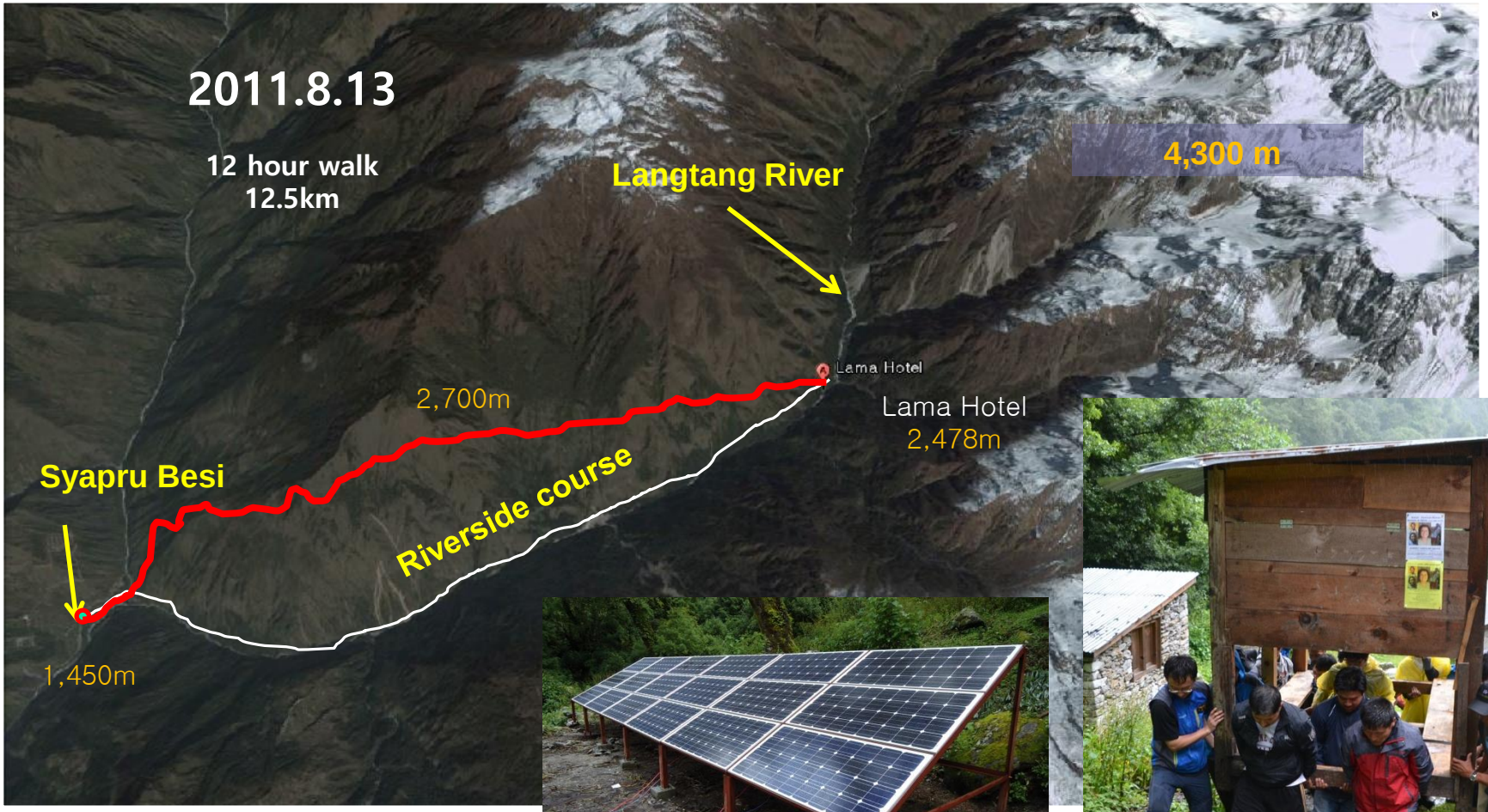
Examples of AT – Energy

- **BOGO Light**
  - Kerosene lamps are not only costly, they're also hazardous to the users' health (exposed to kerosene lantern fumes equivalent to ingesting two packs of cigarettes a day)
  - Solar flashlight
  - Solar-charged batteries run about six hours at full level
  - The flashlight proves water-resistant
  - Cost $25
  - Batteries "last 750/1000 nights!" and the LEDs "last 20 years

Ref) http://www.healthywater.com/bogo.html

Examples of AT – Energy

- **Nepal Solar Volunteer Corps**



Examples of AT – Energy

Before (August 14)

and After (August 15)

Examples of AT – Energy

- **Sustainability of AT**
  - Example of ‘SNU Nepal Solar Volunteer Corps’
- **Key for sustainability**
  - Increase in income
  - Sustainable business model
  - Continuous support

Before electricity	After electricity
Single bed (NRs. 300/night)	Single bed (NRs. 400/night)
Phone (Sometimes)	Phone (Regular)
Camera battery charge (not possible)	Camera battery charge (100/battery)

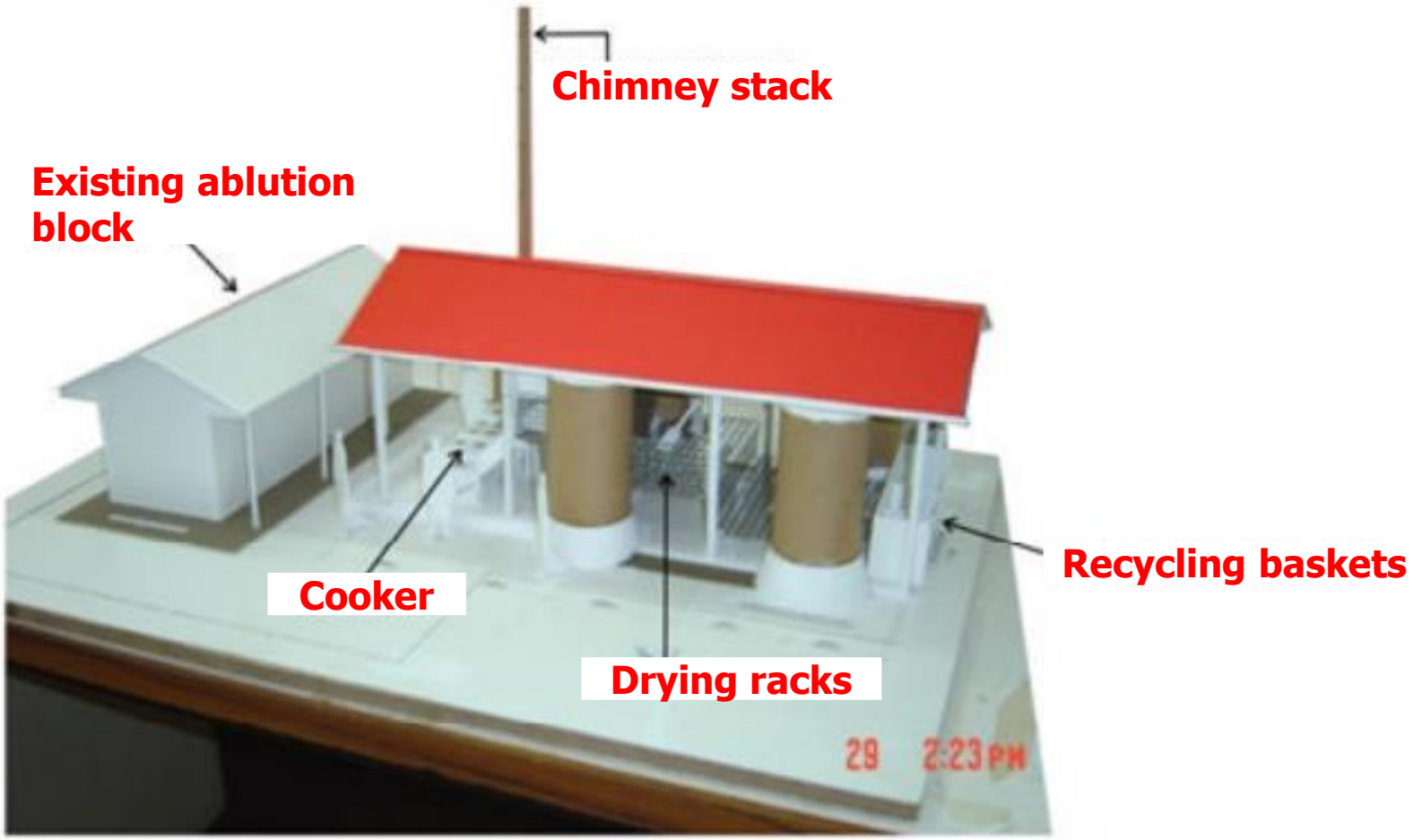
Examples of AT – Energy, Cleanliness

- **Community cooker**
  - Instead of using wood and charcoal Community Cooker, a communal oven that uses rubbish as fuel
  - A water and oil combustion that can burn without releasing toxic fumes
  - Creating an employment opportunity for local youth
  - Improved ground water quality
  - Improved health from
    - Reduced rubbish heaps
    - Washing in hot water
    - Drinking boiled water
    - Cooking food

Ref) http://communitycooker.org/

Examples of AT – Energy, Cleanliness

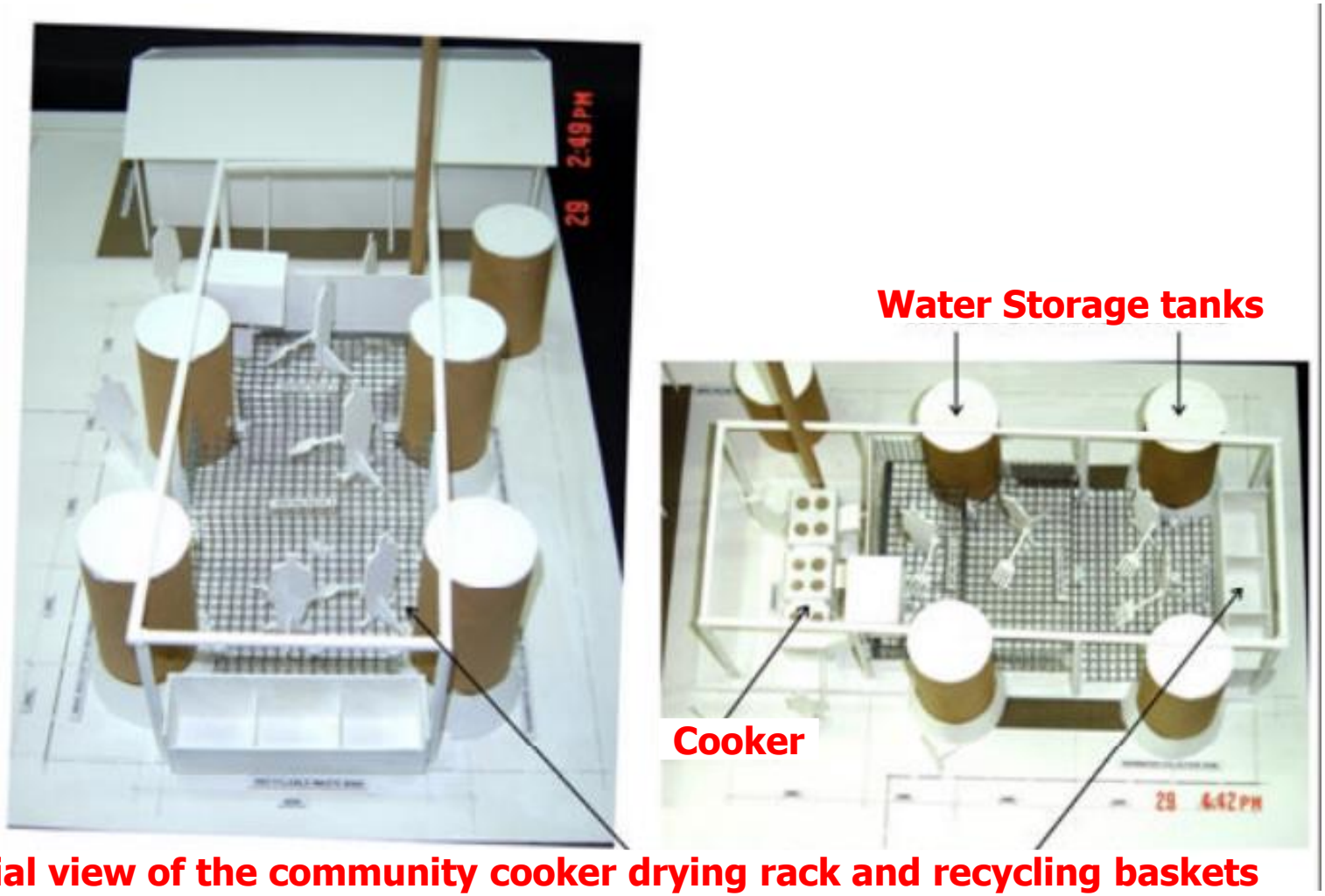
- **Community cooker**



PROPOSED COMMUNITY COOKER NEXT TO EXISTING ABLUTION BLOCK

Examples of AT – Energy, Cleanliness

- **Community cooker**



Aerial view of the community cooker drying rack and recycling baskets

Examples of AT – Residence

- **Concrete Canvas Shelters ™**
  - A 25sqm CCS can be deployed by 2 people in less than 1 hour and is ready to use in only 24 hours Rapid
  - The compressive structure of CCS has been modelled to be covered with sand or earth (berming) to provide protection against small arms fire and shell fragments. Force protection
  - CCS are far more durable than tenting with a design life of over 10 years. Durable

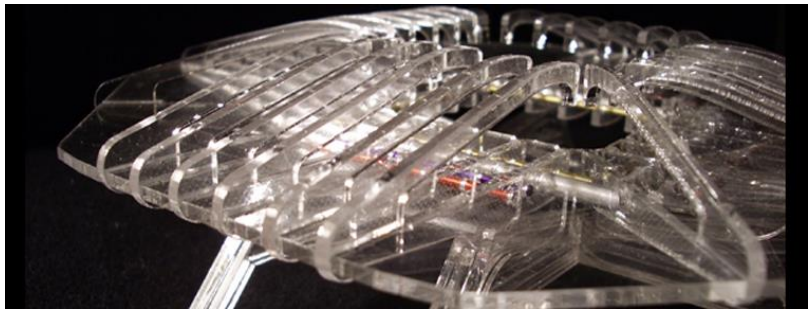
CCS25 deployment, Saudi Arabia, 2009

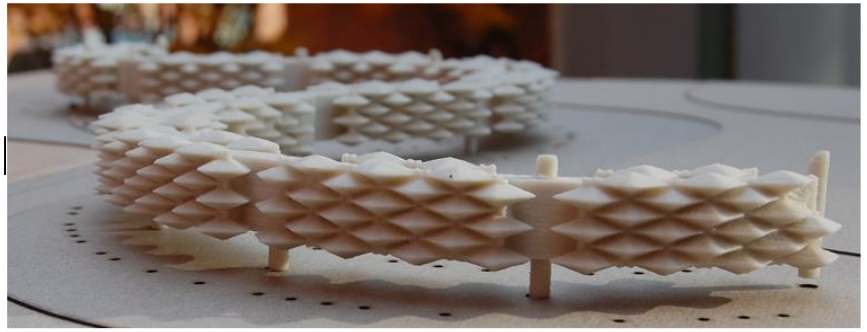
Internal view of a docked CCS25 and CCS50, South Wales

Ref) http://www.concretecanvas.co.uk/

Examples of AT – Residence

- **fabHAUS**
  - Individually fabricated housing unit
  - Repetitive modules
  - Sub-modules
  - Separation of the structure into primary, secondary, and tertiary systems
  - Enable the building components to be fabricated using mass production, customization, and assemblage techniques

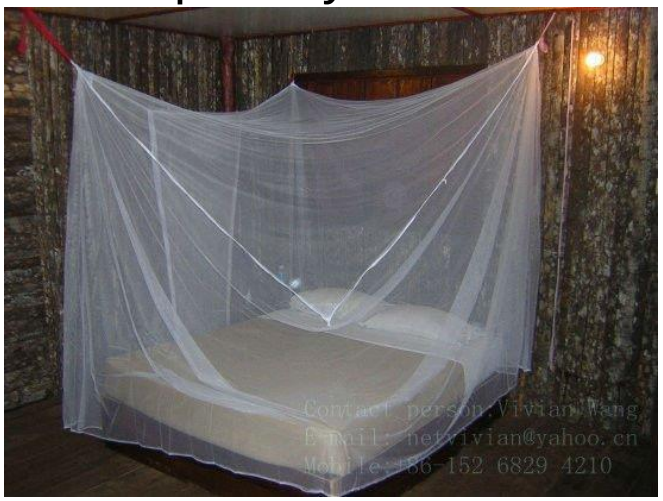




Ref) http://fabhaus.com/

Examples of AT – Residence, health

- **PermaNet® 3.0**
- **Health care**
  - An annual 300-500 million cases of malaria worldwide
  - At least one million people die from the disease
  - Young children account for most of these deaths
  - Malaria is a great drain on many national economies
    - ‘growth penalty’ of up to 1.3% per year in some countries
  - Leads to a vicious cycle of disease and poverty.



Ref) http://vestergaard-frandsen.com/

Examples of AT – Construction

- **Construct the house using 3D printer**

Examples of AT – PermaNet® 3.0

- **Health care**
  - PermaNet® 3.0 technology enables sustained effectiveness of pyrethroids
  - New generation long-lasting insecticidal net (LN)
  - Rapid regeneration of insecticide even after multiple washes
  - Unique wall construction leading to enhanced lifetime of the net

Item	Roof	Sides
Material	100% polyethylene	100% polyester
Yarn	100 deniers	75 deniers
Insecticide (deltamethrin)	4.0 g/kg	2.8 g/kg
Synergist (PBO)	25 g/kg	NA
Mesh	Minimum 156 holes/inch^2	
Available sizes	160x180x150 cm 190x180x150 cm	
Available shape	Rectangular	

Examples of AT – Water

- **Q Drum**
- **Lack of access to water**
  - Practical and durable design of
  - Enables more water to be transported more efficiently than traditional methods
    - Empowers women and children
    - Saves time and energy
    - Reduces suffering

- **Specification**
  - Capacity of 90 liters / 24 gallons
  - Weight of water (90kg / 200lbs)
  - The effective weight on level ground is just 10kg (22 pounds)

Ref) http://www.qdrum.co.za/

Examples of AT – Transportation

- **Leveraged Freedom Chair**
  - Narrow doorways, steep hills, bumpy, muddy roads and long distances to destinations like school (often upwards of two to three miles in Tanzania)
  - The ability to live with as little assistance as possible
    + independence
  - The ability to get to where they want to go, when they want to go
    + Empowerment
  - A tool that's at a price that they're able to afford
    + Affordability

Ref) http://mlab.mit.edu/lfc/Welcome.html

Examples of AT – Transportation

- **Leveraged Freedom Chair**

How it works:

Grabbing high on the levers increases torque

Grabbing low on the levers increases angular velocity

Examples of AT – Nutrition and Energy

- **Pot refrigeration**
  - Maximizing economic and nutritional yield
  - Increased profits from food sales
  - Increased opportunities for women
  - Rural employment opportunities
  - Increased diet variety

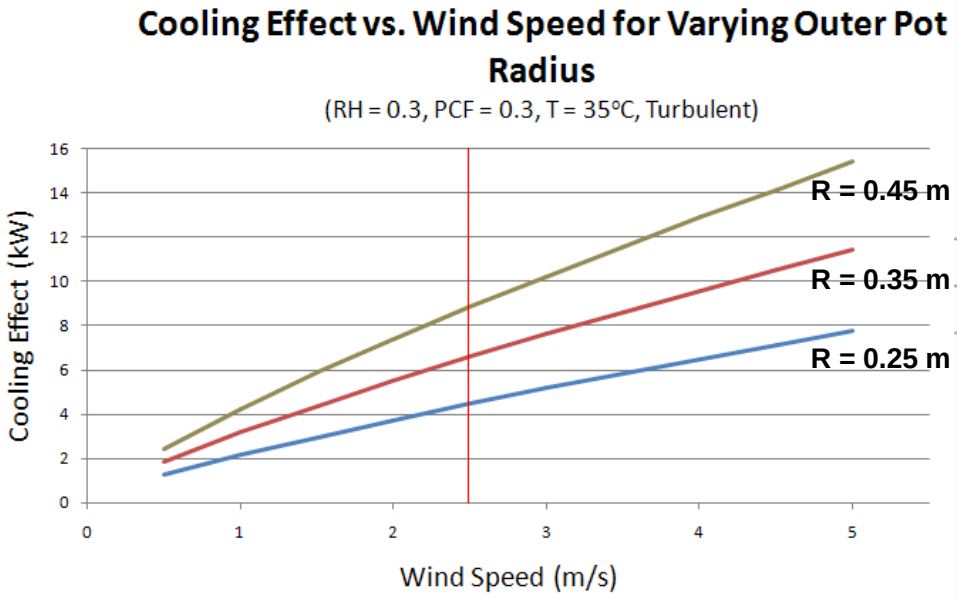
Shelf of common produce with Zeer pot refrigerator

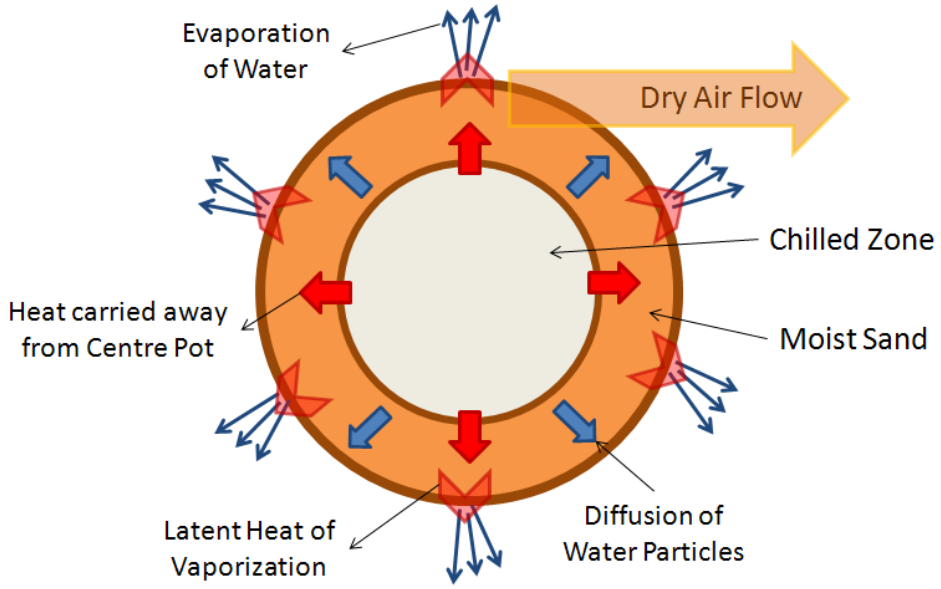
Food	Unrefrigerated shelf life	Shelf life with zeer
Carrots	4 days	20 days
Eggplant	1-2 days	21 days
Guava	2 days	20 days
Meat	<1 day	~14 days
Okra	4 days	17 days
Rocket	1 day	5 days
Tomatoes	2 days	20 days

Ref) http://www.appropedia.org/Zeer_pot_refrigeration_(design)

Examples of AT – Nutrition and Energy

- **Zeer Refrigerator**
  - Using latent heat of vaporization
  - Zeer refrigerator, water evaporates out of the sand through the surface of the outer clay pot and from the whole top surface of the moist sand exposed to the solar radiation, removing energy from the system.





Conceptual Flow of Energy and Water in Zeer Refrigerator

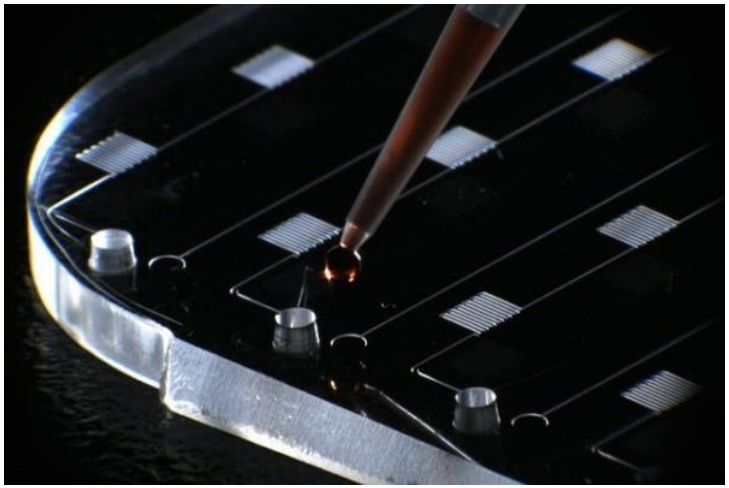
Examples of AT – Food and Nutrition

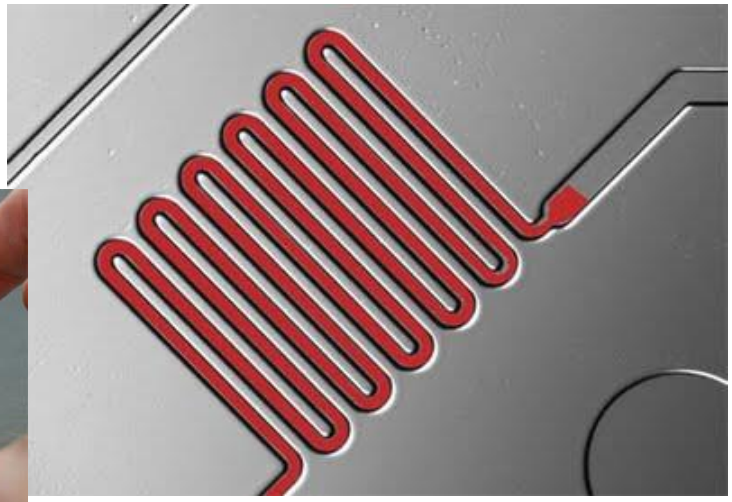
- **Universal Nut Sheller**
  - Every year, in Africa alone, women spend about 4 billion hours shelling peanuts by hand
  - Poorest families, peanuts are the only protein they can afford
  - Simple hand-powered device
  - 50 kg/hr (120 lbs/hr)
  - The device requires less than $50 in common materials to make, lasts 25 years

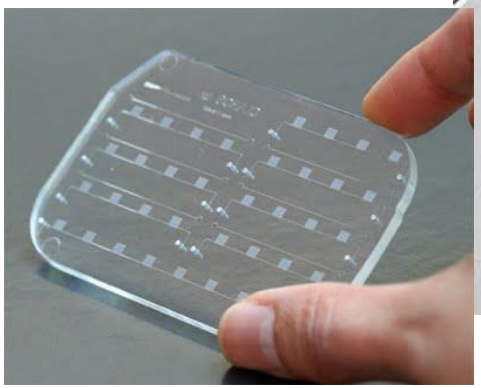
Ref) http://www.instructables.com/id/Universal-Nut-Sheller/

Examples of AT – Health

- **mChip**
  - Portable blood testing device
  - Diagnosis and treatment of HIV and sexually transmitted infections
  - mChip costs only $1
  - smart card sized
  - works based on microfluids
  - A single drop of blood is enough to detect HIV and gives reliable results in just 15 minutes.







Ref) http://www.mchip.net/

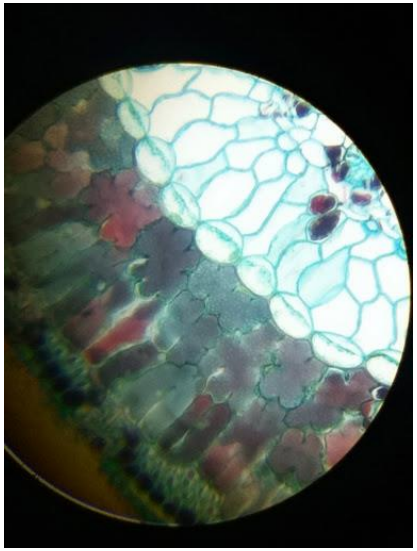
Examples of AT – Health

- **Self-adjustable Eyewear**
  - A tool for use with self-refraction
    - Two clear membranes filled with silicone fluid
  - Self-adjustable eyewear only $3
  - A ready-made pair of spectacles that can be dispensed immediately after refraction (whether by self-refraction or conventional methods such as subjective refraction)
  - Elimination of the delays and extra expense incurred when refractions and dispensing are conducted at separate locations

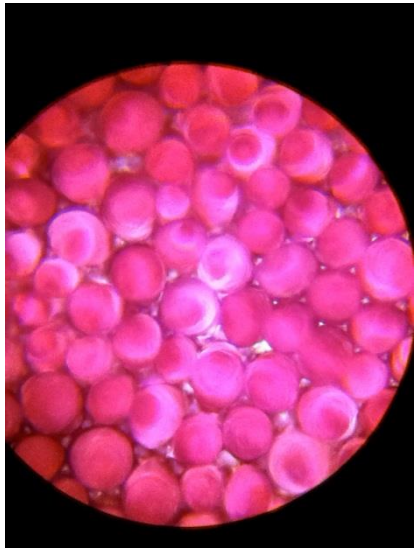
Ref) http://www.gv2020.org/about.htm

Examples of AT – Health

- **CellScope**
  - Portable, Low-Cost Imaging for Monitoring and Disease Diagnosis
  - Microscopy to a mobile phone platform
  - Fletcher Lab at the University of California, Berkeley,
  - Magnification : 5x-60x



A pine needle under high magnification.



A flower petal viewed through the CellScope.

Ref) http://cellscope.berkeley.edu/index.html

Examples of AT – Education

- **digital drum**
  - UNICEF Uganda representative
  - Solar-powered computer kiosk
    - *solar panel (3x55W)*
  - Built affordably with readily available materials
  - weatherproof the keyboards and laptops with inner tubes and sealant

Ref) http://blog.digitaldrum.ca/

Examples of AT – Education

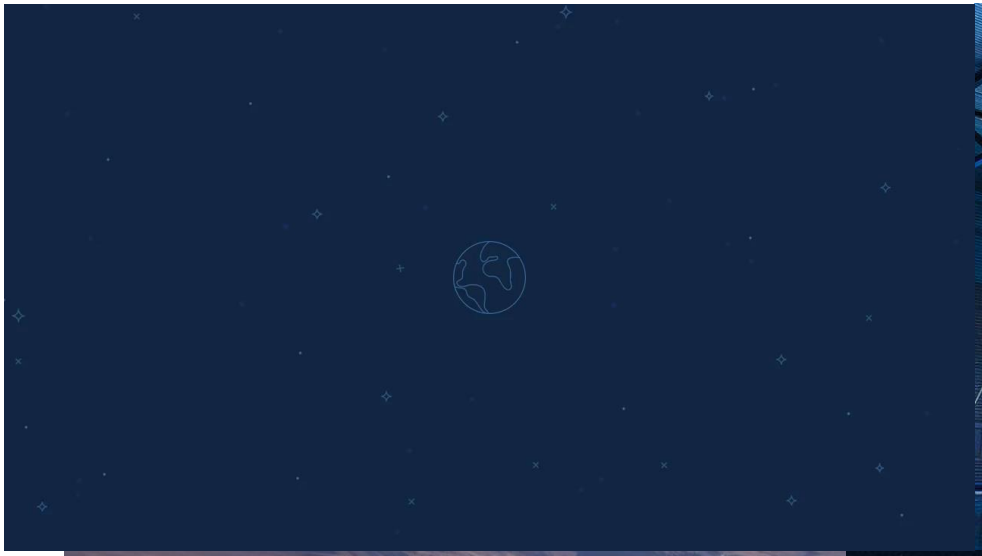
- **One Laptop Per Child (OLPC)**
  - Designed to be inexpensive
  - Use little energy and brave extreme weather conditions
  - Spec.
    - Marvell ARMADA PXA618 SOC processor, Avastar Wi-Fi SOC, standard or Pixel Qi sunlight-readable display, and supports Android and Linux operating systems.
  - Cost $172 (goal $100)

In Pictures: The $75 Future Computer

Ref) http://one.laptop.org/

Examples of AT – Communication

- **Google: Project Loon**



Sustainability of AT

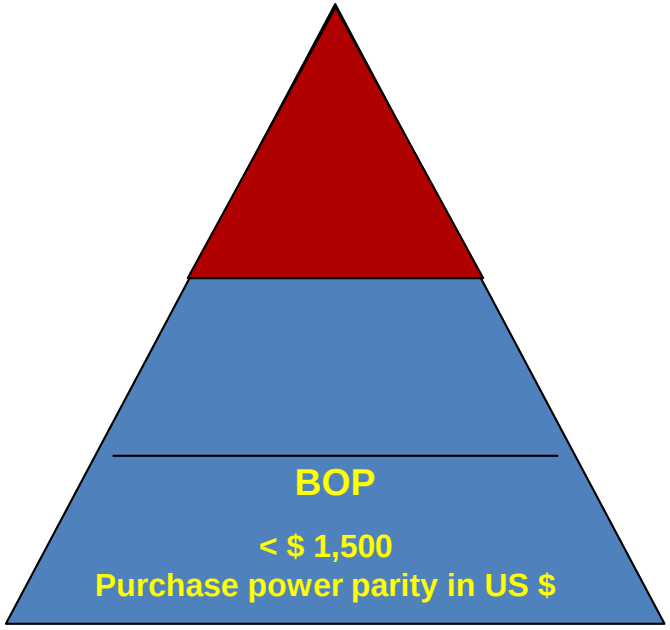
- **Failure example of PlayPump**
  - Trevor Field
  - Spent 16.4 million USD
  - Merry-go-round was not fun for children
  - Failure of components

Vision of AT engineers

“There’s plenty of room at the bottom”

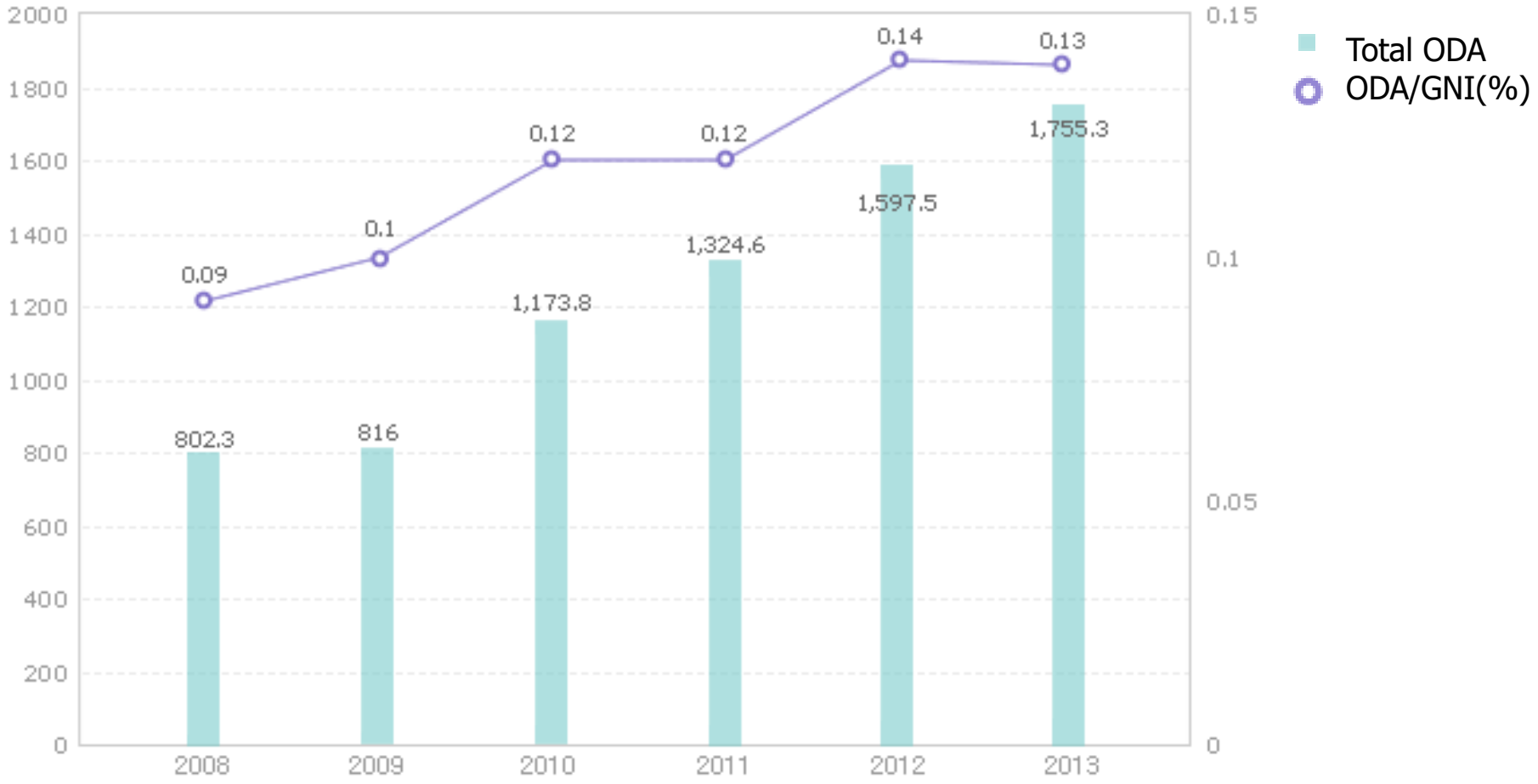
– Richard Feynman

There’re plenty of people you can help at the bottom



ODA (Official Development Assistance)

- **`08 ~ `13 ODA/GNI (million UDS)**



Ref) http://www.odakorea.go.kr/

Reference

- **Reference**
  - *http://kis.stepi.re.kr (과학기술정책연구원)*
  - *http://www.stiweb.org/ (나눔과기술)*
  - *http://www.goodneighbors.kr/ (굿네이버스)*
  - *Creating a World Wide Web of Appropriate Technology, @HUMAN.NET, Yonsei university*
  - *http://www.who.int/topics/millennium_development_goals/en/*
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  - *http://www.gv2020.org/about.html*
  - *http://cellscope.berkeley.edu/index.html*