Engineering and Sustainability

Terry Link

One Planet, One family, One Future
What Do We Need To Consider

In

An Anthropocene World
Design Problem: How to Build a Bridge across a Strait
Or a Bridge to a Sustainable Future
100 Nobel Laureates Statement
December 7, 2001

The most profound danger to world peace in the coming years will stem not from the irrational acts of states or individuals but from the legitimate demands of the world's dispossessed. Of these poor and disenfranchised, the majority live a marginal existence in equatorial climates. Global warming, not of their making but originating with the wealthy few, will affect their fragile ecologies most. Their situation will be desperate and manifestly unjust.
Mother Earth -- Our Home

It is has water, oxygen and a hospitable climate
THE EARTH SYSTEM
Has four major parts:
Biosphere  Hydrosphere
Geosphere  Atmosphere
The Data

Global Departure of Temperature From Average, Jan- Nov 1880 - 2015
Arctic Sea Ice for 1,500 Years

![Graph showing sea ice extent over 1,500 years](chart.png)
Global mean surface temperature is projected to increase during the 21st century.
DECLINING ECOSYSTEM HEALTH

KEY

Condition

Changing Capacity
The Ecological Footprint

MEASURES
how fast we consume resources and generate waste

- Energy
- Settlement
- Timber & paper
- Food & fibre
- Seafood

COMPARSED TO
how fast nature can absorb our waste and generate new resources.

- Carbon Footprint
- Builtup land
- Forest
- Cropland & pasture
- Fisheries

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Ecological Footprint

1960-2007
- Ecological Footprint

2007-2050, Scenarios
- Moderate business as usual
- Rapid reduction

y-axis: number of planet earths, x-axis: years

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Bigger Isn’t Better

- United States (8.0 ha)
- Mexico (3.0 ha)
- Afghanistan (0.6 ha)
- Brazil (2.9 ha)
- Canada (7.0 ha)
- Haiti (0.7 ha)
- Indonesia (1.2 ha)
- World average (2.7 ha)
- China (2.2 ha)
- India (0.9 ha)
- France (5.0 ha)
- Israel (4.8 ha)
- Mozambique (0.8 ha)
I = P \times C \times T
Problem with Growth

http://www.youtube.com/watch?v=x5OYmRyfXBY
Increase in After-Tax Income by Income Group, 1979-2007
(in 2007 dollars)

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom 20% Less than</td>
<td>16%</td>
</tr>
<tr>
<td>$20,500</td>
<td></td>
</tr>
<tr>
<td>Second 20% $20,500 -</td>
<td>23%</td>
</tr>
<tr>
<td>$34,300</td>
<td></td>
</tr>
<tr>
<td>Middle 20% $34,300 -</td>
<td>25%</td>
</tr>
<tr>
<td>$50,000</td>
<td></td>
</tr>
<tr>
<td>Fourth 20% $50,000 -</td>
<td>35%</td>
</tr>
<tr>
<td>$74,700+</td>
<td></td>
</tr>
<tr>
<td>Top 20% $74,700+</td>
<td>95%</td>
</tr>
<tr>
<td>Top 10% $102,900+</td>
<td>125%</td>
</tr>
<tr>
<td>Top 5% $141,900+</td>
<td>160%</td>
</tr>
<tr>
<td>Top 1% $352,900+</td>
<td>281%</td>
</tr>
</tbody>
</table>
Income Gains at the Top Dwarf Those of Low- and Middle-Income Households

Percent Change in After-Tax Income Since 1979

Source: CBPP calculations from Congressional Budget Office data.
JUST 8 BILLIONAIRES OWN THE SAME WEALTH AS THE POOREST 3.6 BILLION PEOPLE
Wealth = Happiness???

Figure 8-1. Average Income and Happiness in the United States, 1957-2002

Source: Myers
Distribution that 92% of Americans Choose as IDEAL
This is Progress?

Global GPI/capita & GDP/capita

2005 USD


GDP/capita
GPI/capita
The long-standing health care mess

- Adverse selection problem in health care
- Less care for more $$
- Denial of coverage due to pre-existing conditions
- Narrow cost-cutting efforts
- Powerful lobbies
- Inability of government to borrow money
- Lack of preventive care
- Unhealthy Life Styles
- Fragmented health care purchases undermining savings
- Rising medical costs
- Unwillingness of politicians to confront insurance companies and lobbies
- Long standing AMA resistance to universal health care
- Increasing use and cost of new medical technologies
- Strong incentives to deny coverage
- Insurance companies’ high administrative costs
- Sick care system
- Severe rise of premiums
- Strong incentives to deny coverage
- Increasing inefficiency of the health care system
- Doctor’s fee for service
- Overemphasis on high tech
- Mistaken assumption that insured people consume more health care
- Increasing inefficiency of health care system
- Lack of true competition
- The federal government’s solvency problem
- Inability of people to make wise decisions about their health
- Decreasing popularity of employer-based health insurance
- The drop in the dollar’s purchasing power
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Increasing Complexity
Dominant Operating Framework
Time for a New Framework

Insanity: doing the same thing over and over again and expecting different results.
Sustainable Development

Meeting the needs of the present generation, without prejudicing the ability of future generations to meet their own needs.

The Triple Bottom Line
Prism of Sustainability
Do we understand how wasteful we are?

10,000 kg Raw Resource → Manufacture → 1000 kg Finished Product (consumed) → 6 months → 100 kg long-term durables left in home

From Biffa, 2000
Life Cycle Assessment
Cradle to Cradle

Cradle-to-Cradle is an innovative and sustainable industrial model that focuses on design of products and a production cycle that strives to produce no waste or pollutants at all stages of the lifecycle.
Current Conditions

- Future is uncertain
- Our knowledge is woefully incomplete
- Complexity is beyond our comprehension
Creating Conditions That Enable

- Free the Imagination
- Humanize others
- Question contradictions
- All voices to be heard and respected
Competition  ➔  Cooperation
Debate ➔ Dialogue
Who Sets the Rules?

- Winner Takes All?
- Money Talks?
- Shared Prosperity?
- Level Playing Field?
Social Change and Politics are not Spectator Sports

- Percentage of all eligible citizens who voted in (2014) 37%
- Political contribution (2006) 13%
- Volunteer (2006) 6%
- Nobel Peace Laureate **Jody Williams**
I say all this to you because hope is not like a lottery ticket you can sit on the sofa and clutch, feeling lucky. I say this because hope is an ax you break down doors with in an emergency; because hope should shove you out the door, because it will take everything you have to steer the future away from endless war, from the annihilation of the earth’s treasures and the grinding down of the poor and marginal. Hope just means another world might be possible, not promised, not guaranteed. Hope calls for action; action is impossible without hope. ... To hope is to give yourself to the future, and that commitment to the future makes the present inhabitable. - Rebecca Solnit, *Hope in the Dark*
You Are the Change

Be the change you wish to see in the world

- Gandhi

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