Lomberg
Research - The Ten Challenges

For Copenhagen Consensus 2008, experts looked at ten of the biggest issues facing the planet: Air pollution, conflict, diseases, education, global warming, malnutrition and hunger, sanitation and water, subsidies and trade barriers, terrorism, women and development.

Below, you can read copies of the research papers that the Expert Panel and Youth Forum considered. More background information about the different Copenhagen Consensus papers can be found here.
<table>
<thead>
<tr>
<th>Rank</th>
<th>Solution</th>
<th>Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Micronutrient supplements for children (vitamin A and zinc)</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>2</td>
<td>The Doha development agenda</td>
<td>Trade</td>
</tr>
<tr>
<td>3</td>
<td>Micronutrient fortification (iron and salt iodization)</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>4</td>
<td>Expanded immunization coverage for children</td>
<td>Diseases</td>
</tr>
<tr>
<td>5</td>
<td>Biofortification</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>6</td>
<td>Deworming and other nutrition programs at school</td>
<td>Malnutrition and Education</td>
</tr>
<tr>
<td>7</td>
<td>Lowering the price of schooling</td>
<td>Education</td>
</tr>
<tr>
<td>8</td>
<td>Increase and improve girl’s schooling</td>
<td>Women</td>
</tr>
<tr>
<td>9</td>
<td>Community-based nutrition promotion</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>10</td>
<td>Provide support for women’s reproductive role</td>
<td>Women</td>
</tr>
<tr>
<td>11</td>
<td>Heart attack acute management</td>
<td>Diseases</td>
</tr>
<tr>
<td>12</td>
<td>Malaria prevention and treatment</td>
<td>Diseases</td>
</tr>
<tr>
<td>13</td>
<td>Tuberculosis case finding and treatment</td>
<td>Diseases</td>
</tr>
<tr>
<td>14</td>
<td>R&amp;D in low-carbon energy technologies</td>
<td>Global Warming</td>
</tr>
<tr>
<td>15</td>
<td>Bio-sand filters for household water treatment</td>
<td>Water</td>
</tr>
</tbody>
</table>
In 2008, we asked: what would help? And help the most?
People from more than 170 countries submitted over 150,000 ideas in response. From that group, we narrowed down the list to 16 top idea themes addressing important common goals.
The public voted for the top five ideas and we reviewed concrete proposals to tackle them. We gave a total of $10 million to five inspiring organizations working on solutions to each of these global challenges:

Project funded: The Khan Academy is a non-profit educational organization that provides high-quality, free education to anyone, anywhere via an online library of more than 1,600 teaching videos. We allocated $2 million to support the creation of more courses and to enable the Khan Academy to translate their core library into the world’s most widely spoken languages.

Project funded: FIRST is a non-profit organization that promotes science and math education around the world through team competition. Its mission is to inspire young people to be science and technology leaders by giving them real world experience working with professional engineers and scientists. We allocated $3 million to develop and jump start new student-driven robotics team fundraising programs that will empower more student teams to participate in FIRST.

Project funded: Public.Resource.Org is a non-profit organization focused on enabling online access to public government documents in the United States. We allocated $2 million to Public.Resource.Org to support the Law.Gov initiative, which aims to make all primary legal materials in the United States available to all.

Project funded: Shweeb is a concept for short to medium distance, urban personal transport, using human-powered vehicles on a monorail. We allocated $1 million to fund research and development to test Shweeb’s technology for an urban setting.

Project funded: The African Institute for Mathematical Sciences (AIMS) is a center for math and science education and research in Cape Town, South Africa. AIMS’ primary focus is a one-year bridge program for recent university graduates that helps build skills and knowledge prior to Masters and PhD study. We allocated $2 million to fund the opening of additional AIMS centers to promote graduate level math and science study in Africa.

Each idea is a broad, ambitious, many-year mission. We hope you will follow the progress on their websites. Thank you to everyone who supported Project 10^100 by voting on ideas or submitting your own. Your participation has helped
Forests

Figure 59. "We must ACT NOW to preserve the last remaining forests on Earth." The WWF's forests web homepage until April 1998. Source: http://www.panda.org/forests/life/

Figure 61. Remaining forest in the Amazon, which accounts for one third of the world's tropical forest, 1978–99. Source: INPE 2000:7; Brown and Brown 1992:121.

Figure 60. Different UN global forest cover estimates, of forest and woodland, 1948–94 and 1961–94, the more restrictive closed forest for 1980–95 and the new unified forest definition 1990–2000, all from FAO. Source: FAO Production Yearbooks 1949–95, FAO 2000, 1995a, 1997c, 2001c:34. Data availability is poor but by far the best available.  

[From Skeptical Environmentalist – Lomberg]
Data is critical

.. to thinking like an engineer.

Visualization is critical to getting human brains to understand the data...

... and represents more information than summary numbers.
<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th></th>
<th>II</th>
<th></th>
<th>III</th>
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<th>IV</th>
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<td>10.0</td>
<td>9.14</td>
<td>10.0</td>
<td>7.46</td>
<td>8.0</td>
<td>6.58</td>
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<td>6.95</td>
<td>8.0</td>
<td>8.14</td>
<td>8.0</td>
<td>6.77</td>
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<td>13.0</td>
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<td>12.74</td>
<td>8.0</td>
<td>7.71</td>
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<td>Y</td>
<td>9.0</td>
<td>8.81</td>
<td>9.0</td>
<td>8.77</td>
<td>9.0</td>
<td>7.11</td>
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<tr>
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<td>9.26</td>
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<td>7.81</td>
<td>8.0</td>
<td>8.47</td>
</tr>
<tr>
<td>Y</td>
<td>14.0</td>
<td>9.96</td>
<td>14.0</td>
<td>8.10</td>
<td>14.0</td>
<td>8.84</td>
<td>8.0</td>
<td>7.04</td>
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<tr>
<td>X</td>
<td>6.0</td>
<td>7.24</td>
<td>6.0</td>
<td>6.13</td>
<td>6.0</td>
<td>6.08</td>
<td>8.0</td>
<td>5.25</td>
</tr>
<tr>
<td>Y</td>
<td>4.0</td>
<td>4.26</td>
<td>4.0</td>
<td>3.10</td>
<td>4.0</td>
<td>5.39</td>
<td>19.0</td>
<td>12.50</td>
</tr>
<tr>
<td>X</td>
<td>12.0</td>
<td>10.84</td>
<td>12.0</td>
<td>9.13</td>
<td>12.0</td>
<td>8.15</td>
<td>8.0</td>
<td>5.56</td>
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<tr>
<td>Y</td>
<td>7.0</td>
<td>4.82</td>
<td>7.0</td>
<td>7.26</td>
<td>7.0</td>
<td>6.42</td>
<td>8.0</td>
<td>7.91</td>
</tr>
<tr>
<td>X</td>
<td>5.0</td>
<td>5.68</td>
<td>5.0</td>
<td>4.74</td>
<td>5.0</td>
<td>5.73</td>
<td>8.0</td>
<td>6.89</td>
</tr>
</tbody>
</table>

N = 11
mean of X’s = 9.0
mean of Y’s = 7.5
equation of regression line: Y = 3 + 0.5X
standard error of estimate of slope = 0.118
\( t = 4.24 \)

sum of squares X - X̄ = 110.0
regression sum of squares = 27.50
residual sum of squares of Y = 13.75
correlation coefficient = .82
\( r^2 = .67 \)
[from tufte]
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Overall</th>
<th>Less than 9th grade</th>
<th>High school drop-out</th>
<th>High school graduate</th>
<th>Some college</th>
<th>Associates degree</th>
<th>Bachelor's degree</th>
<th>Bachelor's degree or more</th>
<th>Master's degree</th>
<th>Professional degree</th>
<th>Doctorate degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median individual income Male, age 25+</td>
<td>$33,517</td>
<td>$15,461</td>
<td>$18,990</td>
<td>$28,763</td>
<td>$35,073</td>
<td>$39,015</td>
<td>$50,916</td>
<td>$55,751</td>
<td>$61,698</td>
<td>$88,530</td>
<td>$73,853</td>
</tr>
<tr>
<td>Female, age 25+</td>
<td>$19,679</td>
<td>$9,296</td>
<td>$10,786</td>
<td>$15,962</td>
<td>$21,007</td>
<td>$24,808</td>
<td>$31,309</td>
<td>$35,125</td>
<td>$41,334</td>
<td>$48,536</td>
<td>$53,003</td>
</tr>
<tr>
<td>Both sexes, age 25+</td>
<td>$32,140</td>
<td>$17,422</td>
<td>$20,321</td>
<td>$26,505</td>
<td>$31,054</td>
<td>$35,009</td>
<td>$43,143</td>
<td>$49,303</td>
<td>$52,390</td>
<td>$82,473</td>
<td>$70,853</td>
</tr>
<tr>
<td>Median household income</td>
<td>$45,016</td>
<td>$18,787</td>
<td>$22,718</td>
<td>$36,835</td>
<td>$45,854</td>
<td>$51,970</td>
<td>$68,728</td>
<td>$73,446</td>
<td>$78,541</td>
<td>$100,000</td>
<td>$96,830</td>
</tr>
</tbody>
</table>
This graph shows the median household income in accordance with the householder's educational attainment. The data only applies to household with a householder over the age of twenty-five. [18]
In the 1800s, what was the killer weapon responsible for the most deaths in war?
Florence Nightingale used this chart to persuade the government of the need for better hygiene in hospitals.
Snow used this map to correctly identify the source of a Cholera epidemic. London 1854.
Which important world problem can be solved for the least money?

How does the scale relate to things we already spend money on?
<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilize population</td>
<td>$10.5 billion</td>
</tr>
<tr>
<td>Eliminate starvation/malnourishment</td>
<td>$19 billion</td>
</tr>
<tr>
<td>Literacy</td>
<td>$5 bil.</td>
</tr>
<tr>
<td>Provide shelter</td>
<td>$21 billion</td>
</tr>
<tr>
<td>Provide basic health care</td>
<td>$15 billion</td>
</tr>
<tr>
<td>Retire developing nation’s debt</td>
<td>$30 billion</td>
</tr>
<tr>
<td>Provide safe, clean water</td>
<td>$50 billion</td>
</tr>
<tr>
<td>Provide clean, safe energy; energy efficiency</td>
<td>$33 billion</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>$17 billion</td>
</tr>
<tr>
<td>Prevent soil erosion</td>
<td>$24 billion</td>
</tr>
<tr>
<td>Acid rain</td>
<td>$8 billion</td>
</tr>
<tr>
<td>Global warming</td>
<td>$8 billion</td>
</tr>
<tr>
<td>Deforestation</td>
<td>$7 billion</td>
</tr>
<tr>
<td>Ozone loss</td>
<td>$5 billion</td>
</tr>
</tbody>
</table>

- Total chart = total annual world military expenditures: $1 trillion
- One square = one-tenth of one percent of world military expenditures: $1 billion
Is there a gap between the rich and poor? What about in the US?
Figure 3: Global Income Distribution

World population arranged by income

<table>
<thead>
<tr>
<th>World Population Arranged by Income</th>
<th>Distribution of Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richest</td>
<td>The richest fifth receives 82.7% of total world income</td>
</tr>
<tr>
<td></td>
<td>11.7% of income</td>
</tr>
<tr>
<td></td>
<td>2.3% of income</td>
</tr>
<tr>
<td></td>
<td>1.9% of income</td>
</tr>
<tr>
<td>Poorest</td>
<td>1.4% of income</td>
</tr>
<tr>
<td></td>
<td>The poorest fifth receives 1.4% of total world income</td>
</tr>
</tbody>
</table>

Distribution of annual household income in the United States
(2012 estimate)

Median household income was roughly $51,000.

These two groups include households reporting income greater than $200,000 (approximately 4 percent households).

The top 25 percent reported an income greater than $85,000.

[Image from gapminder.org]
Most People

Homeless in USA

You

Image from gapminder.org
We must always also keep in mind that buried in dry statistics about differences between rich and poor is an enormous amount of human misery, an endless series of almost incomprehensible tragedies.

— Paul and Anne Ehrlich, *The Population Explosion*
1-2 $/day  
Mbarara, Uganda

2-5 $/day  
Kampala, Uganda

10-50 $/day  
Cape Town, South Africa

2-5 $/day

Garden

Garden

Street
Compare across time

Allows determining if things are …
… getting better or worse?
This graph shows the median household income in 2003 dollars according to educational attainment. The change in median personal and household since 1991 also varied greatly with educational attainment. The following table shows the median household income according to the educational attainment of the householder. All data is in 2003 dollars and only applies to householders whose householder is aged twenty-five or older. The highest and lowest points of the median household income are presented in bold face.
Has the relative richness of rich and poor been changing?

[Household income from wikipedia]
Figure 1: Income Gains at the Top Dwarf Those of Low- and Middle-Income Households

Percent Change in After-Tax Income Since 1979

- Top 1 percent: +281%
- Highest fifth: +95%
- Middle fifth: +25%
- Bottom fifth: +16%

Source: CBPP calculations from Congressional Budget Office data.
• http://www.gapminder.org/world/
What are main points today?
Discussion

What metrics?
How do various issues compare?
The criticism of a single number metric … 
.. life expectancy as an example.
Life expectancy

... is the average lifespan a newborn can expect

... is short when child deaths are common
Can you get old in Burundi?
Burundi
Look at the expected life of five newborn Burundians...

Life expectancy (years)

Income per person (comparable dollars per year)
How long will they live...

...if conditions remain as in Burundi in 2007 during their whole lifetime?
Burundi 2007

Age (years)

Pierre 1
Liz 36
Jean 57
Ann 72
Sarah 84
So yes, 2 of 5 get old in Burundi.
Calculate the mean...

\[
\frac{1+36+57+72+84}{5} = 50
\]
Sweden

Do all Swedes live 31 years longer than the Burundians?
Look at the expected life of five newborn Swedes…
How long will they live...

...if conditions remain as in Sweden in 2007 during their whole lifetime?
Age (years)

Sweden 2007

63
77
84
88
93

1 adult

4 old

Per
Lisa
Jan
Anton
Sara
Calculate the mean...

\[
\frac{63 + 77 + 84 + 88 + 93}{5} = 81
\]
Sweden

Population (millions)

Life expectancy (years)

Income per person (comparable dollars per year)
Let’s compare Sweden and Burundi.
"To live long" in **Sweden** is almost the **same** as "to live long" in **Burundi**

But **all Burundians do not live** 31 years **shorter** than Swedes
Life expectancy

... is an average
- Most Burundians get older than 50
- Some die in childhood

... is low when child-deaths are common
- It is low in Burundi not because all die a bit earlier
- But because some die much younger
• Something engineers good at Example of ‘world inequality growing’ statements, Rosling, Copenhagen consensus, Lomberg, criticism of Lomberg, examples of unsubstantiated claims in ads, importance of assessment and criticisms of international aid for failure, bednets example to compare good done per dollar spent, Sachs vs easterly, vs collier,

• Discussion: Metrics, Top Problems, How to Rank, what are the top problems,