New Directions In Nuclear Energy
Panel Discussion

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Global Energy Distribution
as indicated by nighttime electricity use

from the generation of 24 trillion kWhs/year, going to 35 trillion kWhs/year by 2040
In order to address any of the environmental issues we seem to care about like climate change: almost 20 tkWhrs must be non-fossil fuel.

Historic: 2/3 of present total

World presently at 24 trillion kWhrs/year

U.S. has been flat at 4 trillion kWhrs/year
1.2 billion people still have no access to electricity, 80% of them in South Asia and sub-Saharan Africa.

2.4 billion people burn wood and manure as their main energy source.

3 billion more people will be born by 2040.

Source: Kay Chernush for the U.S. Department of State

Map of Global Energy Poverty

It takes 3,000 kWhs per person per year to lift someone out of poverty.

What Paris COP21 was about is how to give these people 3,000 kWhs/person/year without giving them coal, and who’s going to pay for it.

This is the only way to eradicate global poverty.

With modern efficiencies, conservation and technologies, 3,000 kWh/year can provide an HDI > 0.8; >6,000 kWh/year is unnecessary and wasteful.

It requires about 3,000 kWhrs/yr to have what we consider a good life.

75% of the world’s population of over 7 billion people is below 0.8 on the U.N. Human Development Index (HDI).

Source: United Nations Development Program; McFarlane 2006
How much energy do we need by 2040? - what levels are needed to end poverty, war and terrorism, i.e., raise everyone up to 0.8 HDI?

<table>
<thead>
<tr>
<th>Subpopulation group</th>
<th>Energy/capita needed to raise HDI to &gt;0.8 or maintain at 0.9</th>
<th>Approximate subpopulation</th>
<th>Annual energy requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrialized world -</td>
<td>cut to 6,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>6 tkW-hrs</td>
</tr>
<tr>
<td>Intermediate -</td>
<td>maintain 3,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>3 tkW-hrs</td>
</tr>
<tr>
<td>Developing world -</td>
<td>increase to 3,000 kWhrs/yr</td>
<td>4,500,000,000</td>
<td>13.5 tkW-hrs</td>
</tr>
<tr>
<td>Those born by 2040 -</td>
<td>achieve 3,000 kWhrs/yr</td>
<td>3,500,000,000</td>
<td>10.5 tkW-hrs</td>
</tr>
</tbody>
</table>

Total Annual Global Energy Requirement 33 tkW-hrs

Climate Change is not a new phenomenon

Relative changes in global average temperature for the past 550 million years based on various methods from various researchers. The time scale is vastly different for each of the five general time segments, going from hundreds of millions of years per segment, to millions of years, to thousands of years. Note that the Earth has generally been warmer than it is today, and that we have been in a major cooling period for the last 10 million years, with glaciation the last 2.3 my.
Two scenarios for global temperature changes depending upon CO2 emissions reductions:

A2 - no reductions
B1 – significant reductions

Paris COP21 climate meeting was only about who would pay for implementing B1

Emissions pathways to limiting global warming to just 2° Celsius (3.6° Fahrenheit) above the temperatures of the 1800s.
U.S. Electric sector monthly CO2 emissions are at a 25-year low as natural gas overtakes coal’s share of power generation and we have implemented significant efficiency and conservation policies.


Huge shale gas production

What is the fastest growing energy source in the world?