Climate Change Crisis
Brilliant Light Power’s value in a carbon constrained world

Kert Davies, Director - Climate Investigations Center
Climate Change

- The largest environmental, ecological, social challenge we face
- Issue is broad and complex
- Science and policy arenas interwoven
- Society and governments slow to react
- Big changes in energy sector needed to avert worse impacts than we are already seeing
Atmospheric CO$_2$ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

PARTS PER MILLION

YEAR


March 2015
Monthly global data of NASA
Goddard Institute for Space Studies
Baseline 1951-1980

October 2015
2015 was the warmest year since modern record-keeping began in 1880, according to a new analysis by NASA’s Goddard Institute for Space Studies. The record-breaking year continues a long-term warming trend — 15 of the 16 warmest years on record have now occurred since 2001. (Credit: NASA/GSFC/Scientific Visualization Studio)
Climate Change Impacts

- Extreme weather
- 1000-year events now common
- Sea level rise threatens coasts worldwide
- Species extinction
- Agricultural disruption
- Destabilized governments - refugees
U.S. Drought Monitor
California

October 4, 2016
(Released Thursday, Oct. 6, 2016)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

<table>
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<tr>
<th>One Year Ago</th>
<th>0.00</th>
<th>10.00</th>
<th>25.00</th>
<th>50.00</th>
<th>75.00</th>
<th>90.00</th>
<th>95.00</th>
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<td>One Year Ago</td>
<td>0.14</td>
<td>99.86</td>
<td>97.33</td>
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<td>71.08</td>
<td>46.00</td>
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</tbody>
</table>

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying field summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/
Extremely Hot Days Projected by 2050
Philadelphia, PA

Total Days with a High of at Least 90°F

- **1950-2009 AVERAGE**: 20
- **2010**
  - Low Emissions: 25
  - High Emissions: 50
- **2050**
  - Low Emissions: 30
  - High Emissions: 60

Number of days when maximum temperature is 90°F or higher for the 1950-2009 average, 2010 observed through the end of July (in dark red) and expected for the year if August and September follow the past average (in pink), climate projections for 2040-2069 using a lower emissions scenario, and climate projections for 2040-2069 using a higher emissions scenario.

**Data source for observed temperatures:**
National Oceanic and Atmospheric Administration Global Historical Climatology Network
CO$_2$ Emissions

- Fossil fuels responsible for the majority of existing problem
- Deforestation, agriculture and land use related emissions are the rest of the problem
- Emissions growing in ‘developing’ countries – China, India
- Carbon bubble- We simply cannot burn the fossil fuels we know exist
- 2° degree target – Paris agreement/ US Clean Power Plan
Energy-related CO₂ emissions by region

Billion metric tonnes

- Rest of World
- Key Growth
- India
- China
- OECD32

Exxon – The Outlook for Energy: A View to 2040
CARBON BUBBLE
Emissions from burning all known reserves of coal, oil and natural gas.

2.795 billion tons of CO₂

Remaining carbon budget
This is how much CO₂ can be emitted until 2050 and still give a reasonable chance of staying below 2 degrees Celsius of global warming.

Source: Carbon Tracker Initiative 2015/ Pik Professor Institute for Climate Economics
Illustration: Felix Mellier/www.illustrations-album.ch
Fossil Fuels “externalities”

- Fossil fuel use causes many other environmental problems
  - Air pollution, smog, acid rain,
  - Oil spills, pipeline breaks, oil trains
  - Ocean acidification
Global Energy Demand

• The hill we have to climb
• “Energy Poverty”
• What is Brilliant Light Power’s true value in a carbon constrained world?
Industrial demand by fuel type
Quadrillion BTUs

- Electricity/market heat
- Biomass/other
- Coal
- Gas
- Oil

Exxon - The Outlook for Energy: A View to 2040
GDP
Trillion 2010$

Energy demand
Quadrillion BTUs

Exxon – The Outlook for Energy: A View to 2040
Exxon – The Outlook for Energy: A View to 2040

Electricity demand by sector

Electricity demand by region

Exxon – The Outlook for Energy: A View to 2040
Climate Solutions

• Massive de-carbonization of the economy urgently needed
• Nuclear – too expensive
• “Clean coal” mythology
• Natural gas – better than coal, but not clean
• Solar & Wind – growing faster than expected but not fast enough
• Batteries
• Efficiency and Conservation
FIGURE 8.7 | ESTIMATED RENEWABLE ENERGY SHARE OF GLOBAL ELECTRICITY PRODUCTION, END-2014

- FOSSIL FUELS AND NUCLEAR: 77.2%
- RENEWABLE ELECTRICITY: 22.8%
  - HYDROPOWER: 16.6%
  - WIND: 3.1%
  - BIO-POWER: 1.8%
  - SOLAR PV: 0.9%
  - GEOTHERMAL, CSP AND OCEAN: 0.4%

Source: REN21.
The Energy Revolution

- Business as Usual path of energy use unacceptable
- Renewable energy
- Energy efficiency
- Conservation
- Smart policies

http://www.greenpeace.org/international/en/campaigns/climate-change/energyrevolution/#tab=4
FIGURE 8.1 | GLOBAL ANNUAL POWER PLANT MARKET 1970 - 2014

Greenpeace- Energy Revolution 2015

source Platts, REN21, EWEA, GWEC, EPIA, National Statistics, IEA, Breyer.
data compilation Dr. Sven Teske/Greenpeace.
Batteries
EVs