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# **CLIMATE CHANGE/Global Warming/ Fossil Fuels**

## **Recommended Reading**

- **The Weather Makers**  
by Tim Flannery, 2005
- **Sustainable Fossil Fuels**  
by Mark Jaccard, 2005
- **An inconvenient Truth**  
by Al Gore, 2006
- **Nuclear Power is not the Answer**  
by Helen Caldicott, 2006
- **IPCC Reports issued in 2007**

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# **IPCC Reports 2007**

- **First report Feb. 2007:**  
**Causes of Global Warming —► Human Activity**
- **Second Report April 2007:**  
**Worldwide Impact**
- **Third Report May 4, 2007:**  
**Comprehensive Strategy to avoid the  
catastrophic Effects of Global Warming**

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# IPCC Reports 2007

**According to IPCC May 4, report, the worst effects of global warming can be avoided if:**

- **GHG emissions to peak in 15 years, and fall to 50% of current levels by 2050.**
- **Limit temperature increase to 1.6°C**
- **Above actions will stabilize GHG emissions below 490 ppm, the current concentration being about 430 ppm.**

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## What is in a name?

- **Is it Climate Change?**
- **Is it Global Warming?**
- **Is it Climate Disaster?**
- **Is it Climate Catastrophe?**

**Correct name should be:  
Climate Catastrophe**

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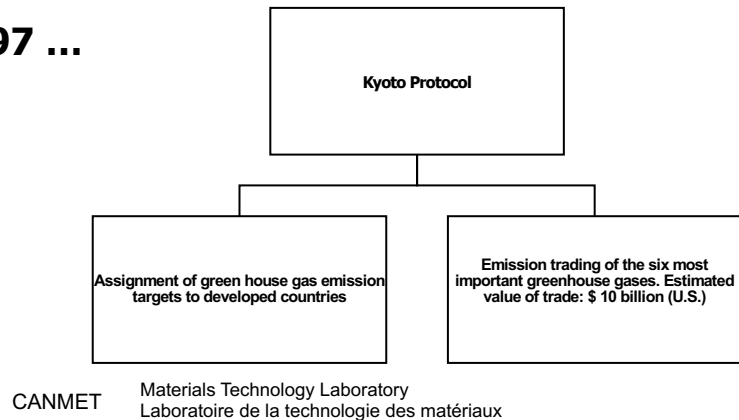
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# Road to Kyoto

- 1985 ..... Villach, Austria
- 1988 ..... Toronto
- 1992 ..... Rio Earth Summit
- 1997 ...



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# 1997 Kyoto Protocol

## Main Thrust :

**The developed countries agree to stabilize the GHG emissions to about 6% below the 1990 level by the year 2012.**

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# **Stabilization of our climate**

**Kyoto targets need to be strengthened  
12 times over to achieve cuts of GHG  
70% by Year 2050.**

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# **CO<sub>2</sub> Emissions and the Developing World**

- **Developing countries are responsible for just over 1/3 of the world's GHG emissions but they emit less than 1/5<sup>th</sup> as much per person as do the industrialized nations.**
- **By 2100, developing countries will emit two or three times as much as the developed world.**

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# **SURFACE TEMPERATURE of The EARTH**

**Estimated Potential Increase in Surface  
Temperature of the Earth between year  
2001 – 2099:**

**$3^{\circ}\text{C} \pm 2^{\circ}\text{C}$**

**Rate of change seen at the end of last  
glacial change:**

**$1^{\circ}\text{C}$  per 1000 years**

**From: Weather Makers**

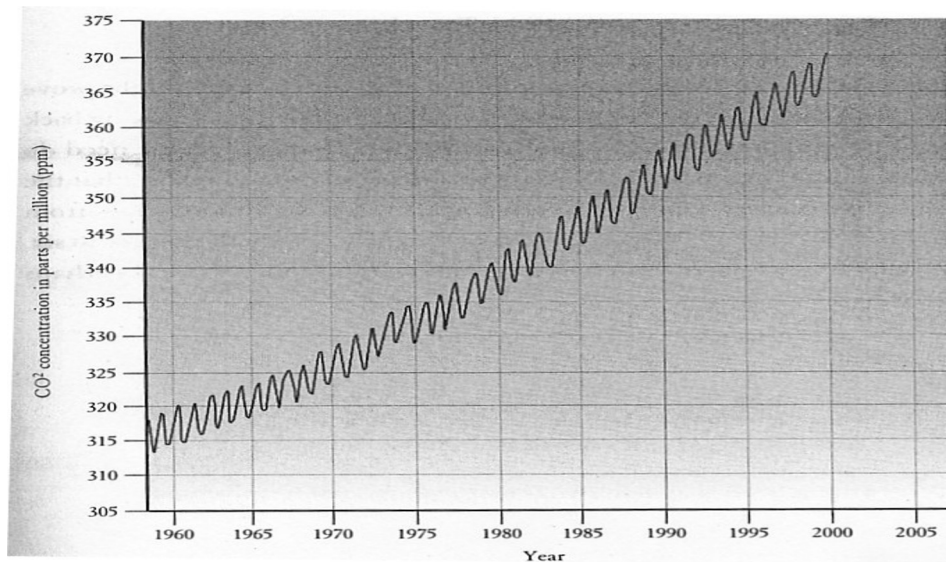
**by T.M. Flannery, 2005**

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**"Keeling" curve showing the concentration of CO<sub>2</sub> in the atmosphere as  
measured atop Mount Mauna Loa, Hawaii between 1958 and 2000.**

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## **CO<sub>2</sub> EMISSIONS per Person/year**

**Americans emit 3 times more CO<sub>2</sub> per person per year than Europeans, and over a hundred times more than the citizens of the least developed countries.**

**From: Weather Makers  
by Tim Flannery, 2005**

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## **Relative Damage Index of Different GHG**

<b>CO<sub>2</sub></b>	<b>1X</b>
<b>Methane</b>	<b>20X</b>
<b>Nitrous Oxides</b>	<b>200X</b>
<b>Fluorine</b>	<b>15,000X</b>

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## **What are the possible solutions?**

- **Carry out Carbon Sequestration**

**Or**

- **Reduce GHG Emissions**

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## **Carbon Sequestration**

- **Carbon sequestration involves techniques that capture GHG emissions so that they can be stored underground rather than be allowed to enter into the atmosphere.**
- **Unfortunately sequestration is very difficult and no techniques exist at present**

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# Geological sequestration of CO<sub>2</sub>

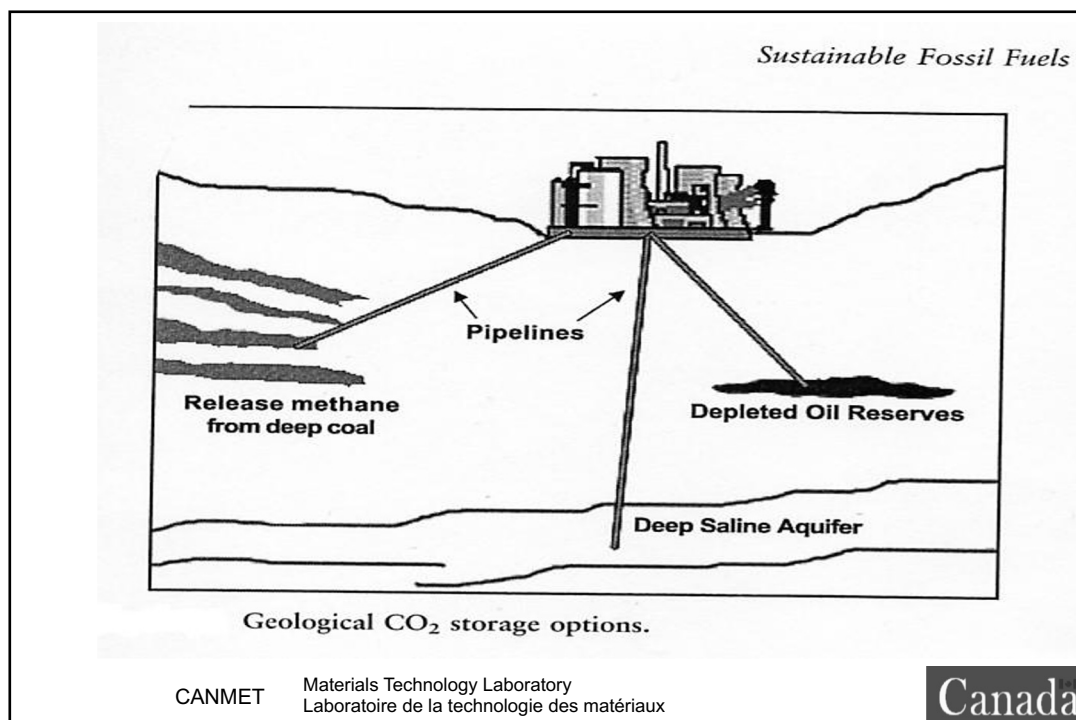
- Norway
  - Sleipner Project in Norway is one example
- Several other countries, e.g. Australia, Algeria, U.K., U.S.A. have projects in planning stage or under development.

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## Reduce GHG Emissions

- This is the only solution possible at present, and for the immediate future.

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## CO<sub>2</sub> Emissions Per Capita Per Year (tonnes)

**U.S.A. = 19.7 (20)**

**E.U. = 8.6 (9)**

**China = 2.8 (3)**

**India = 1.1 (1)**

**World Average = 3.9 (4)**

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## CO<sub>2</sub> Emissions by Industrialized Countries in 2000

Country	%
U.S.A.	25
E.U.	20
Russia	17
Japan	8
China	15
India	5

Total CO<sub>2</sub> emissions worldwide ~ 21 billion tonnes

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## World Leader in Global Warming

### North America

- In 1998, the North American continent accounted for 25.8 per cent of global emissions of carbon dioxide, a leading green-house gas.
- North America's per capita annual gasoline consumption for motor vehicles is nine times the world's average.
- By 1996, the North American Continent's impact on the environment, also called the "ecological footprint", had grown 4.4 times the world average.

*U.N. Report, Globe and Mail  
August 15, 2002*

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# **World Leader in Energy Consumption**

## **North America**

- North Americans burn an estimated 25.7 billion litres of fuel annually in traffic jams.
- Canada and the U.S consume 25 per cent of global energy used each year, despite having only about 5 per cent of the world's population.
- Although today's cars are 90 per cent cleaner than those of the 1970's, U.S. drivers now drive on average twice as many kilometers as they did in the 70's. Also, automobile fuel efficiency gains have been offset by an 18-year old trend towards heavier cars such as SUV's.

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# **Environment, Energy and Cost Related Issues in the Production of Portland Cement**

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# **Environmental Issues**

**The production of one tonne of portland cement clinker releases approximately one tonne of CO<sub>2</sub> into the atmosphere.**

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# **Energy Related Issues**

- **After aluminium and steel, the manufacturing of portland cement is the most energy-intensive process.**
- **The manufacturing of portland cement requires about 4 GJ of energy per tonne of the finished product.**

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## **Resource Conservation**

- **The production of one tonne of portland cement requires 1.55 to 1.60 tonnes of raw materials. These materials are primarily good quality limestone and clay.**
- **Therefore, for 1.6 billion tonnes of cement annually we need 2.5 to 2.6 billion tonnes of raw materials.**

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## **Cost Considerations**

- **Typically, the minimum economic size (MES) of an integrated cement plant is 1.0 to 1.5 million tpa, and the associated investment cost is in the order of 130 to 150 dollars (U.S.)/tpa.**
- **Thus, for one million tpa capacity integrated plant, the cost is in the order of 130 to 150 million dollars.**

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## Cement Consumption (millions of tonnes) 1985 – 2020 E

	1985	2003 E	2020 E
<b>Developed Countries</b>	<b>320</b>	<b>400</b>	<b>500</b>
<b>Developing Countries</b>	<b>360</b>	<b>1200</b>	<b>2500</b>
<b>Total</b>	<b>680</b>	<b>1600</b>	<b>3000</b>

*M. Betts, World Cement, Nov. 2003*

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## Production of cement/population/GDP of selected countries – 2004\*

Country	Production	Population	Amount -Cement
	Million Tonnes	Millions	Per person, kg
<b>CHINA</b>	<b>850</b>	<b>1299</b>	<b>654</b>
<b>INDIA</b>	<b>110</b>	<b>1065</b>	<b>103</b>
<b>U.S.A.</b>	<b>97</b>	<b>293</b>	<b>331</b>
<b>JAPAN</b>	<b>69</b>	<b>127</b>	<b>543</b>
<b>SOUTH KOREA</b>	<b>60</b>	<b>49</b>	<b>1224</b>
<b>RUSSIA</b>	<b>46</b>	<b>144</b>	<b>319</b>
<b>SPAIN</b>	<b>40</b>	<b>40</b>	<b>1000</b>
<b>BRAZIL</b>	<b>38</b>	<b>184</b>	<b>206</b>

**\*From: Prof Tang Mingshu, Nanjing University of technology, June 2005**

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## **Forecast for Cement Production China (millions of tonnes)**

### **2004**

**Estimated current Production = 700**

**Estimated % of world total = 43%**

### **2020**

**Estimated Production = 1500**

**Estimated % world total = 52%**

**The above assumes an annual compound  
growth rate of 5%**

*M. Betts, World Cement, Nov. 2003*

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## **Forecasting ..... Science?/Art?**

**"The only reason economists produce  
forecasts is to make astrology look  
respectable"**

**J.K. Galbraith**

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**"To err is human, to get paid for it divine"**

**from: "?"**

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# **Cement Plants**

**In an effort to reduce CO<sub>2</sub> emissions,**

**“Should we phase-out the cement plants?”**

**The answer is:**

**“Of course, not. This is not an option.”**

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# **Cement Plants (cont'd)**

**Due to the potential demand to meet the infrastructure needs of the world,**

**“Should we build new cement plants?”**

**The answer is categorically “NO!”**

**because we have other options.**

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## World-Wide Availability of Fly Ash

Country	Availability, (millions t/y)
China	> 300
India	>100
U.S.A.	> 50
E.U.	>50
Others	>150

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## So How Do We Make Our Concrete More Green? :

- Use less Portland Cement
- Use more supplementary cementing materials
- Use less unit water content
- Incorporate recycled aggregates in concrete

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## **So How Do We Make Our Concrete More Green?(Cont'd):**

- **Use stainless steel reinforcement in critical parts of structures to make them more durable.**
- **Where possible, specify strength acceptance criteria on 56 or 91 days instead of 28 days.**
- **Use lightweight concrete where possible**

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## **Water - The next world crisis on the horizon ?**

- **Estimated 500 million people on the planet live in countries critically short of water.**
- **By 2025, the above number will leap to 3 billion.**

*Globe and Mail, June 2001*

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# **Water Use and Water Wastage**

## **Use**

**9.5 billion liters of water it would take to support 4.7 billion people at the U.N. daily minimum needs.**

## **Waste**

**9.5 billion liters of water used a day to irrigate the world's golf courses.**

**Time Magazine  
April 5, 2004**

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# **Water (cont'd)**

**According to the Pacific Institute for Studies in Development and Security:**

- **Water shortages have arisen in recent years across the U.S. Southwest and Northwest, as well as in India, China, Africa, among other places. As a result, some plants have had to close or had disruptions.**

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## **Water (cont'd)**

**For example, this year in the southwest Indian state of Kerala, PepsiCo Inc. and Coca-Cola Co. bottling plants were ordered closed amid drought-induced water shortages.**

*Wall Street Journal August 2004*

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## **Water (cont'd)**

**The World Commission on Water estimates that the demand for water will increase by around 50% in the next 30 years. Moreover, around 4 billion people – one half the world's population – will live in conditions of severe water stress, meaning they will not have enough water for drinking and washing to stay healthy, by 2025.**

**The Economist  
July 30, 2005**

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## Water consumption by Continent

Continent	Water Consumption Litres/day
North America	600
Europe	300
Africa	30

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**Himalayan glaciers are melting fast. This could lead to water shortages for hundreds of millions of people.**

**Then glaciers which regulate the water supply to Ganges, Indus, Brahmaputra, Mekong, Thanlwin, Yangtse and Yellow rivers are believed to be retreating at a rate of about 10 to 15 m each year**

**BBC News  
March 14, 2005**

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# Kilimanjaro Global Warning



ALEX MAJOLI / MAGNUM PHOTOS

Tanzania's 5,895-metre Kilimanjaro, seen in this aerial photograph, is without its snow cap for the first time in what scientists estimate could be 11,000 years. G8 ministers meet in London today to discuss climate change.

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## Melting of the ice and how it will affect sea levels

**Arctic Ice...** This is sea ice and its melting will not affect sea level

**Greenland Antarctic Ice**

This ice mostly on land and its melting will affect sea levels

- **Greenland ice** sheet is up to 3- km thick. If all of this is to melt, sea levels would rise by about 7 meters.
- **Antarctic's ice** sheet is up to 4.2 km. If this also melts, it would add another 5 meters to the rise in sea level.
- It is estimated that one meter rise in sea levels would flood 17% of land mass of Bangladesh and cause serious problems for coastal cities : Florida, New York and London.

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## **CO<sub>2</sub> EMISSIONS & CHINA**

- **China builds about 100 large 500-megawatt coal-fired power stations per year, and, most likely, it will continue to do so for the next 25 to 30 years.**
- **Characteristics of a 500-megawatt power plant:**
  - **It needs about 1.4 million tonnes of coal a year for operation**
  - **It produces 3.5 billion kilowatt-hours and thus can power 140 000 homes.**
  - **If it has no scrubbers, it will emit 3.7 million tonnes of CO<sub>2</sub>**

**(From a recent report by MIT)**

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## **Global Warming and Bangladesh**

- **Population about 150 million, (about 1/2 of the U.S.A.) people packed in an area the size of Iowa state, U.S.A. It is also as flat as Iowa.**
- **One foot (30 cm) rise in sea level by year 2040 would render 18 million homeless (a very likely scenario).**
- **Three-foot rise (90 cm) by year 2100 would render 30 million homeless (a possible scenario).**

**Data extracted from various reports  
Including an article by Henry Chu in  
LA times & Washington Post**

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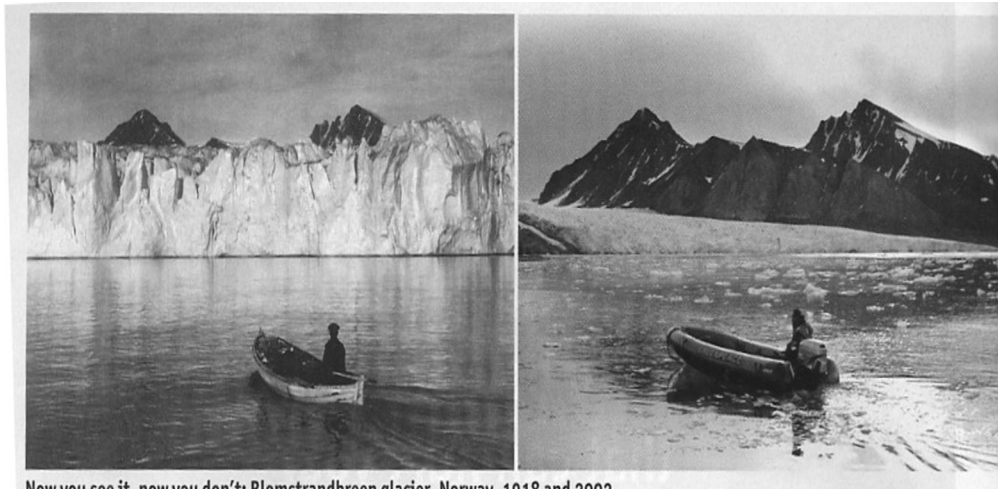
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## Blomstrandbreen Glacier, Norway



Now you see it, now you don't: Blomstrandbreen glacier, Norway, 1918 and 2002

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## End of Civilization?

**Unless we stop now, we will really doom the lives of our descendants. If we just go on for another 40 – 50 years, faffing around, they will have no chance at all; it will be back to the stone age. There will be people around still. But civilization will go.**

**James Lovelock  
Independent, 24 may, 2004**

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# **Extinct Homo Sapiens 2500 BC - 2500 AD ?**

**Cause of death :**

**Self inflicted by excessive GHG  
emissions and excessive use of  
Natural resources, including water  
and cement.**

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