
lecture 13
Climate Policy

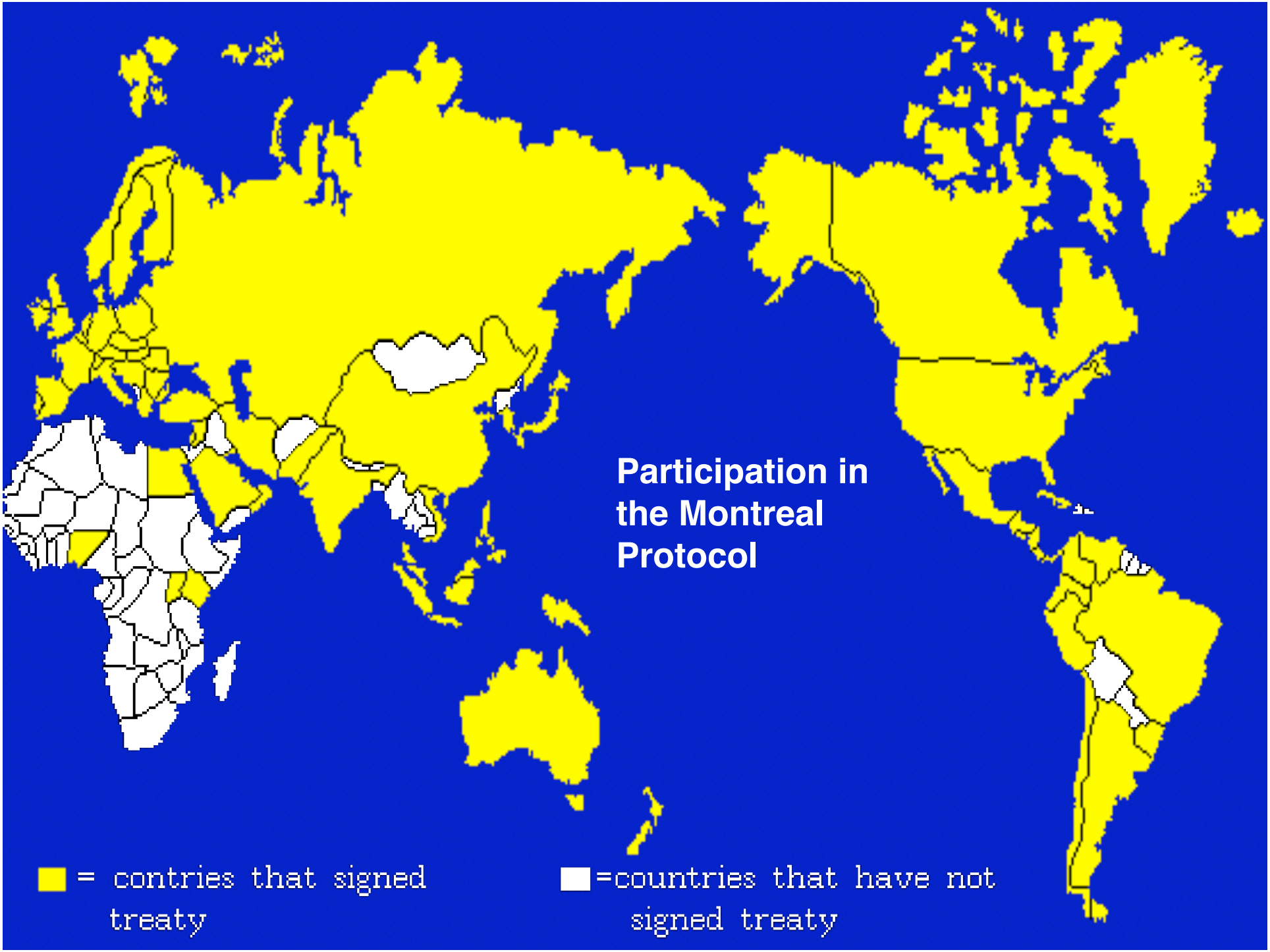
The Montreal Protocol: a model for addressing Climate Change?

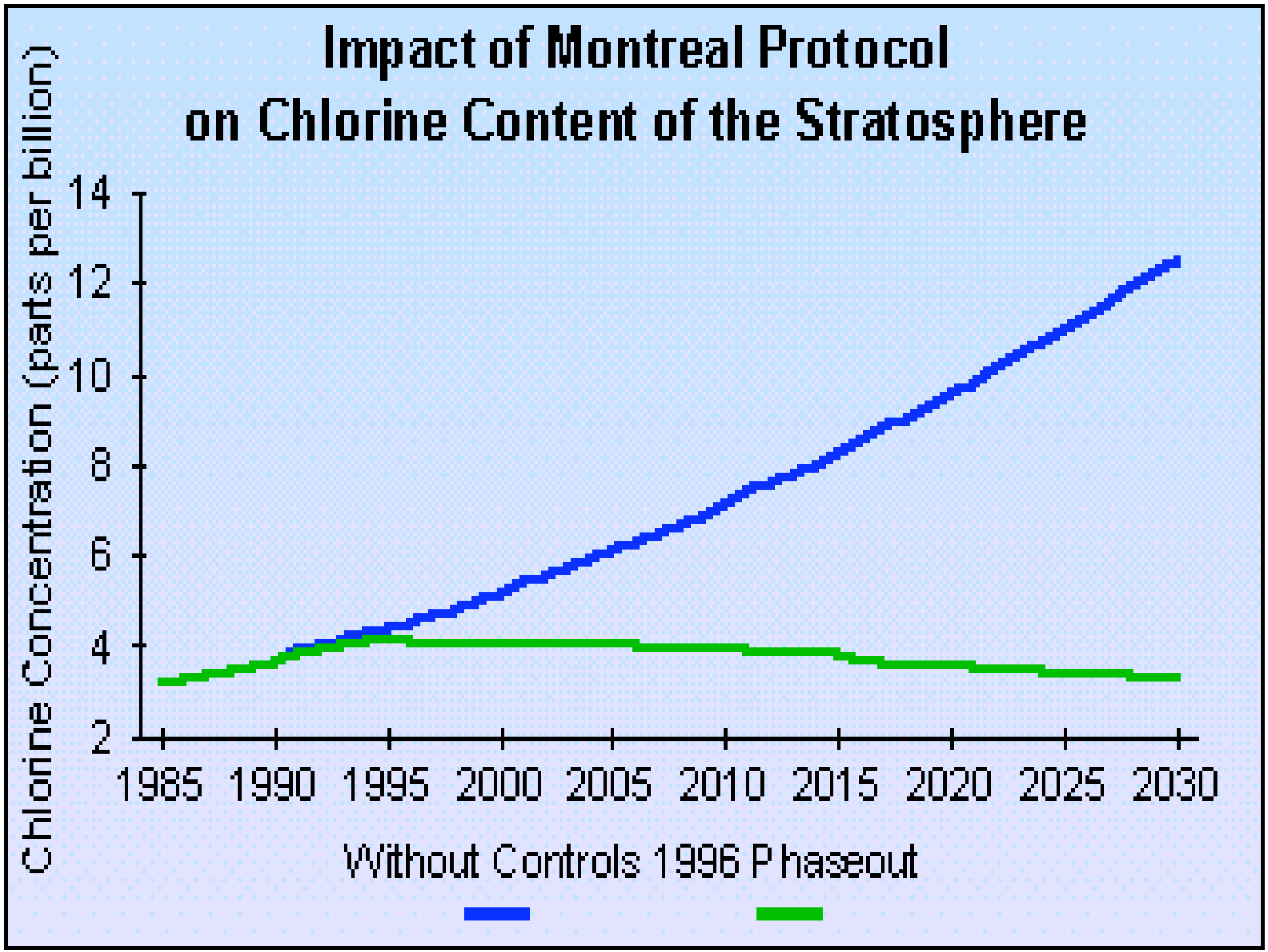
The discovery of the ozone hole over Antarctica in 1984 was spectacular confirmation that CFCs were destroying the ozone layer. This lead to the Montreal Protocol, the only example of an international agreement to combat a global environmental problem.

The Montreal Protocol was signed in 1987, soon after the discovery of the ozone hole. It was amended in 1990 and 1992.

It will gradually phase out the production of ozone-destroying CFCs. CFC production ended in the U.S. and Europe in 1996, and is slated to end in less developed countries in 2010.

Countries that did not participate are subject to trade sanctions by the countries that did.


Participation in the Montreal Protocol
= contries that signed treaty
=countries that have not signed treaty


Impact of Montreal Protocol
on Chlorine Content of the Stratosphere
Chlorine Concentration (parts per billion)
14
12
10
8
6
4
2
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
Without Controls
1996 Phaseout

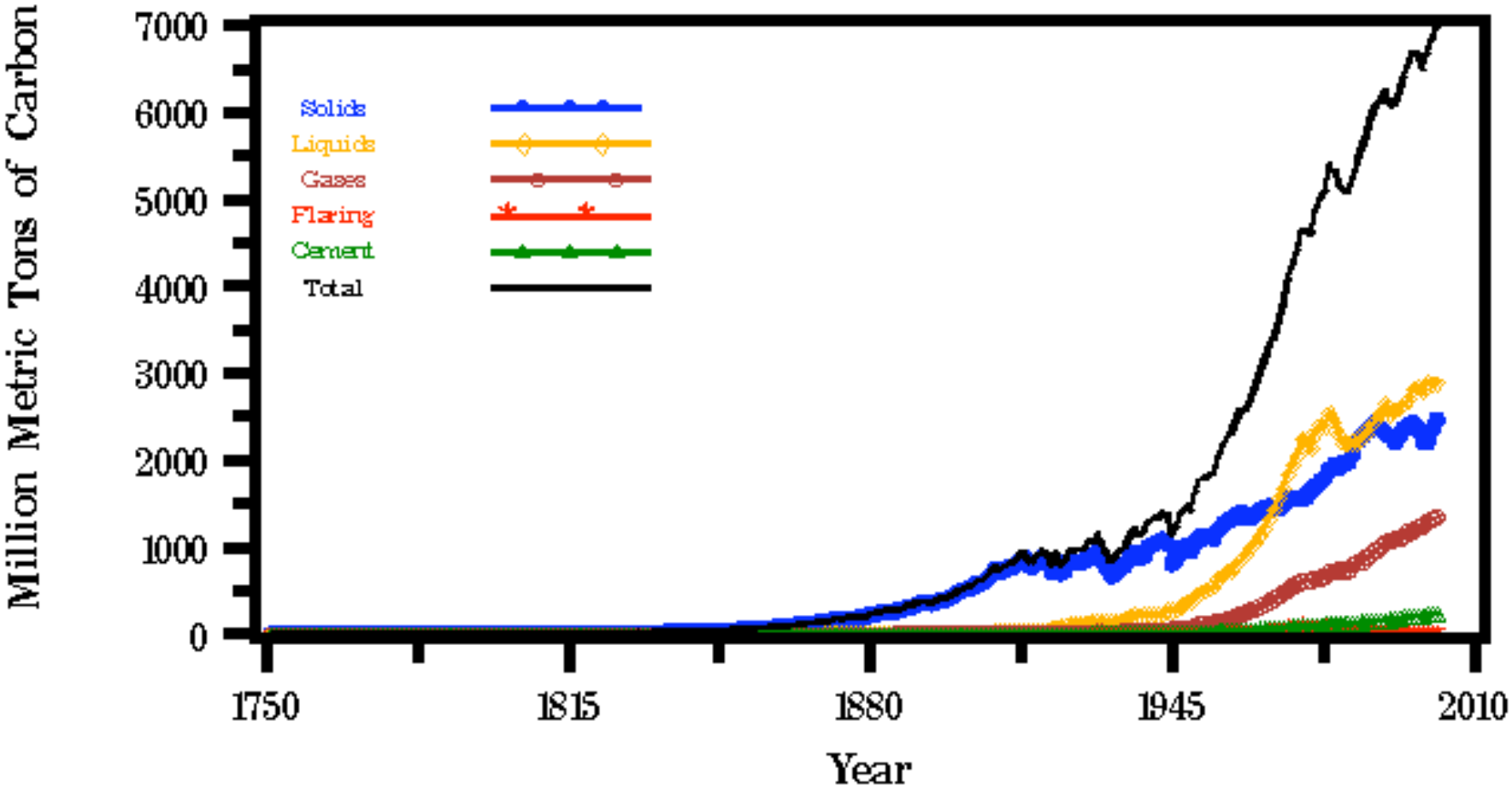
Why has the effort to fight ozone depletion been so successful?

(1) The connection between CFCs and ozone destruction was made very clear by **sound science**.

(2) Once the ozone hole was discovered, the chemical industry realized that some political action to limit CFCs was probably inevitable, creating a strong economic incentive to develop **viable alternatives to CFCs**, which the chemical industry did within a year or two.

(3) Equity issues between developed and developing nations were recognized. The developing nations were asked to phase out CFCs later than the wealthy countries, and a fund was established by the wealthy countries to assist the developing countries in converting from CFCs to less harmful chemicals. This resulted in a truly **global commitment** to solving the problem.

Global carbon emissions since 1750, total and by sector



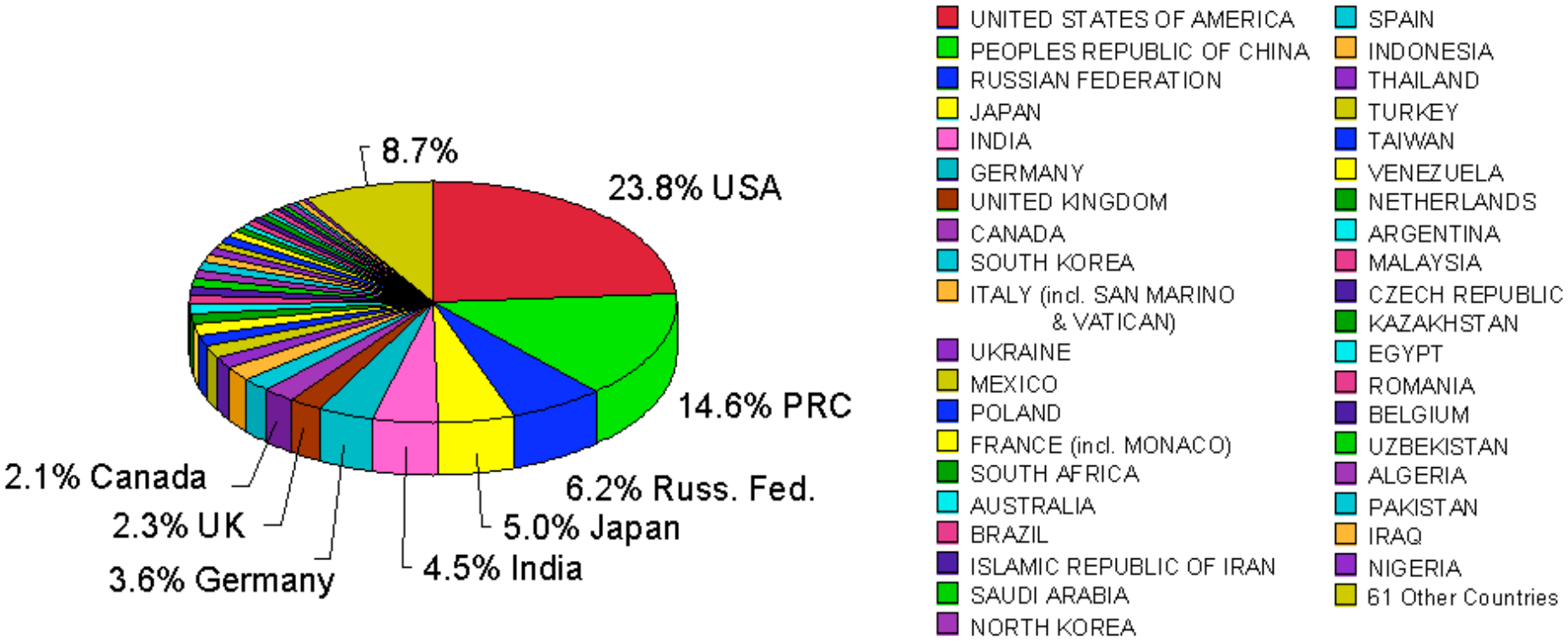
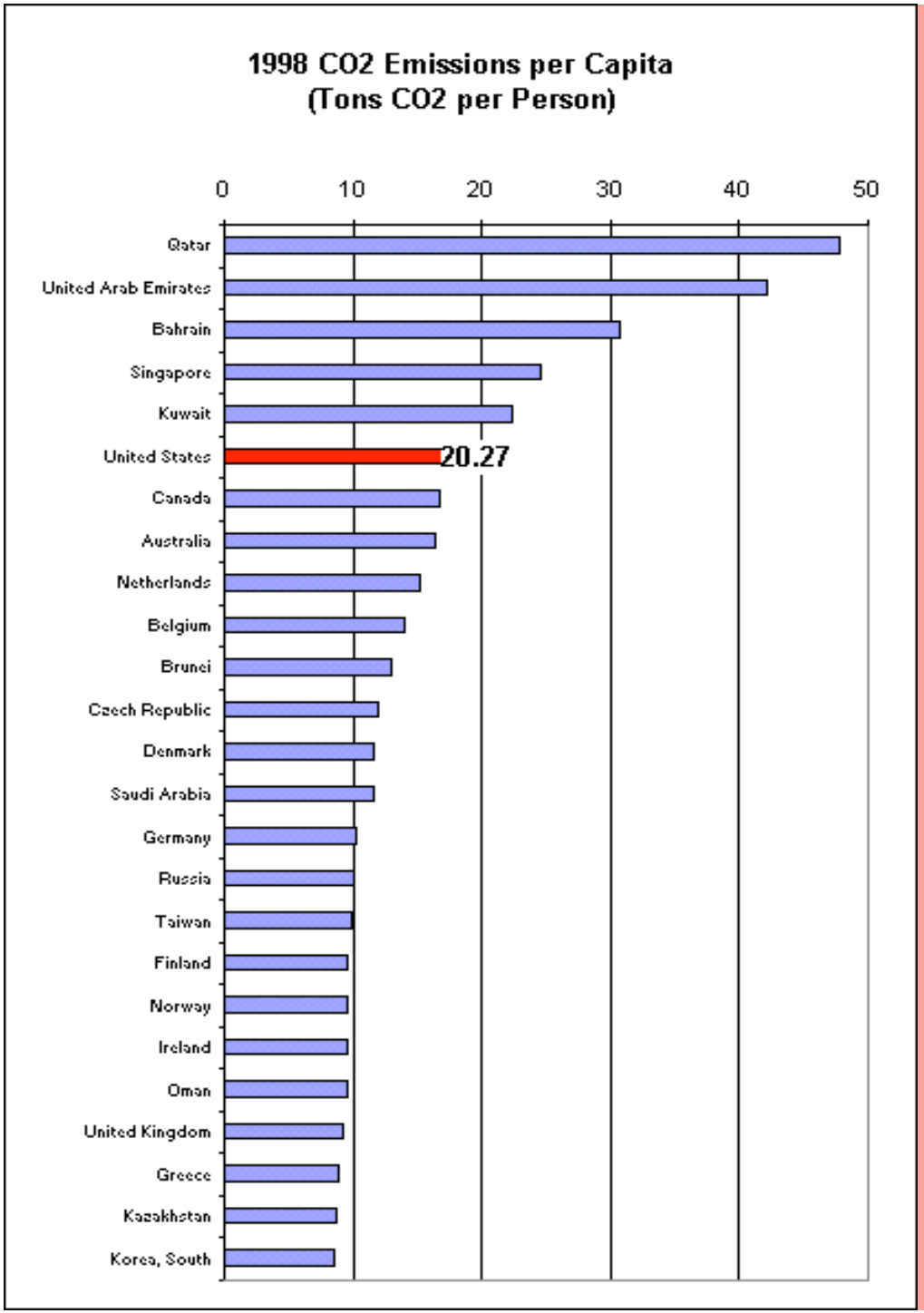


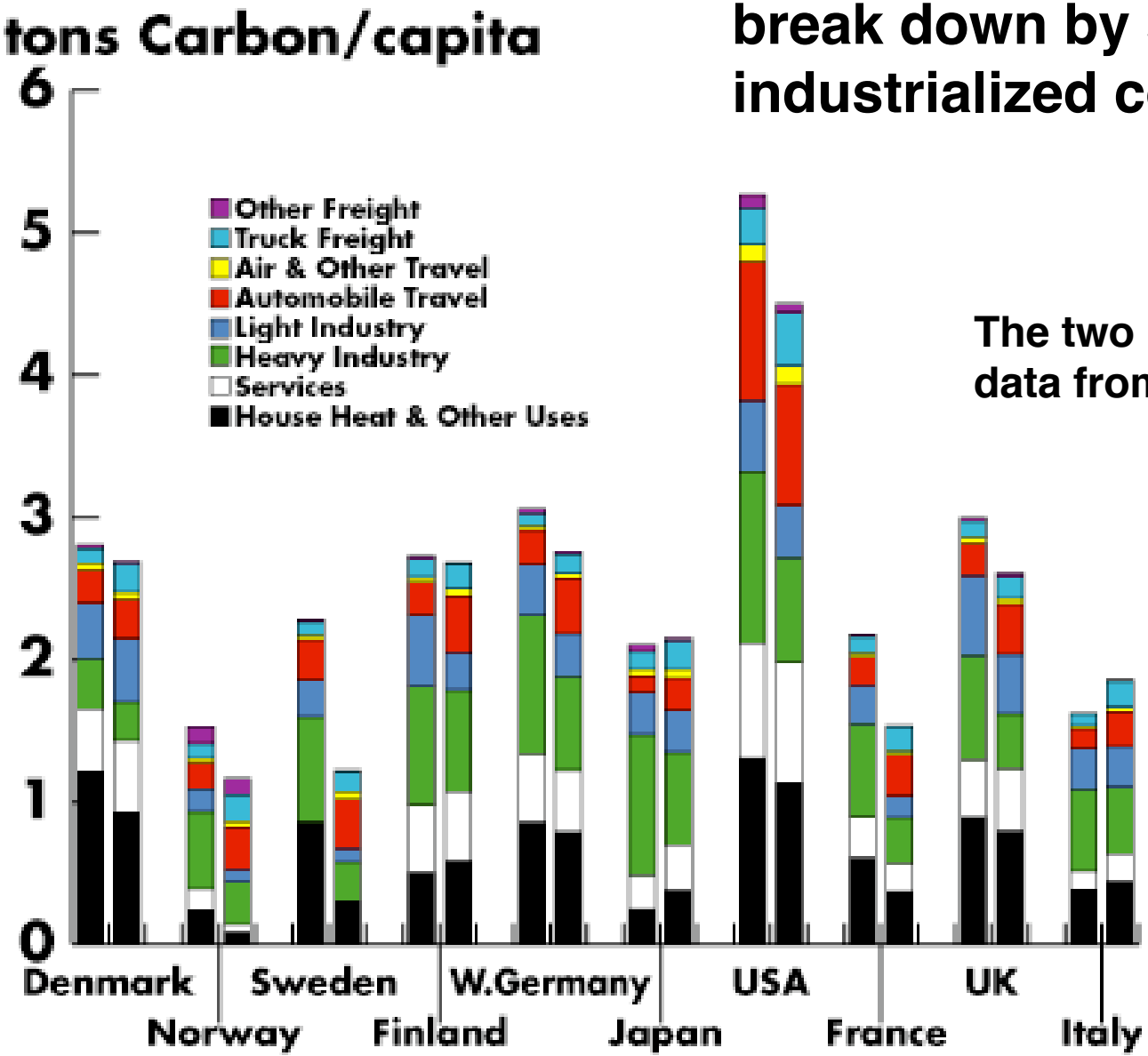
Figure by M. Horning based on Data from Gregg Marland and Tom Boden (Oak Ridge National Laboratory) and Bob Andres (University of North Dakota), available from the Carbon Dioxide Information Analysis Center (http://cdiac.esd.ornl.gov/)

Here's how each country's emissions break down as a percentage of the total.

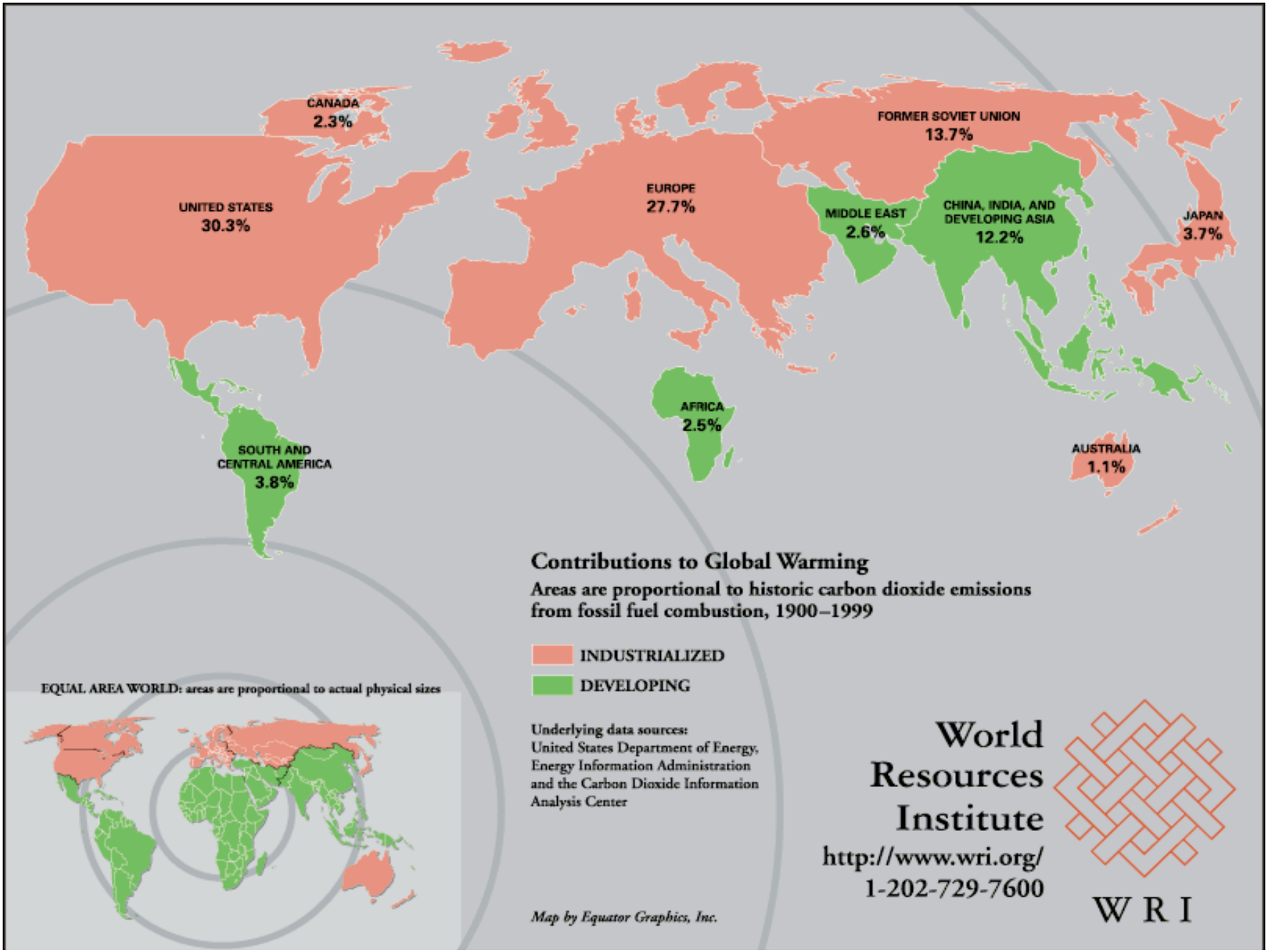


We've seen that the U.S. produces by far the most emissions of CO2 of any country in the world. How does the U.S. compare to other countries on a per capita basis?

Here's how the emissions break down by sector for industrialized countries.



The two bars represent data from 1973 and 1991



Contributions to Global Warming

Areas are proportional to historic carbon dioxide emissions from fossil fuel combustion, 1900–1999

INDUSTRIALIZED

DEVELOPING

EQUAL AREA WORLD: areas are proportional to actual physical sizes

Underlying data sources:
United States Department of Energy, Energy Information Administration and the Carbon Dioxide Information Analysis Center

Map by Equator Graphics, Inc.

World Resources Institute
http://www.wri.org/
1-202-729-7600

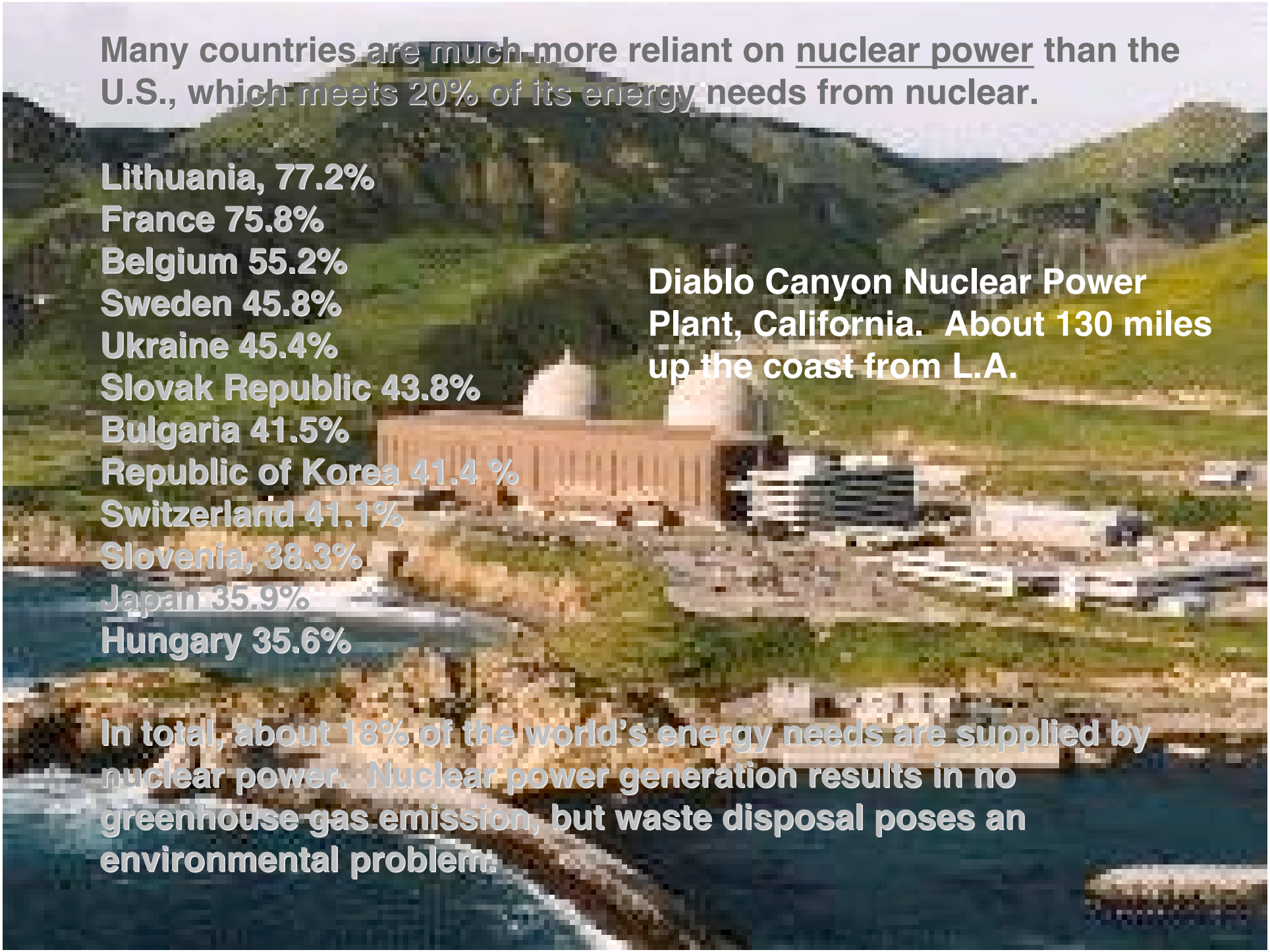
WRI

Energy Alternatives

Solar power is harnessed through two principal means:

(1) Solar thermal collectors, which can produce hot water and warm air for homes and industrial applications.

(2) Solar photovoltaic cells, shown here, which generate pollution-free electricity directly from sunlight.



Many countries are much more reliant on nuclear power than the U.S., which meets 20% of its energy needs from nuclear.

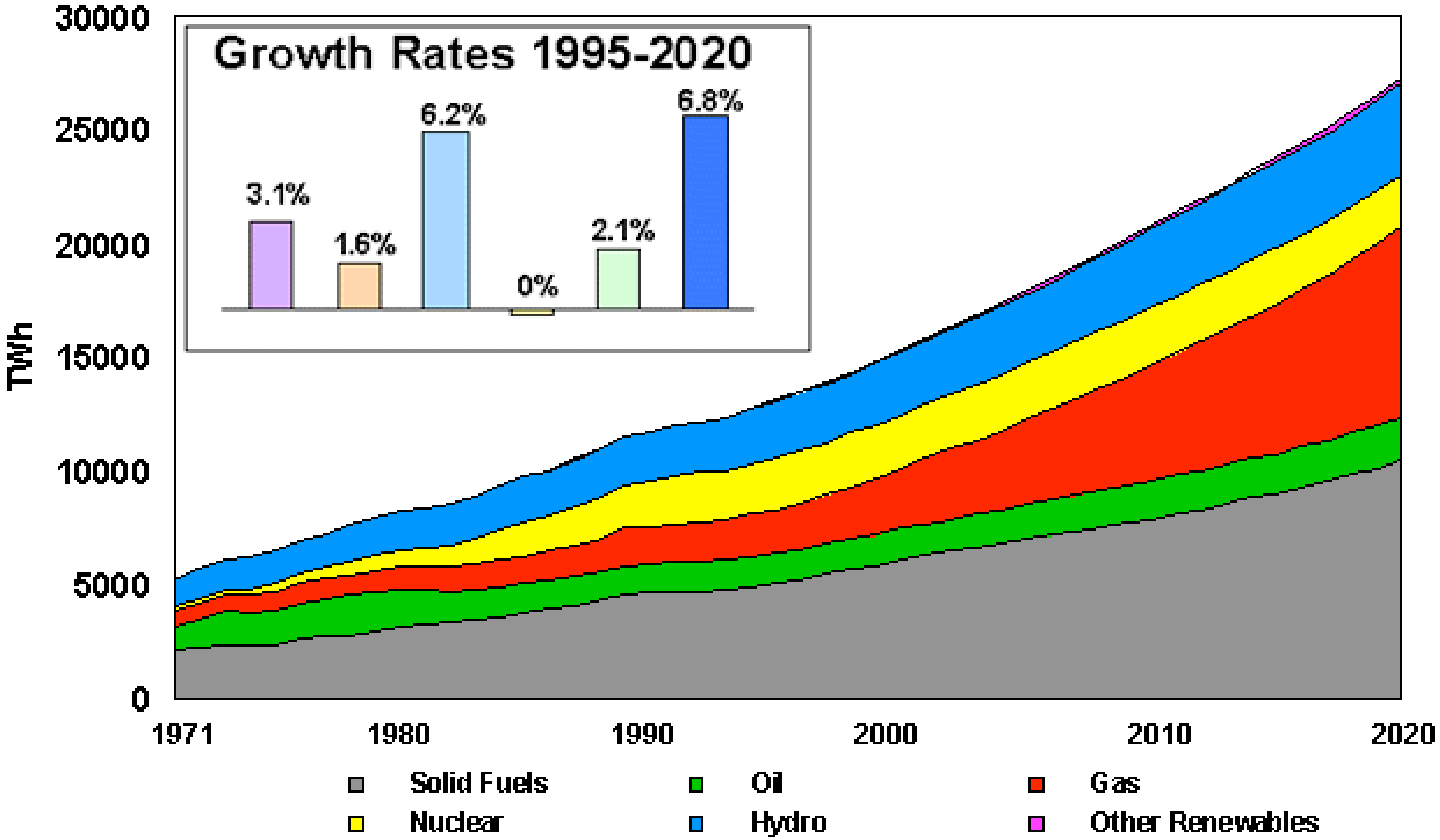
Lithuania, 77.2%
France 75.8%
Belgium 55.2%
Sweden 45.8%
Ukraine 45.4%
Slovak Republic 43.8%
Bulgaria 41.5%
Republic of Korea 41.4 %
Switzerland 41.1%
Slovenia, 38.3%
Japan 35.9%
Hungary 35.6%

Diablo Canyon Nuclear Power Plant, California. About 130 miles up the coast from L.A.

In total, about 18% of the world's energy needs are supplied by nuclear power. Nuclear power generation results in no greenhouse gas emission, but waste disposal poses an environmental problem.

Hydroelectric power also generates no greenhouse gas emissions. Like nuclear power, it can also create other environmental problems. Hydroelectric power provides about 15% of the world's electricity needs.

How exactly will energy needs be met in the future? Based on current knowledge of the viability of energy generation techniques, almost all projections indicate that fossil fuels will continue to dominate energy production.



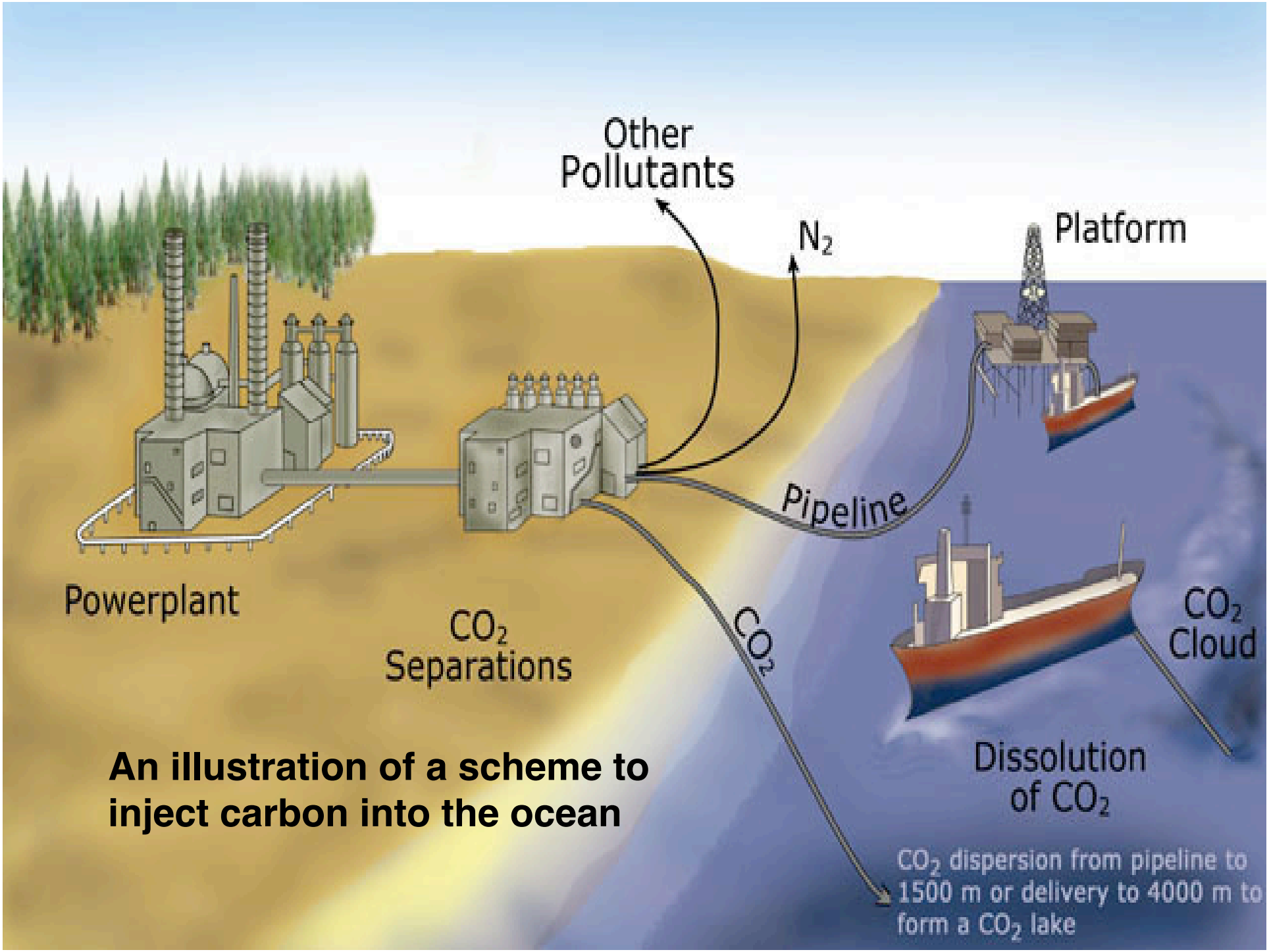
Ideas have been proposed to remove CO_2 directly from the atmosphere.

Iron Fertilization:

1. Supertankers would spread millions of tons of iron over the ocean surface.
2. The iron stimulates growth of algae which consume carbon dioxide from the ocean surface as they grow.
3. When the algae and the organisms that consume them die, they sink to the sea floor, taking the carbon with them.
4. The ocean draws more carbon dioxide from the atmosphere to replace what the algae took from its surface.

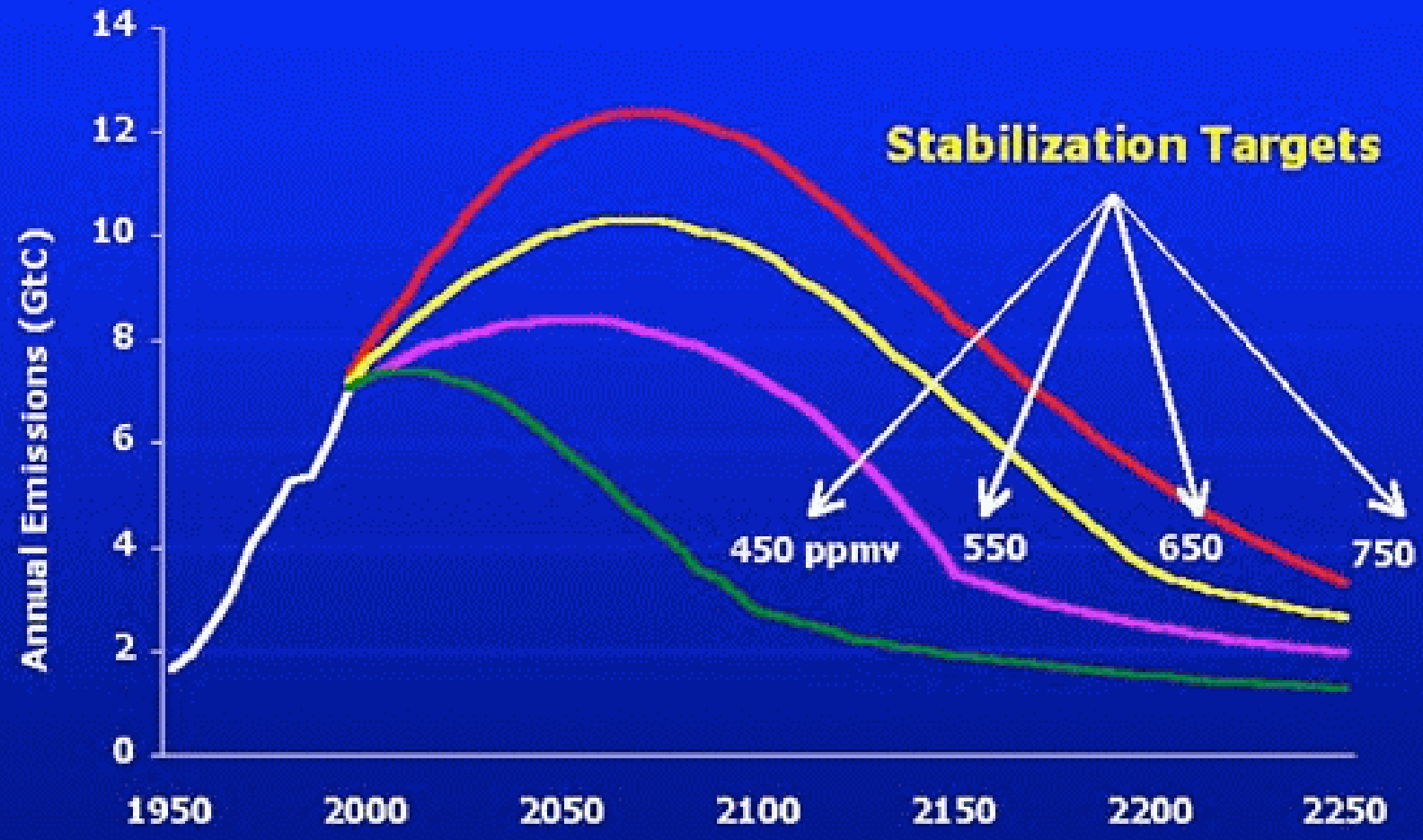
Carbon Sequestration:

These techniques would involve removing the CO_2 as it's emitted from a power plant and either injecting it directly into the deep ocean or burying it deep in the ground.



An illustration of a scheme to inject carbon into the ocean

Greenhouse gas emission scenarios



Note that the pre-industrial CO2 level was about 280 ppm

WORLD RESOURCES INSTITUTE

The Kyoto Protocol was negotiated in Kyoto, Japan by more than 160 nations in December 1997. It aims to reduce net emissions of greenhouse gases, primarily carbon dioxide.

The US agreed to reduce its average emissions 7% from their 1990 levels during the period 2008-2012. Other developed countries agreed to similar reductions. The way the reductions were achieved was up to the individual countries. Developing countries did not agree to meet any requirements.

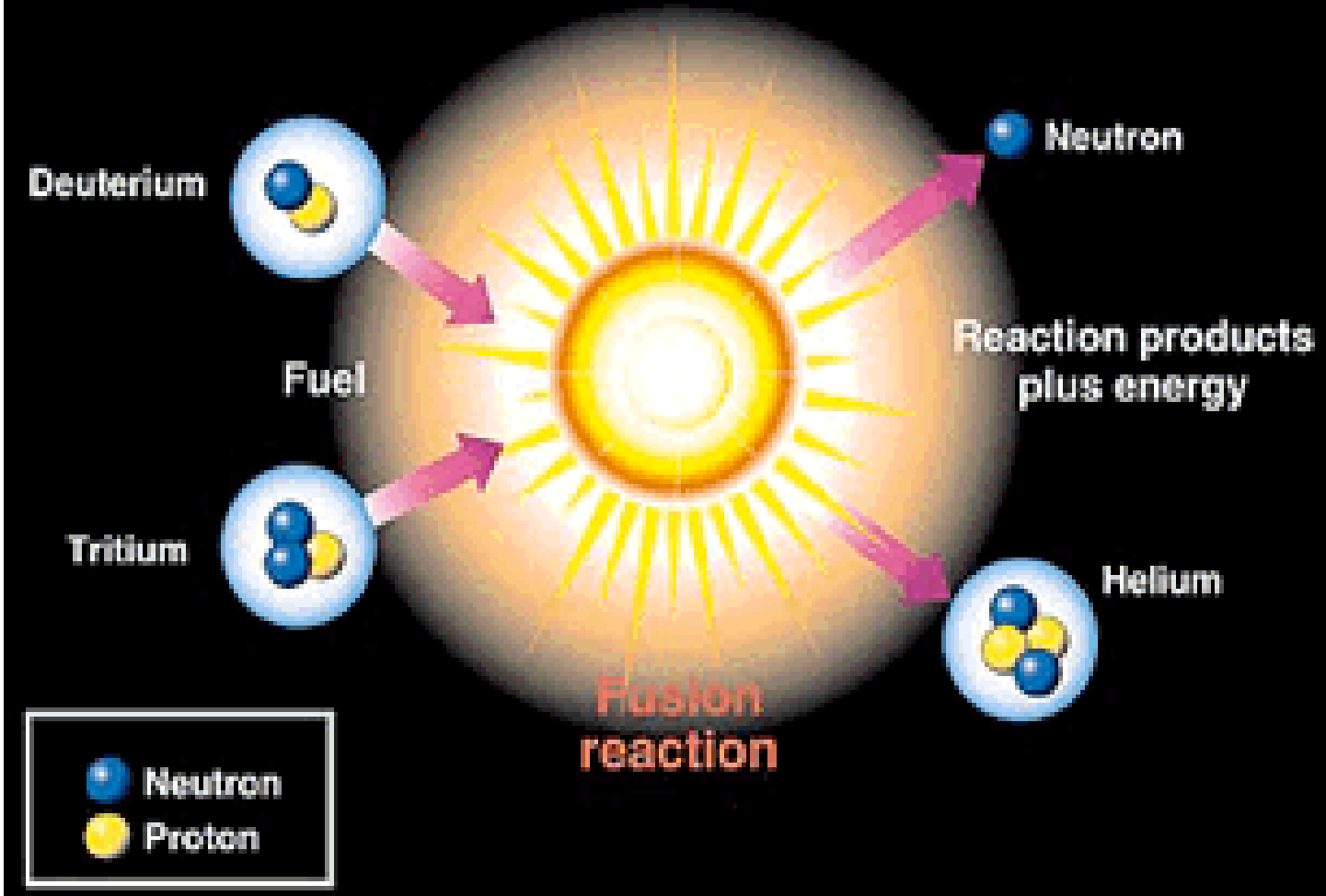
It incorporated some novel mechanisms for achieving greenhouse gas reductions, including emissions trading, and joint implementation. These flexible, market-based mechanisms were included with the urging of the US delegation.

The fate of the Kyoto protocol

Accounting for 25% of the world's greenhouse gases, the US has effective veto power over any treaty to combat climate change. In March 2001, the newly elected president George W. Bush declared that the US would not participate in the Kyoto Protocol, citing the lack of participation of developing countries and the burdens it would place on the US economy. Though the Clinton administration strongly supported the treaty, US senate ratification had always been in doubt.

Though reaction in the US was muted, protests occurred elsewhere in the world. Europeans were particularly outraged that the treaty was effectively being shelved.

This photo shows Europeans carrying Texas-style "wanted" posters.



What about the possibility of a technological breakthrough in energy production?

Fusion is the reaction that fuels the sun and H-bombs. The energy release in a fusion reaction is tremendous. The fusion of all the nuclei of one kilogram of a mixture of deuterium and tritium would produce as much energy as the burning of 10,000 tons of coal. The main barrier to generating power from fusion is controlling the reaction.