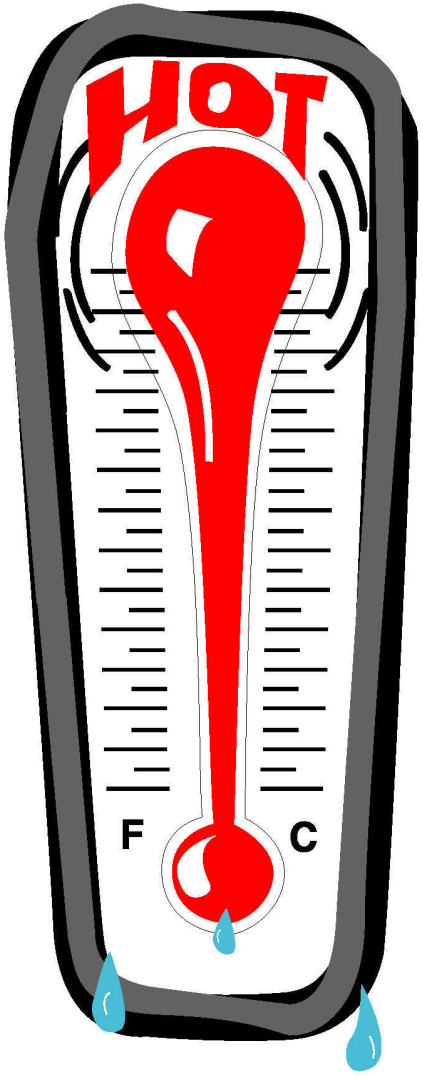
THE GREENHOUSE EFFECT
AND
YOUR FAMILY'S CONTRIBUTION TO IT



Stephen E. Schwartz

April 17, 2007

http://www.ecd.bnl.gov/steve

by far the most terrifying film
you will ever see.
an inconvenient truth
A GLOBAL WARNING
now playing in select theaters
PARTICIPANT

TIME MAGAZINE, APRIL 3, 2006

CANADA

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RETREAT OF MID-LATITUDE GLACIERS

South Cascade Glacier, Washington

1928

2000

http://ak.water.usgs.gov/glaciology/south_cascade/1928-2000comparison.htm

PASTERZE GLACIER, AUSTRIA 1875 - 2004

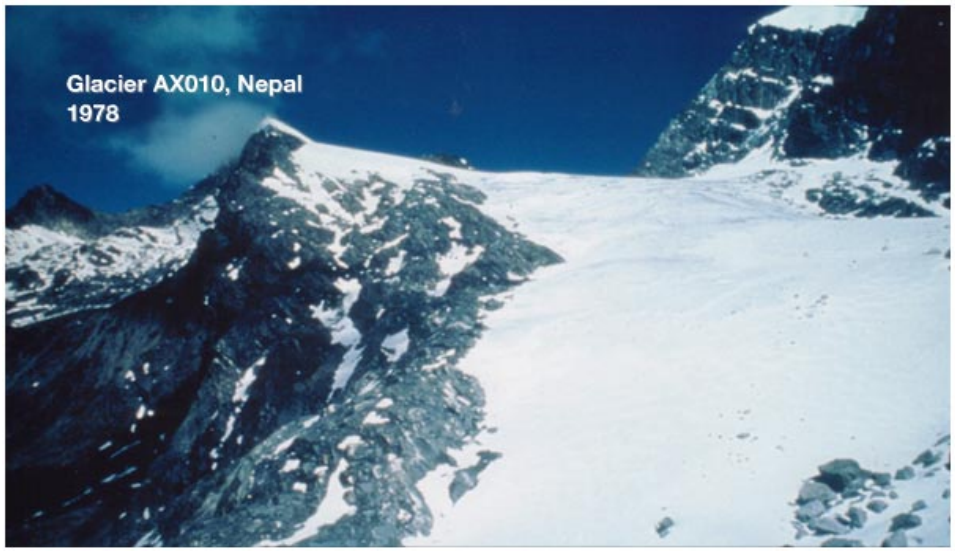
About 2 km shorter.
Terminus replaced by artificial lake.
Decrease in length about 15 meters per year.
In 2003, decrease was 30 m in length and 6.5 m in thickness.

http://www.worldviewofglobalwarming.org/pages/glaciers.html

GRINNELL GLACIER
GLACIER NATIONAL PARK 1911 - 2000

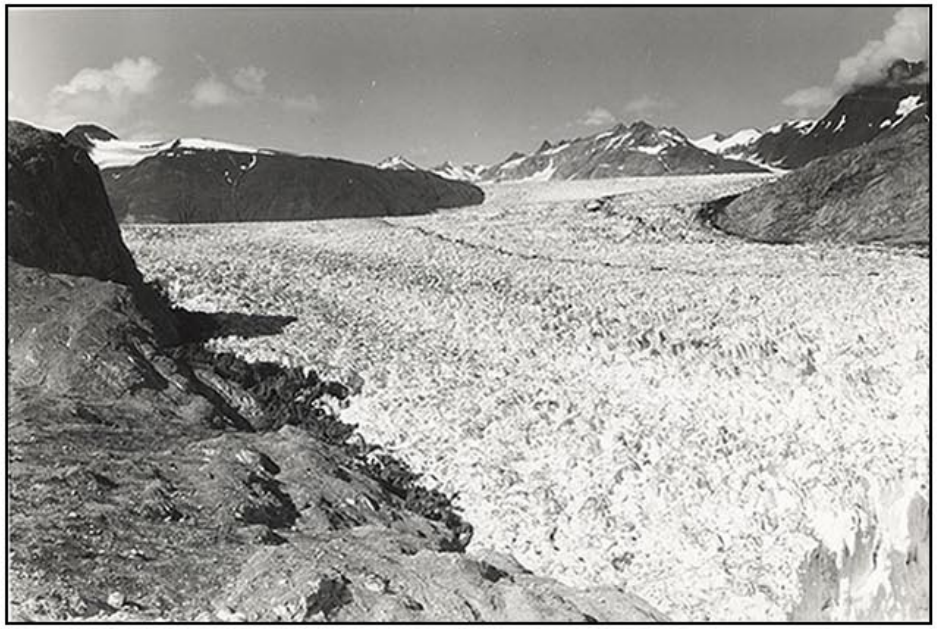
http://www.worldviewofglobalwarming.org/pages/glaciers.html

GLACIER AX010, NEPAL, 1978-2004



http://snowman.ihas.nagoya-u.ac.jp/download/photo/AX010.html

MUIR GLACIER - MUIR INLET
GLACIER BAY NATIONAL PARK, ALASKA
1941 vs. 2004



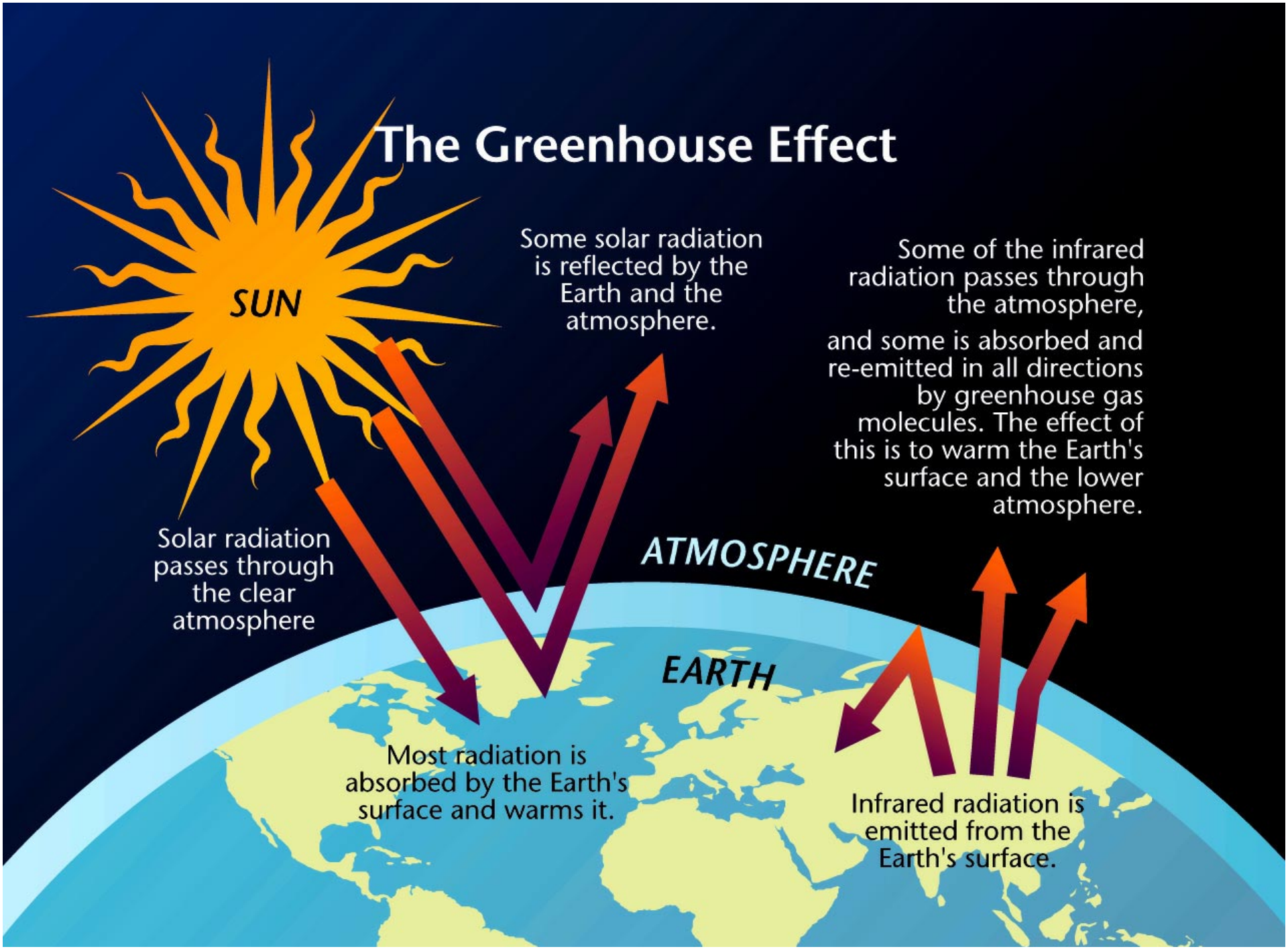
Muir Glacier, William O. Field on 13 August 1941 and by Bruce F. Molnia on 31 August 2004

RHONE GLACIER, VALAIS, SWITZERLAND
1859 - 2001

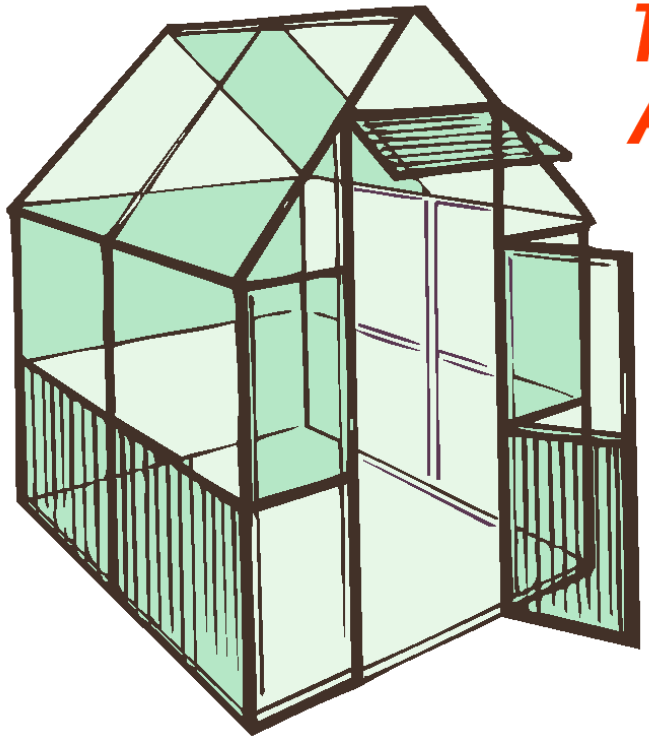
Glacial retreat is 2.5 km.

Base is 450 meters higher.

http://www.worldviewofglobalwarming.org/pages/glaciers.html


The Greenhouse Effect
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere,
and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere
ATMOSPHERE
EARTH
Most radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

THE GREENHOUSE EFFECT



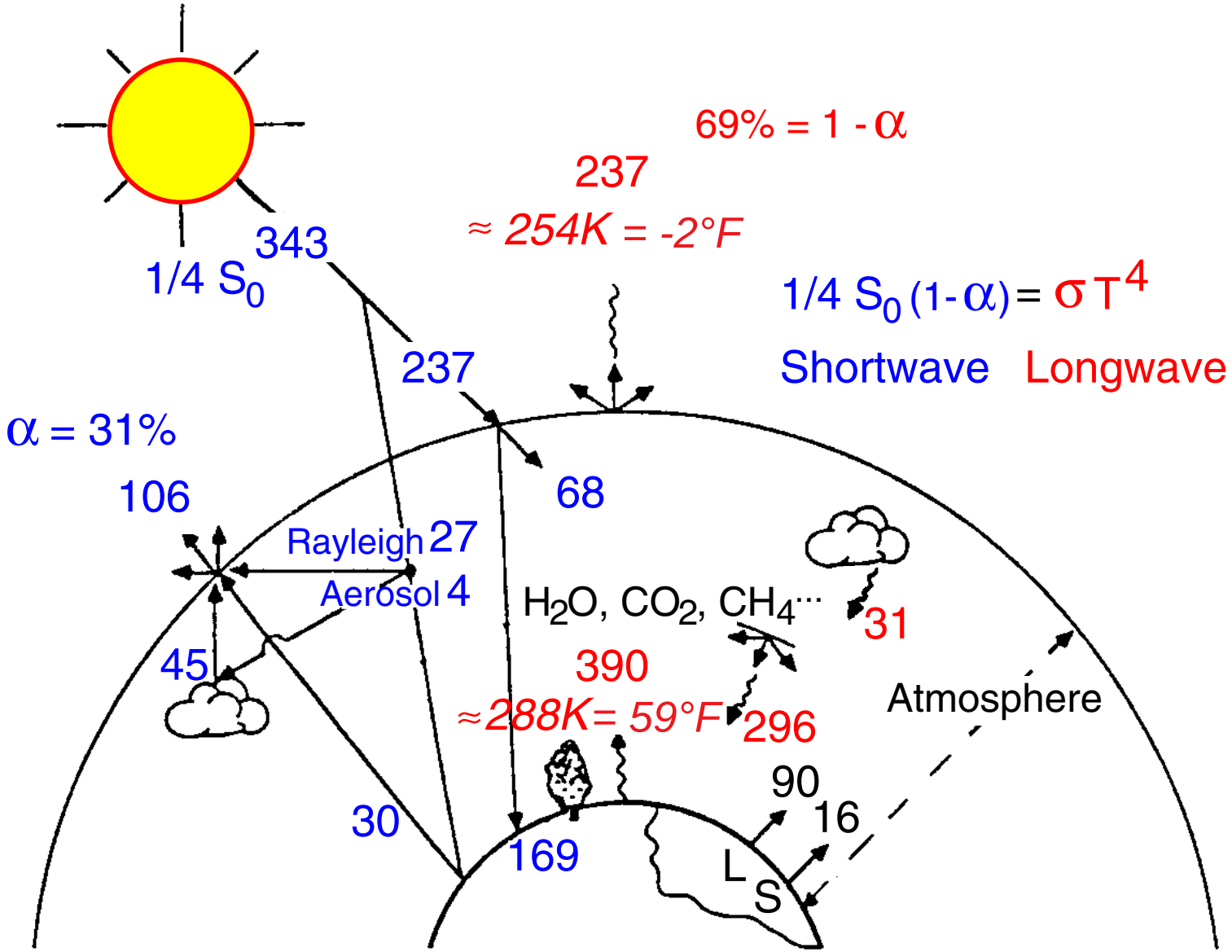
THE EARTH'S ENERGY BUDGET: A DELICATE BALANCE

- Sunlight heats the Earth.
- The warm Earth radiates energy (in the form of infrared radiation, or heat) back out to space.
- Some of this infrared radiation is trapped in the atmosphere, giving Earth its temperate climate.

This is the greenhouse effect. Without it, the Earth's climate would be like the moon's, harsh and severe.

GLOBAL ENERGY BALANCE

Global and annual average energy fluxes in watts per square meter



Schwartz, 1996, modified from Ramanathan, 1987

ATMOSPHERIC RADIATION

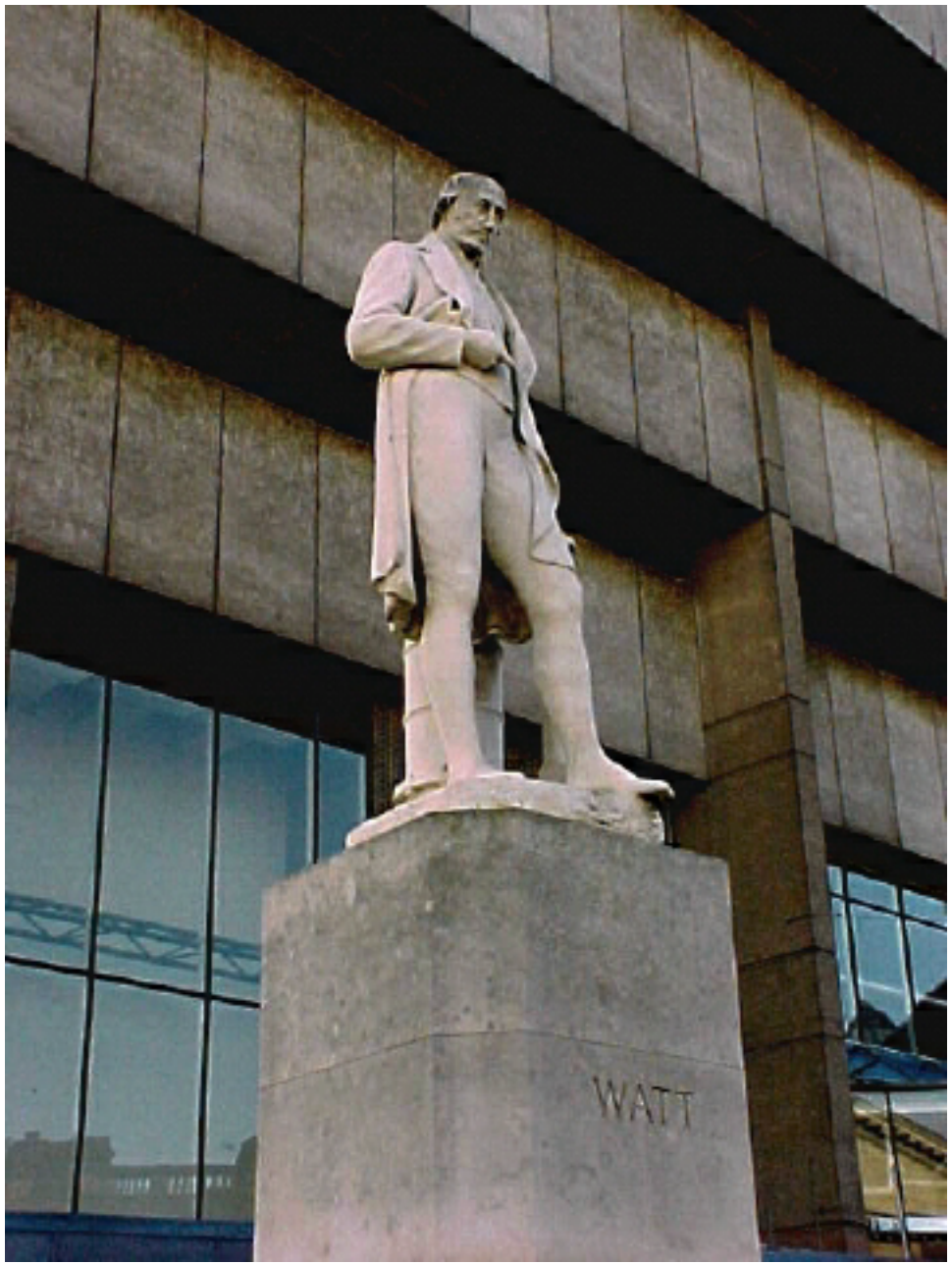
Energy per area per time

Power per area

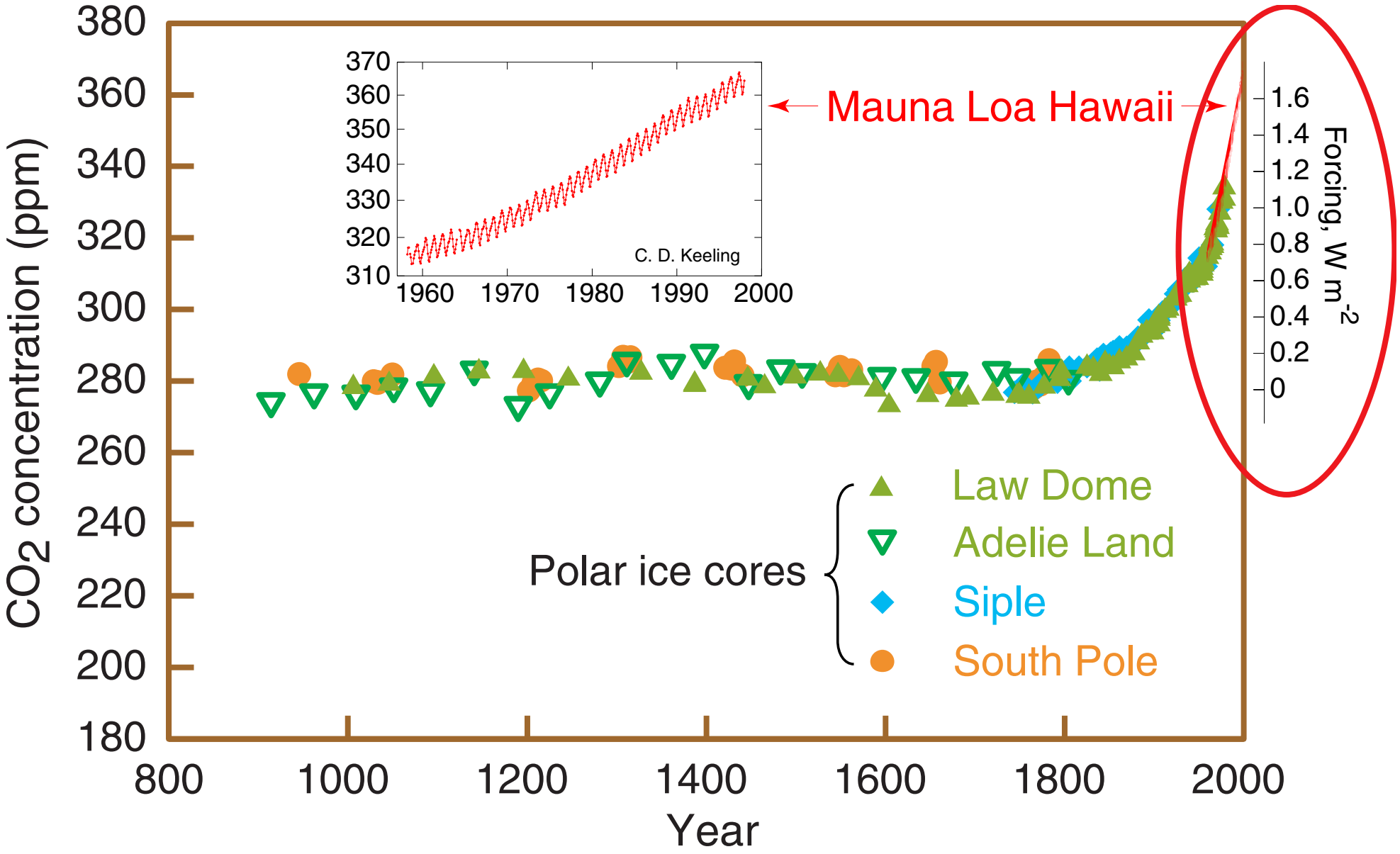
Unit:

Watt per square meter

$W\ m^{-2}$

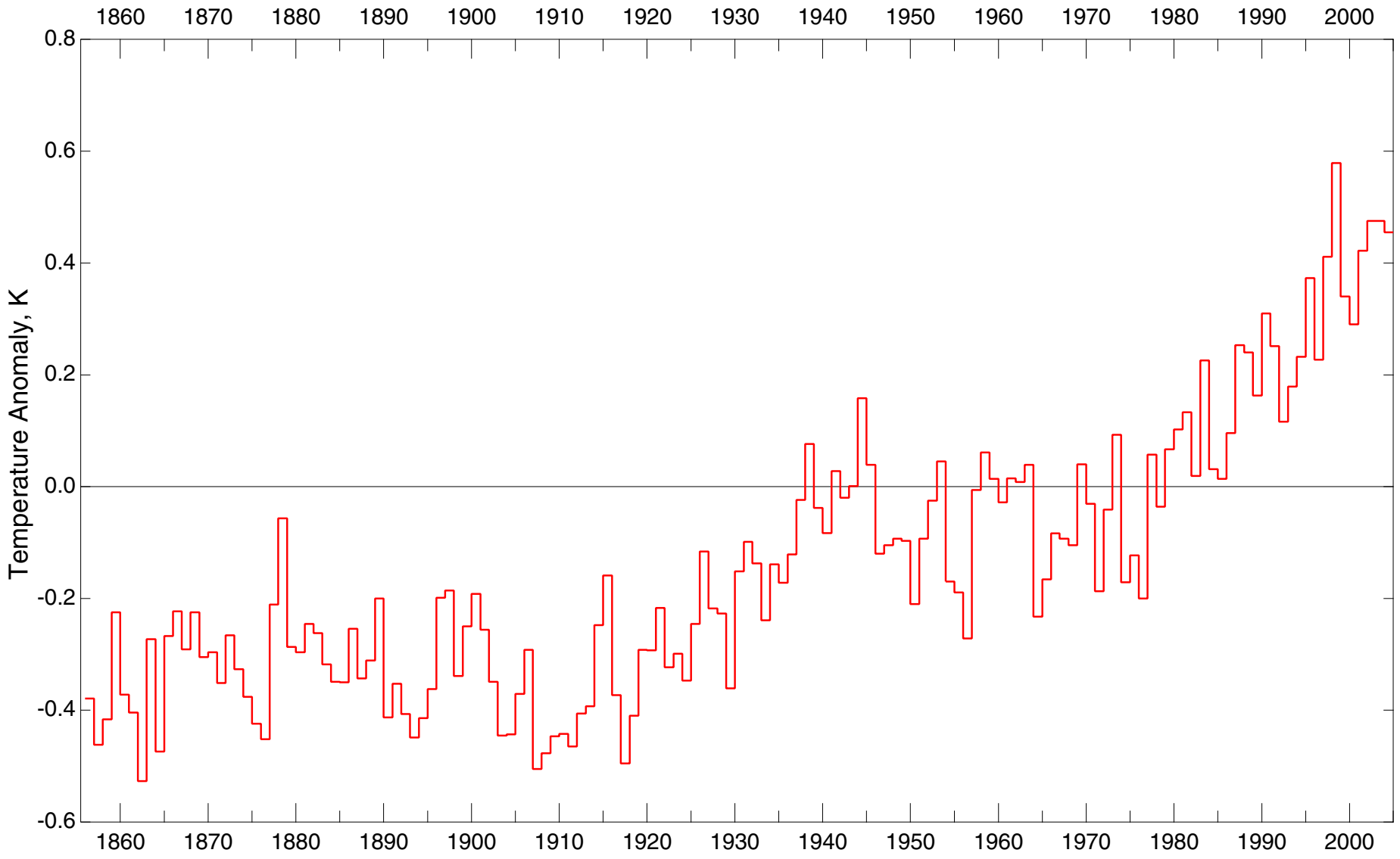


ATMOSPHERIC CARBON DIOXIDE IS INCREASING



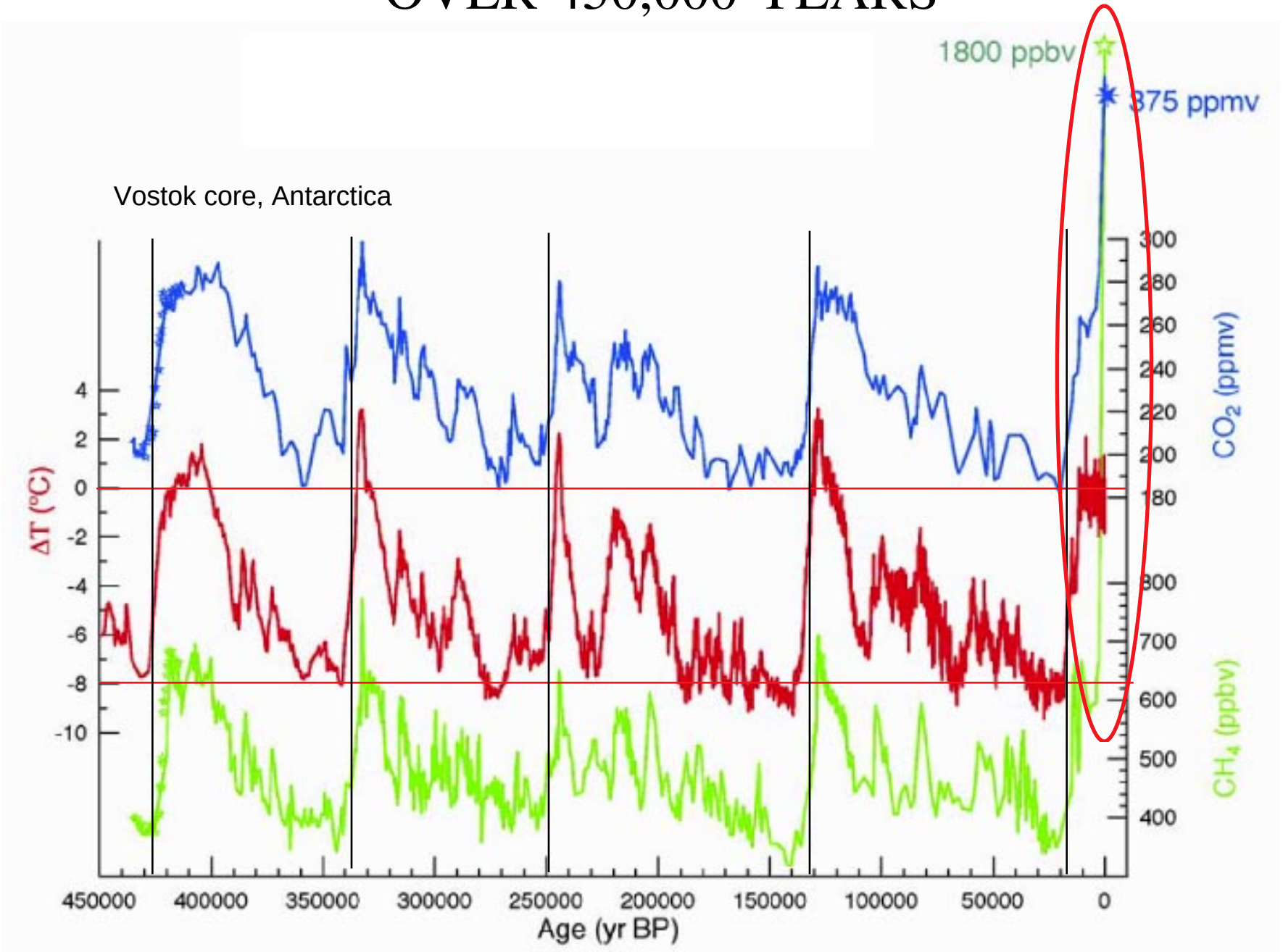
Global carbon dioxide concentration and infrared radiative forcing over the last thousand years

CHANGE IN GLOBAL MEAN SURFACE TEMPERATURE 1855-2004



Climate Research Unit, University of East Anglia, UK

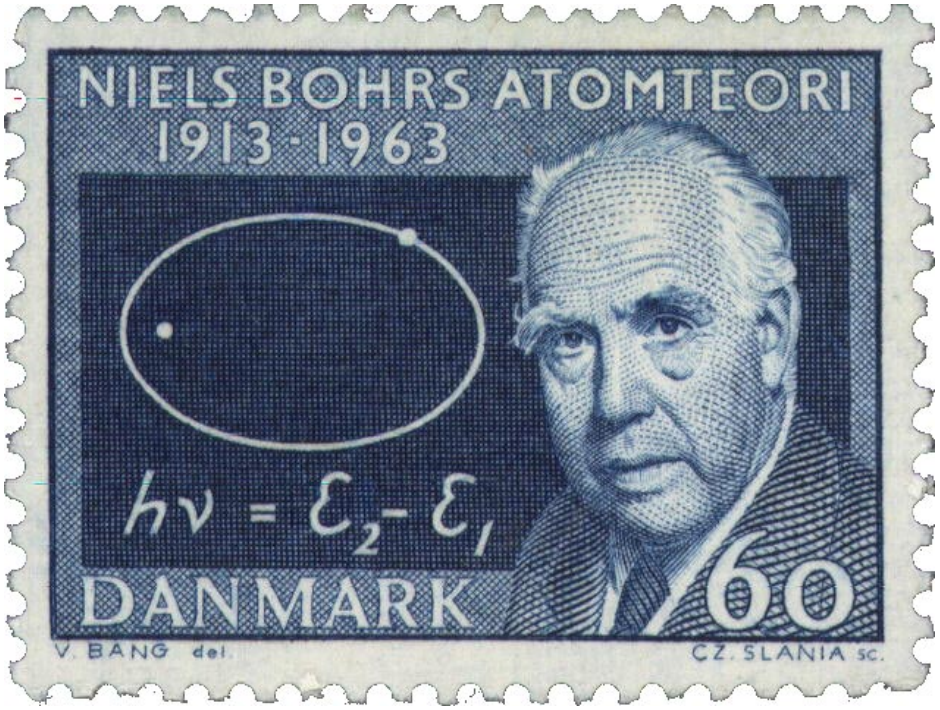
GREENHOUSE GASES AND TEMPERATURE OVER 450,000 YEARS



Modified from Petit et al., Nature, 1999

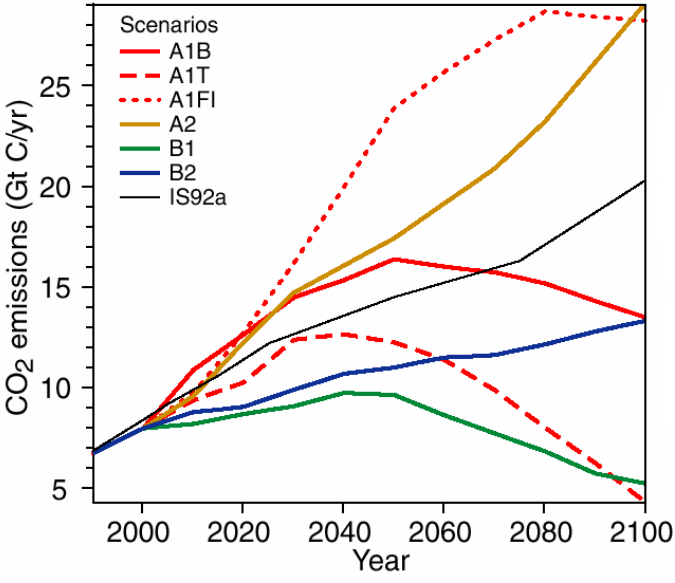
Looking to the Future . . .

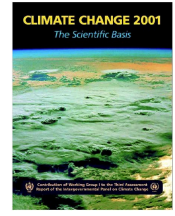
Prediction is difficult,
especially about the future.



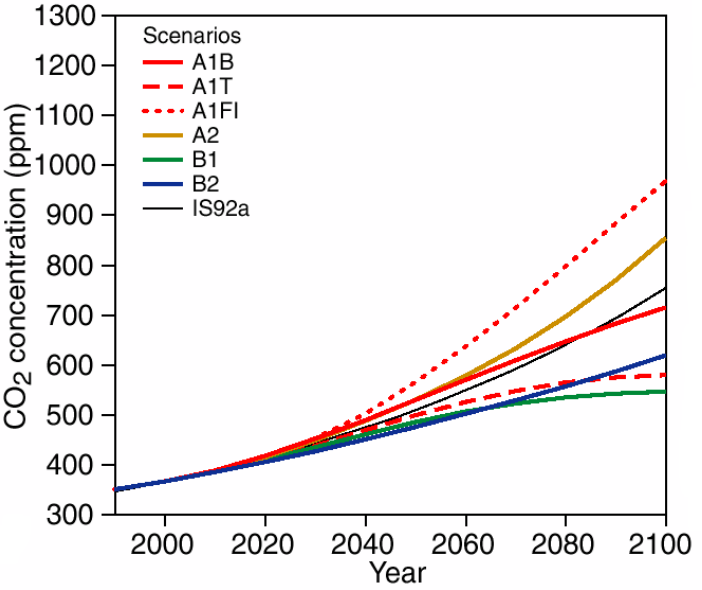
– Niels Bohr

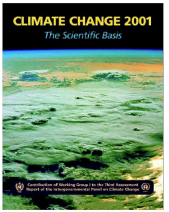
PROJECTIONS OF FUTURE CO2 EMISSIONS



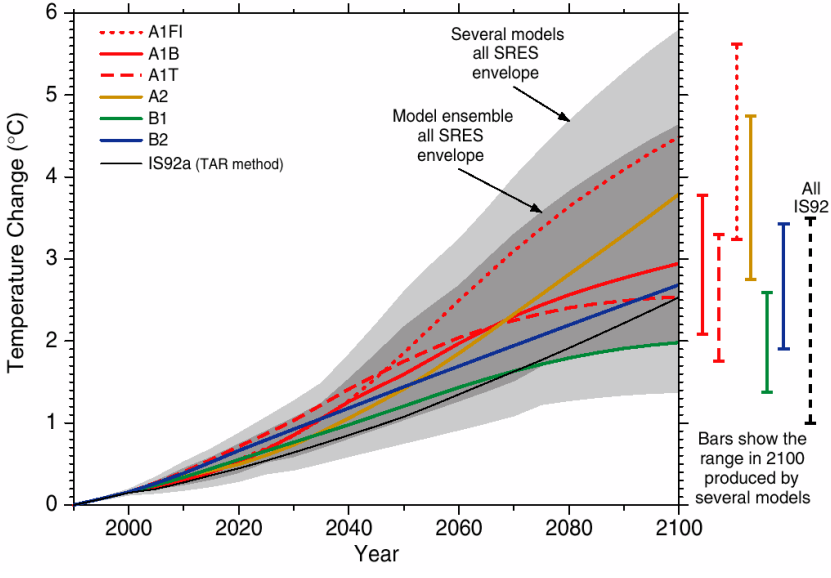


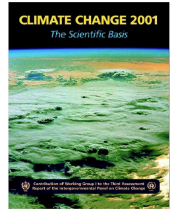
PROJECTIONS OF FUTURE CO2 CONCENTRATIONS



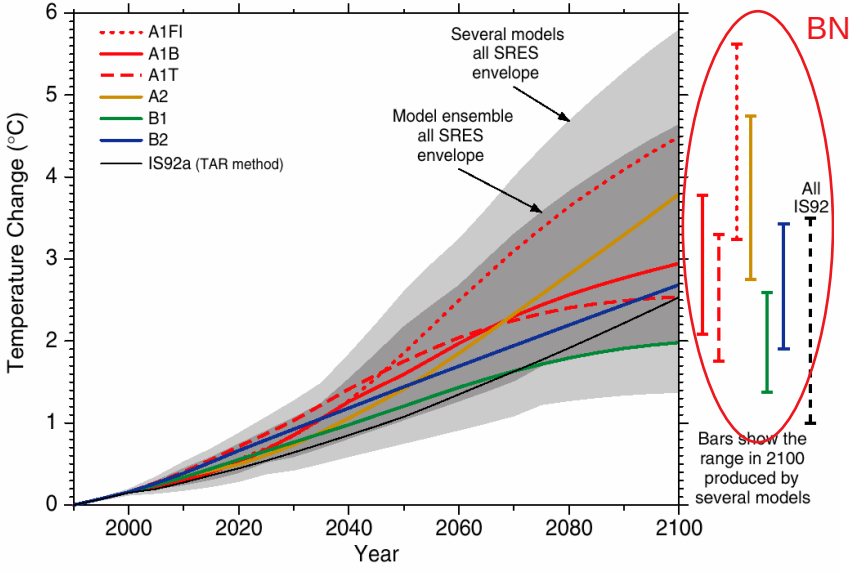


PROJECTIONS OF FUTURE TEMPERATURE CHANGE

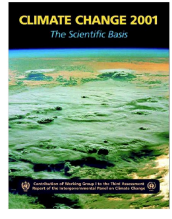




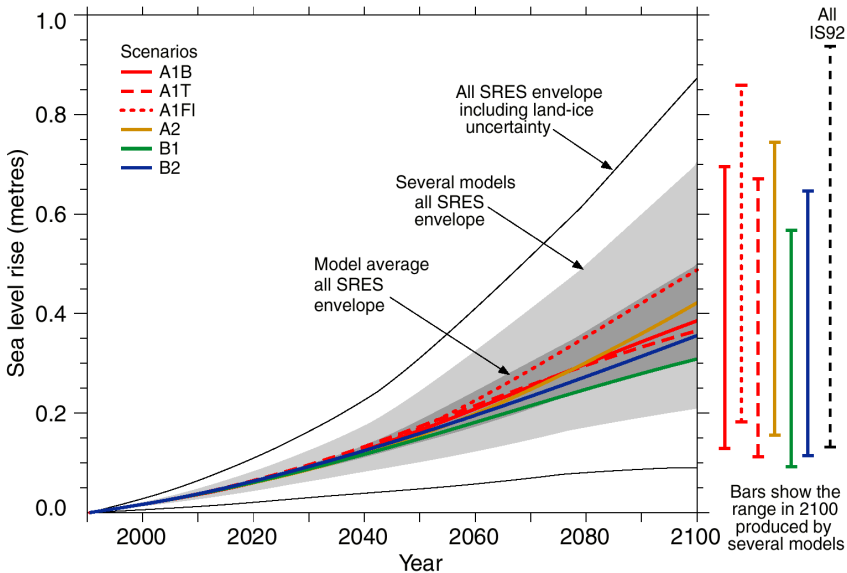
PROJECTIONS OF FUTURE TEMPERATURE CHANGE

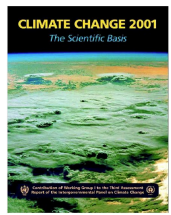


BNL Research



PROJECTIONS OF FUTURE SEA LEVEL RISE

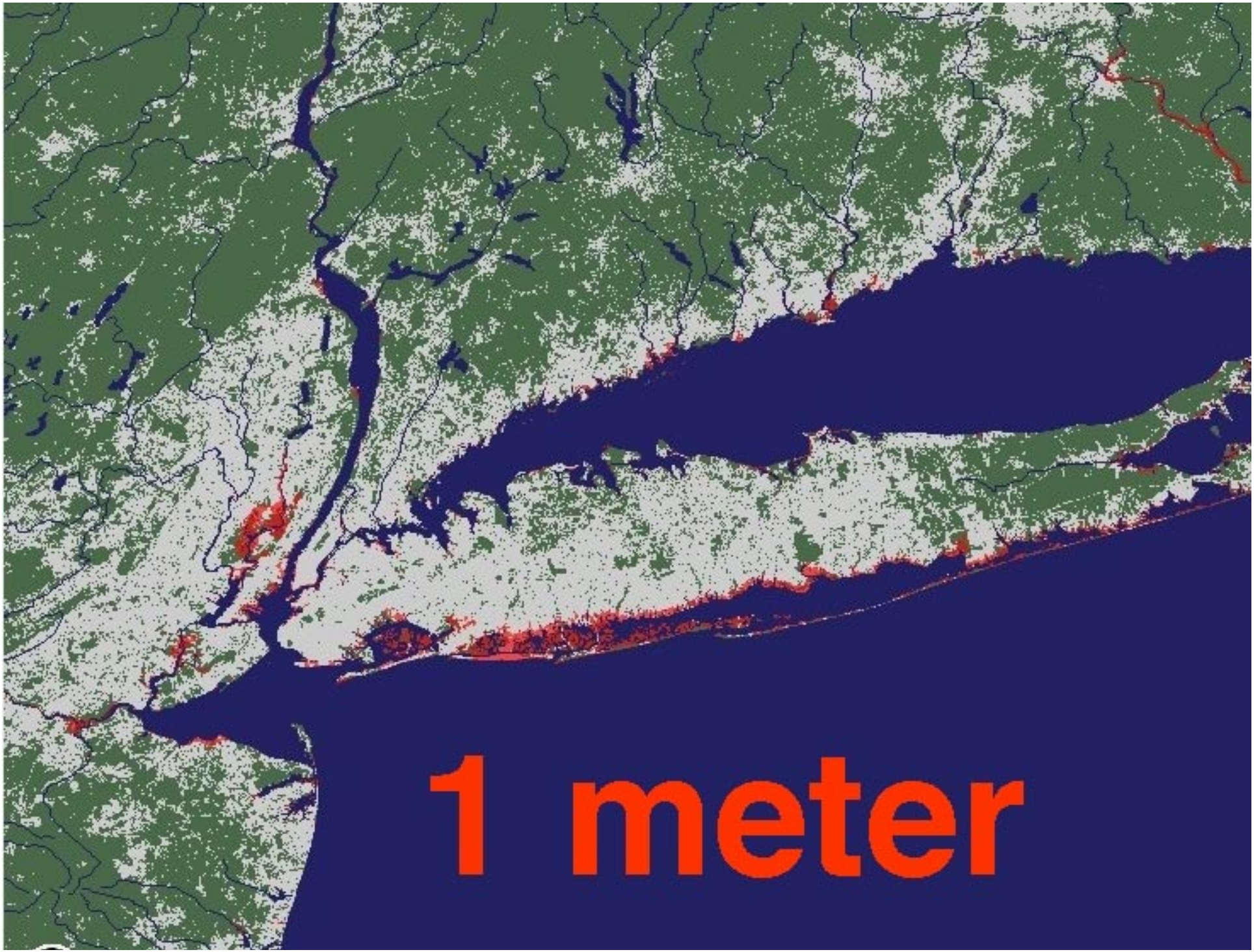




THE BIG PROBLEM FOR LONG ISLAND . . .

RISING SEA LEVEL

present

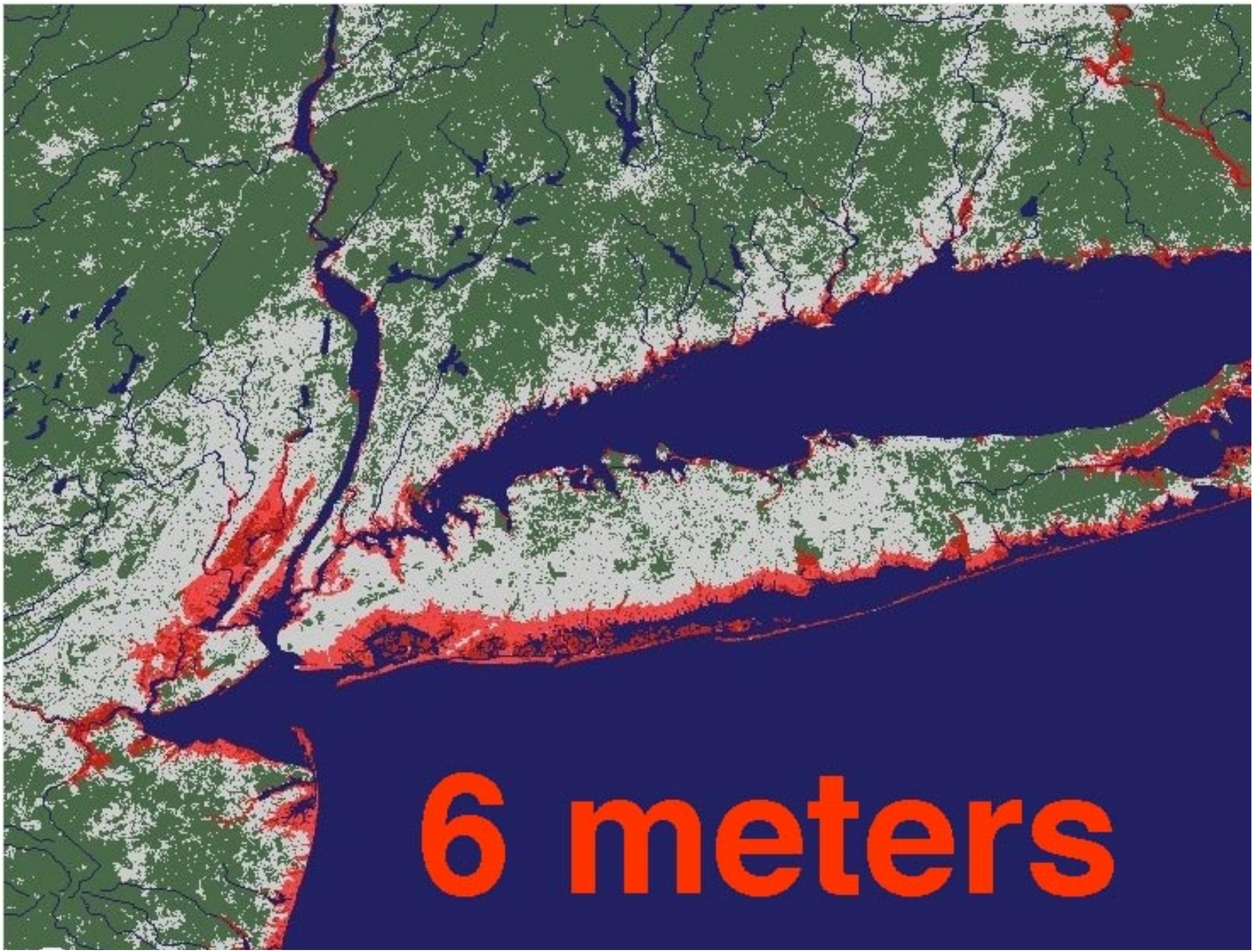

1 meter

2 meters

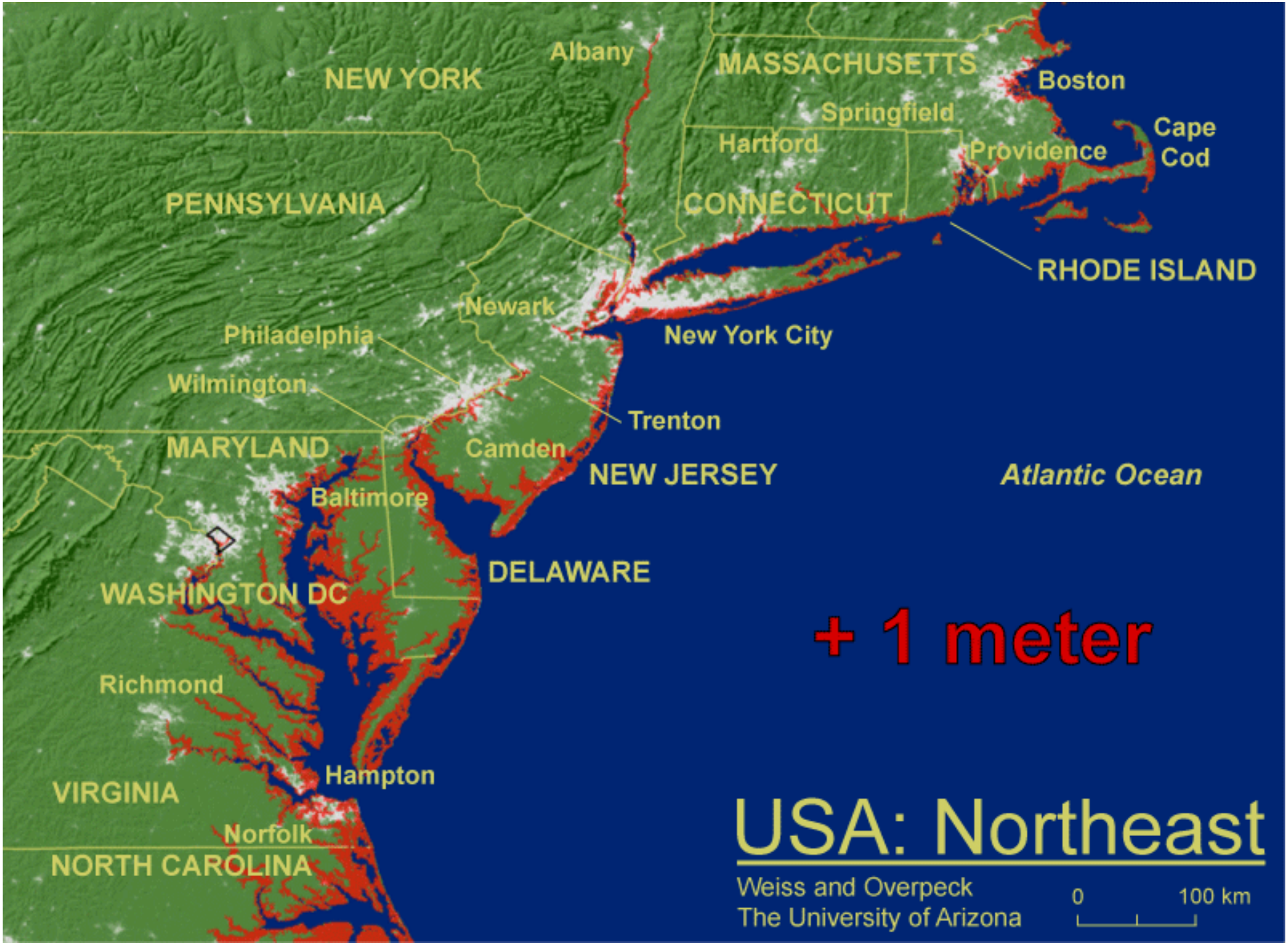
3 meters

4 meters

5 meters


6 meters

NEW YORK
Albany
MASSACHUSETTS
Boston
Springfield
Hartford
Providence
Cape Cod
PENNSYLVANIA
CONNECTICUT
RHODE ISLAND
Newark
Philadelphia
New York City
Wilmington
Trenton
MARYLAND
Camden
NEW JERSEY
Atlantic Ocean
Baltimore
DELAWARE
WASHINGTON DC
Present
Richmond
Hampton
VIRGINIA
Norfolk
NORTH CAROLINA
USA: Northeast
Weiss and Overpeck
The University of Arizona
0
100 km


NEW YORK
Albany
MASSACHUSETTS
Boston
Springfield
Hartford
Providence
Cape Cod
PENNSYLVANIA
CONNECTICUT
RHODE ISLAND
Newark
New York City
Philadelphia
Wilmington
Trenton
MARYLAND
Camden
NEW JERSEY
Atlantic Ocean
Baltimore
DELAWARE
WASHINGTON DC
+ 1 meter
Richmond
Hampton
VIRGINIA
Norfolk
NORTH CAROLINA
USA: Northeast
Weiss and Overpeck
The University of Arizona
0
100 km

"Gentlemen, it's time we gave some serious thought to the effects of global warming."

WHAT CAN WE DO ABOUT IT?

INVENTORY OF NEW YORK CITY
GREENHOUSE GAS EMISSIONS

April 2007

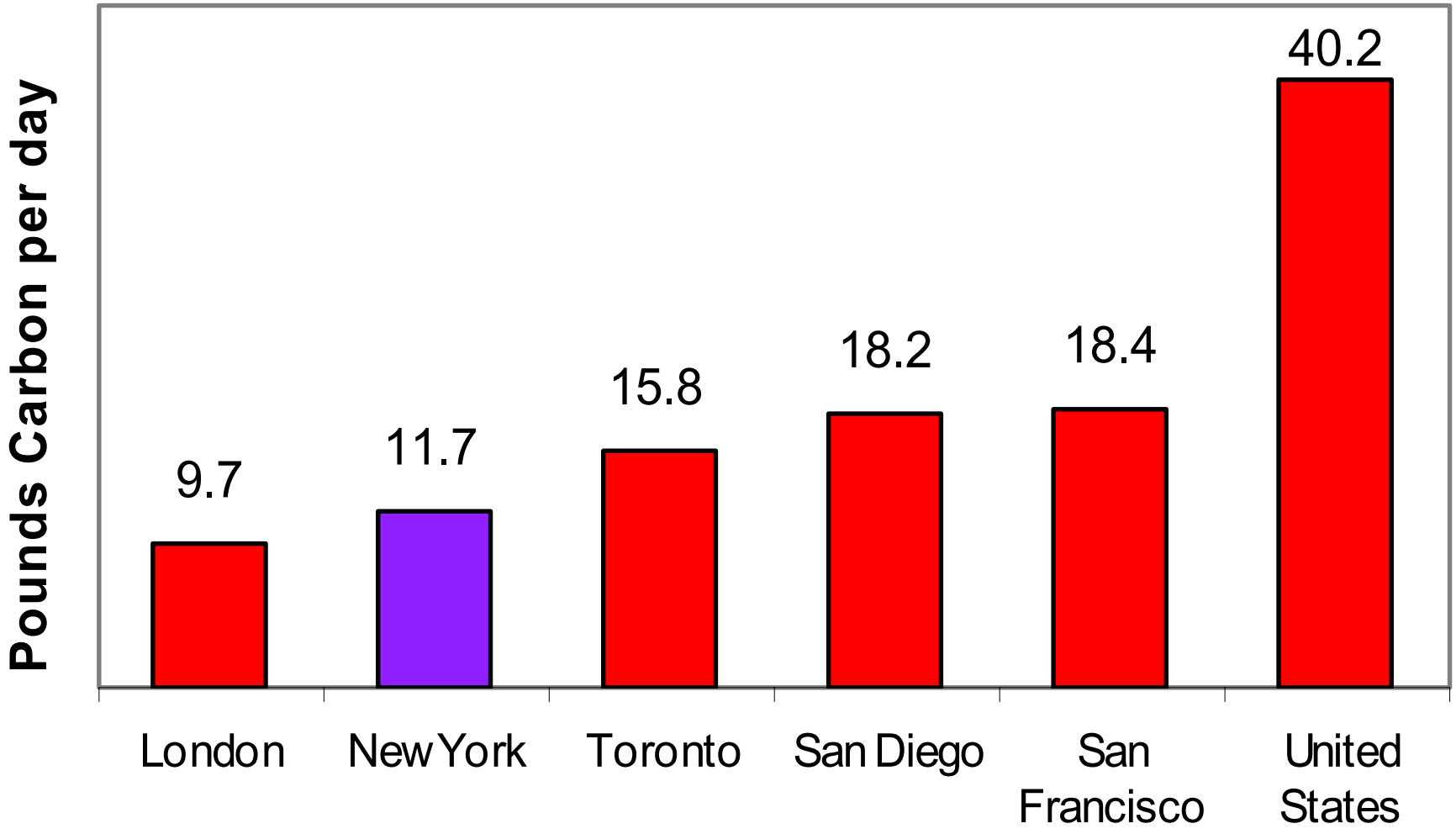
planYC

Michael R. Bloomberg
Mayor

Mayor s Office of Operations
Office of Long-term Planning and Sustainability

CARBON DIOXIDE EMISSIONS IN SELECTED CITIES

Pounds of carbon per person per day



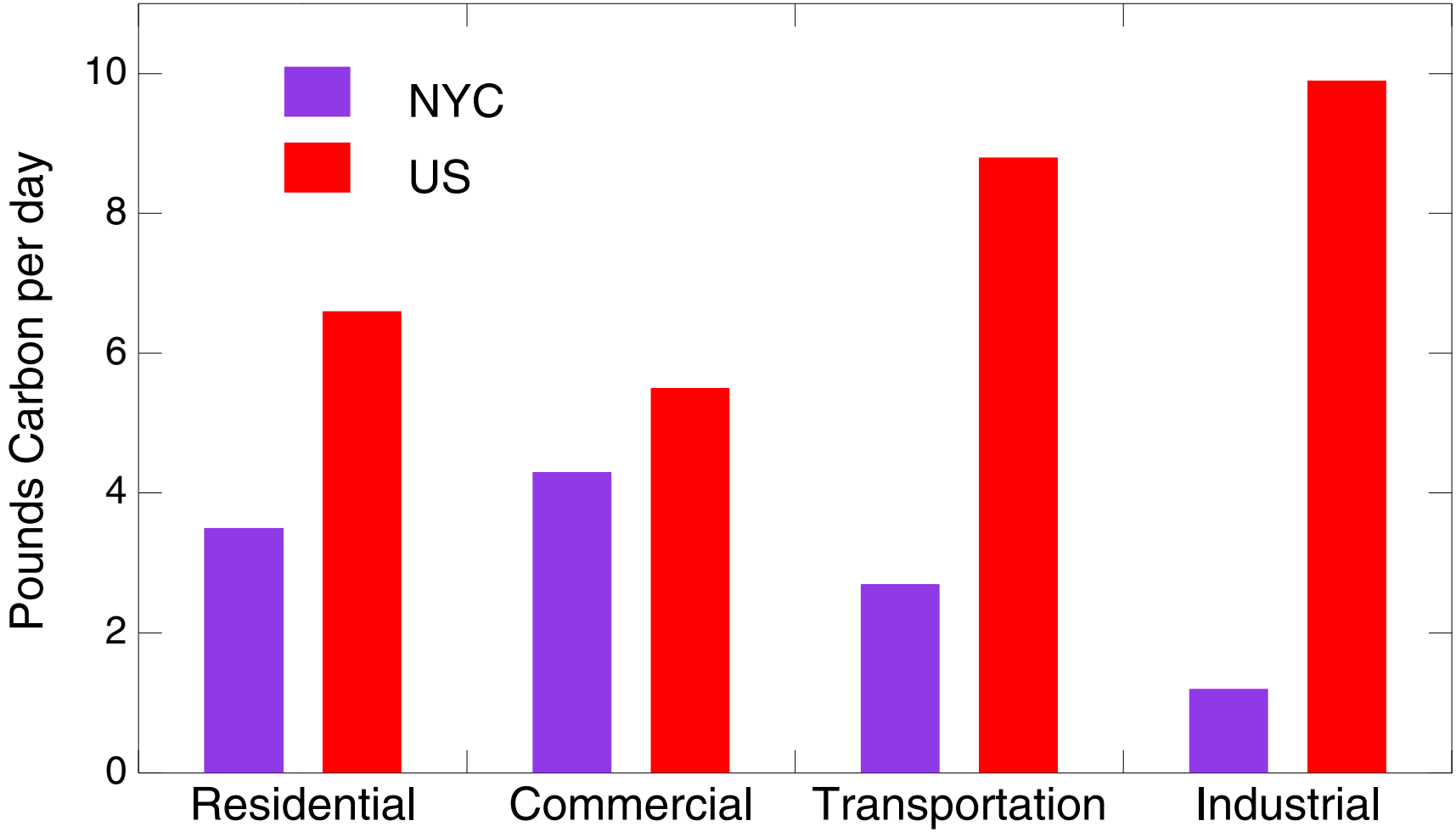
New York City Greenhouse Gas Emissions, April, 2007

Cities are energy efficient.

CARBON DIOXIDE EMISSIONS BY SECTOR

Comparison of New York City vs. United States Average

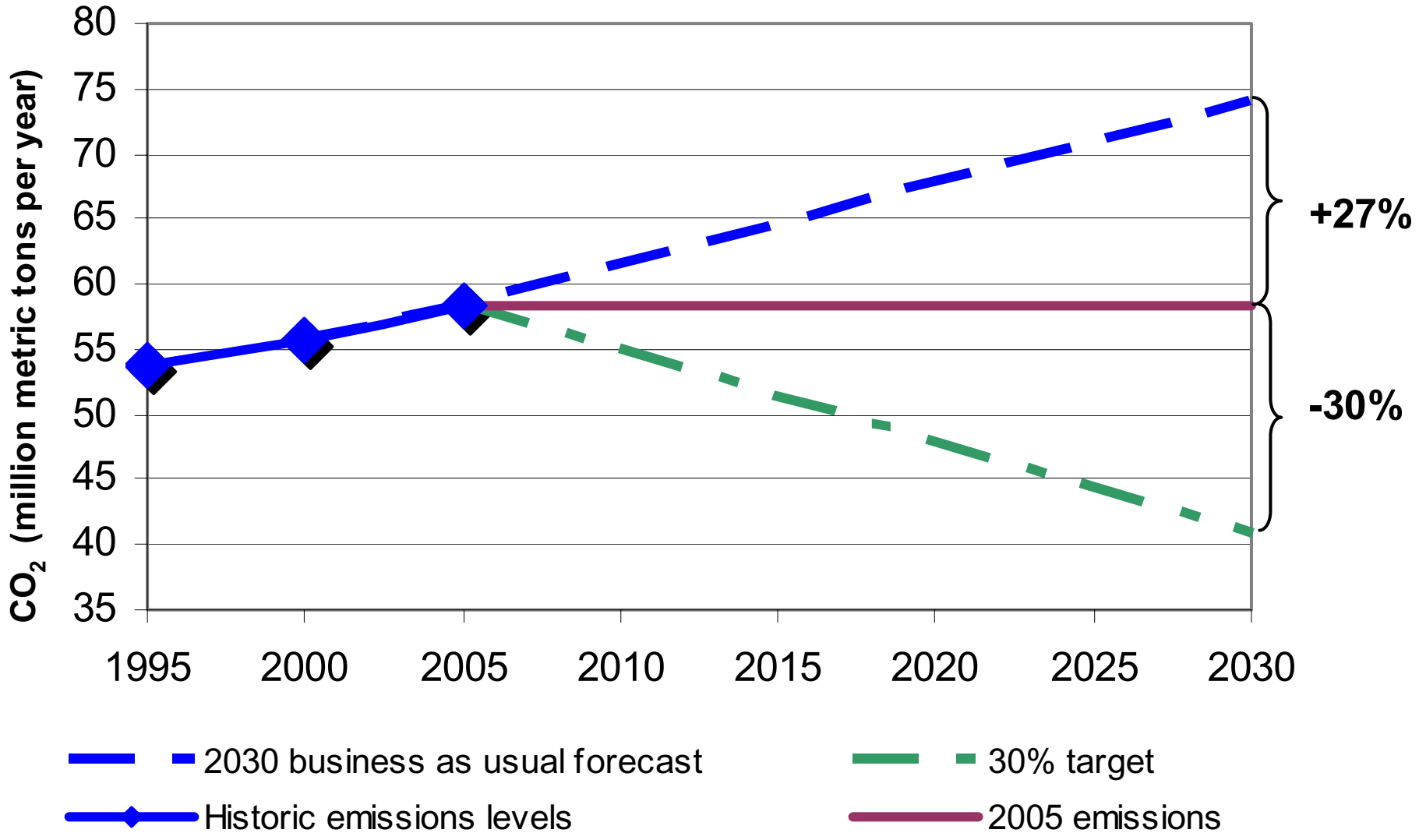
Pounds of carbon per person per day



New York City, EPA

PROJECTED CARBON DIOXIDE EMISSIONS FOR NEW YORK CITY

2005 - 2030

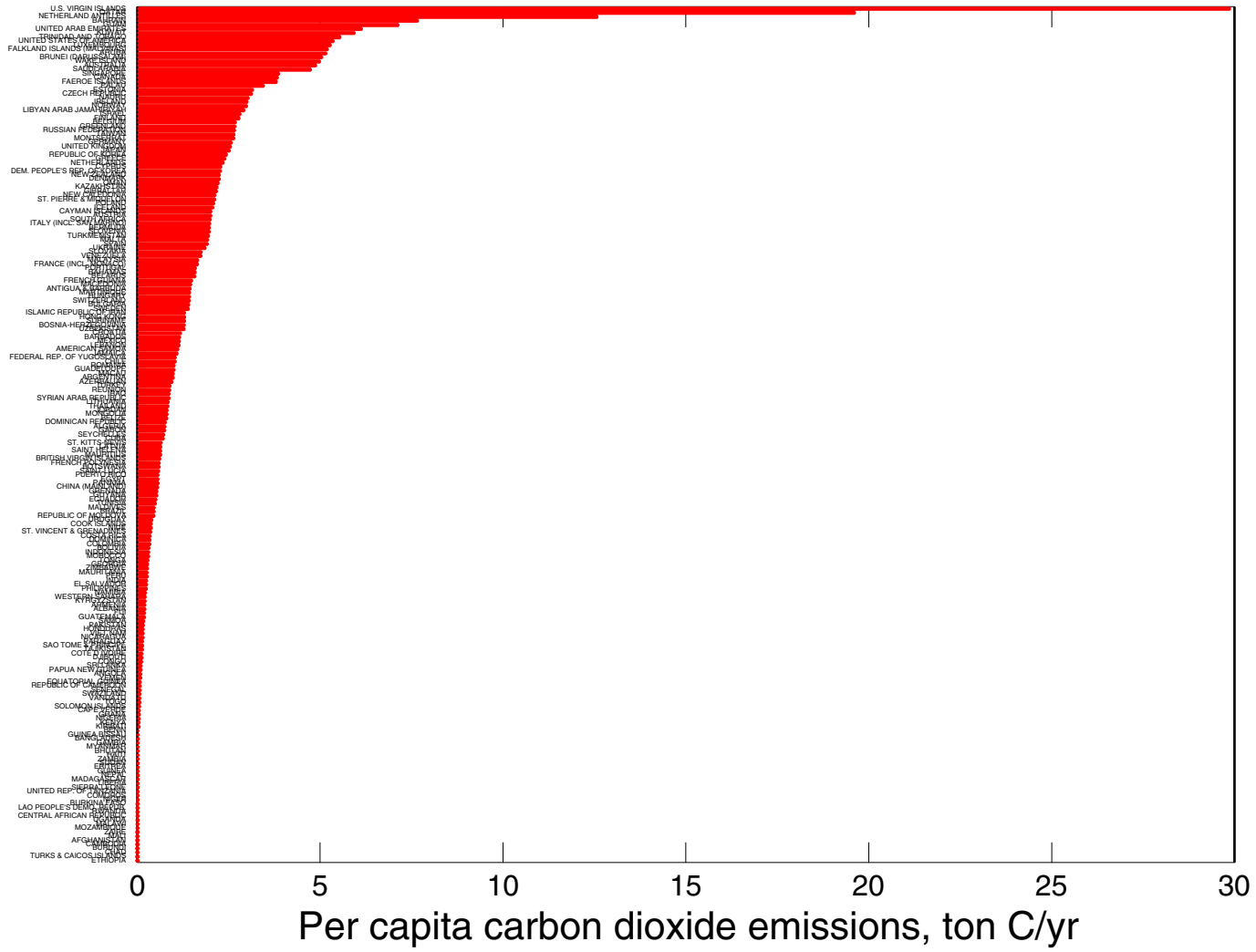


New York City Greenhouse Gas Emissions, April, 2007

WHERE IS ALL THIS CO_2 COMING FROM?

WHO IS RESPONSIBLE?

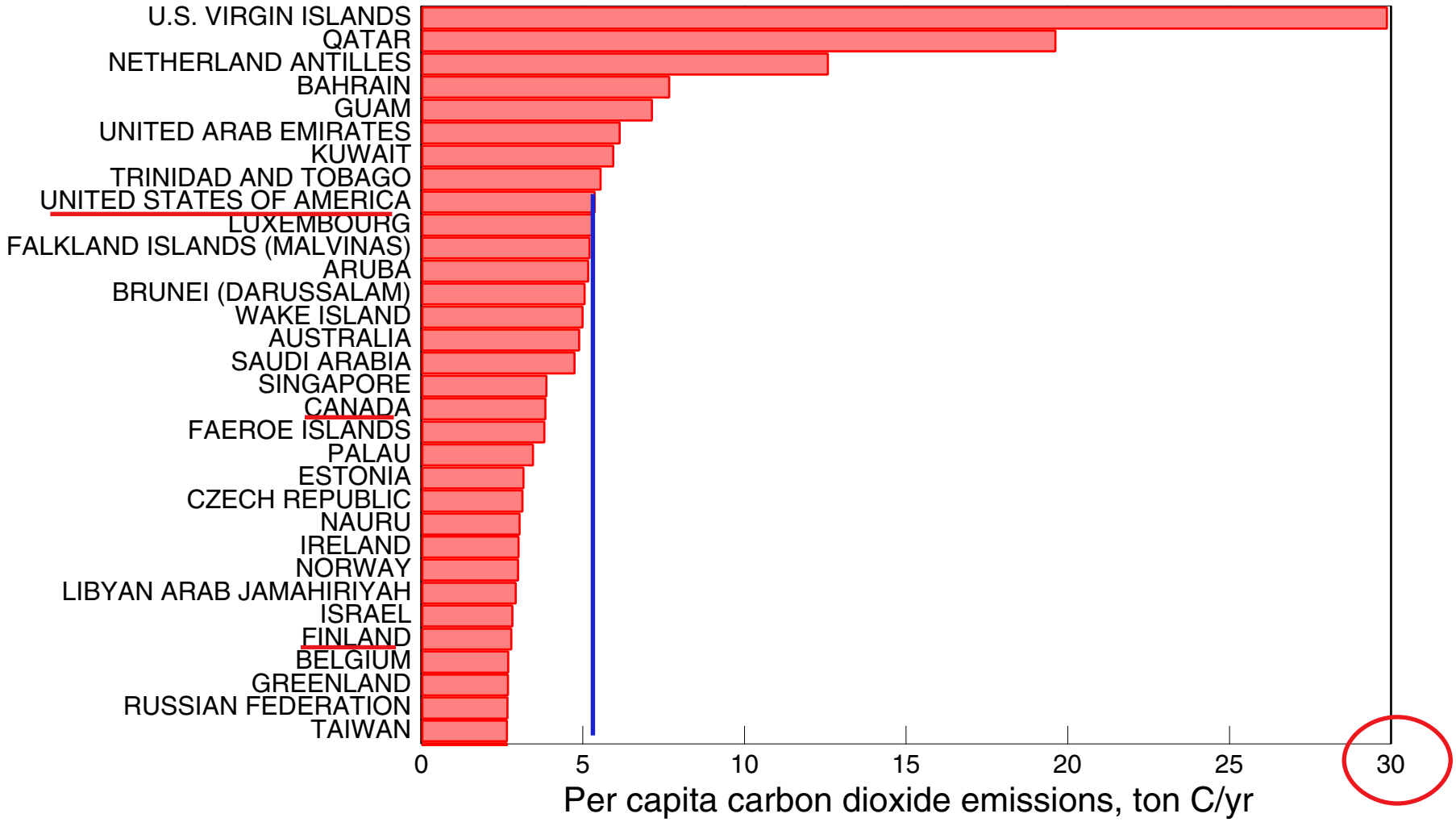
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

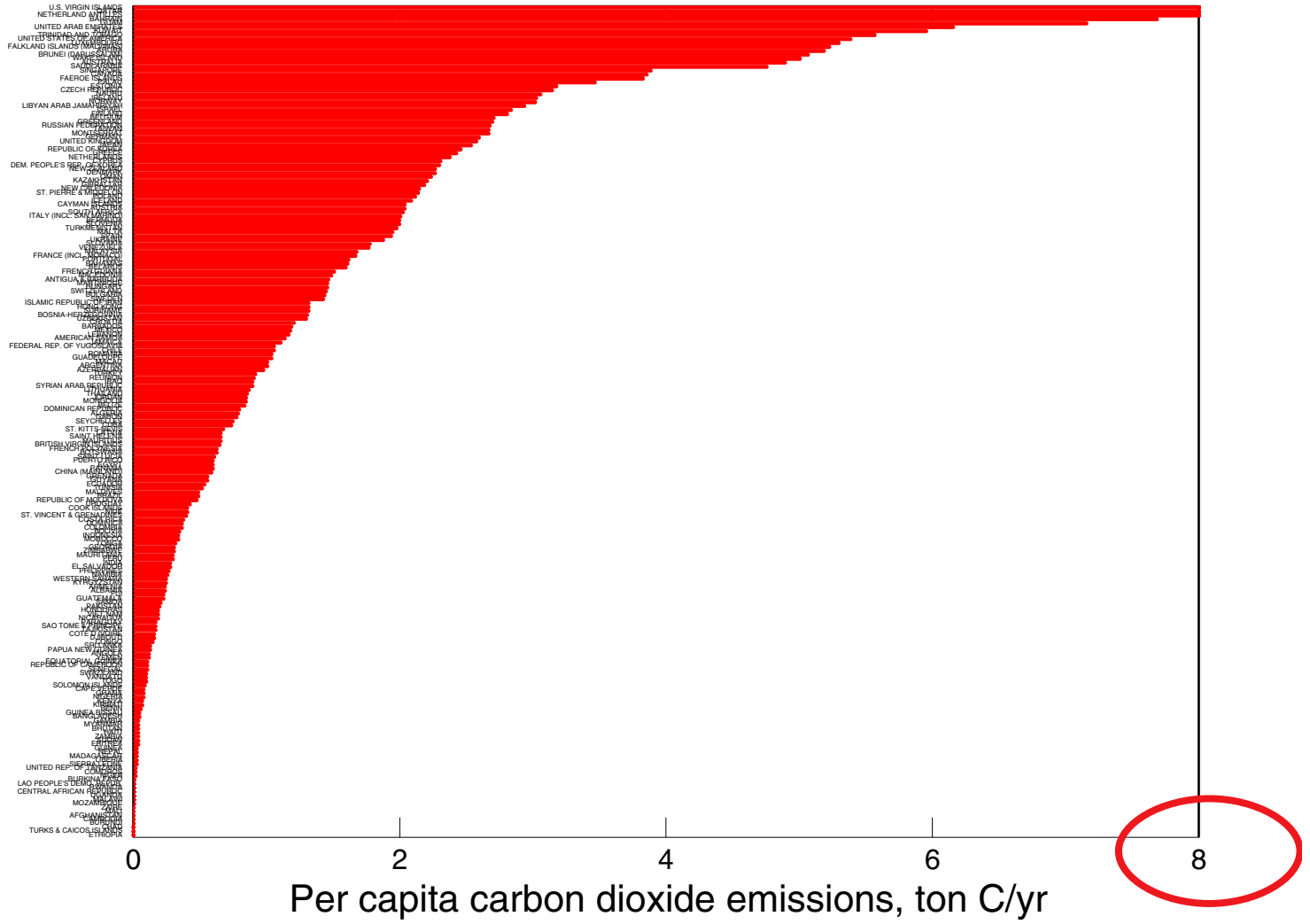
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

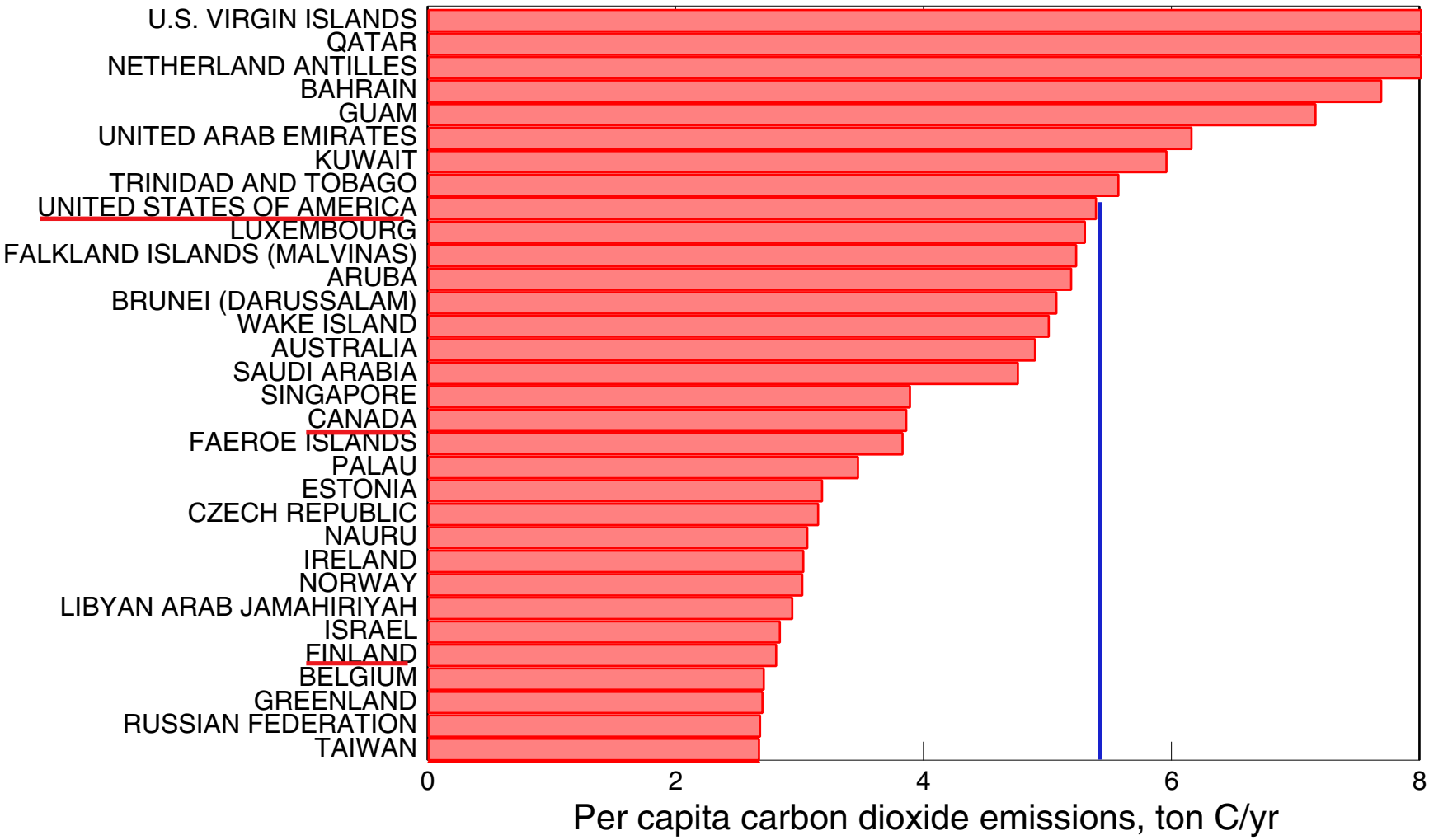
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

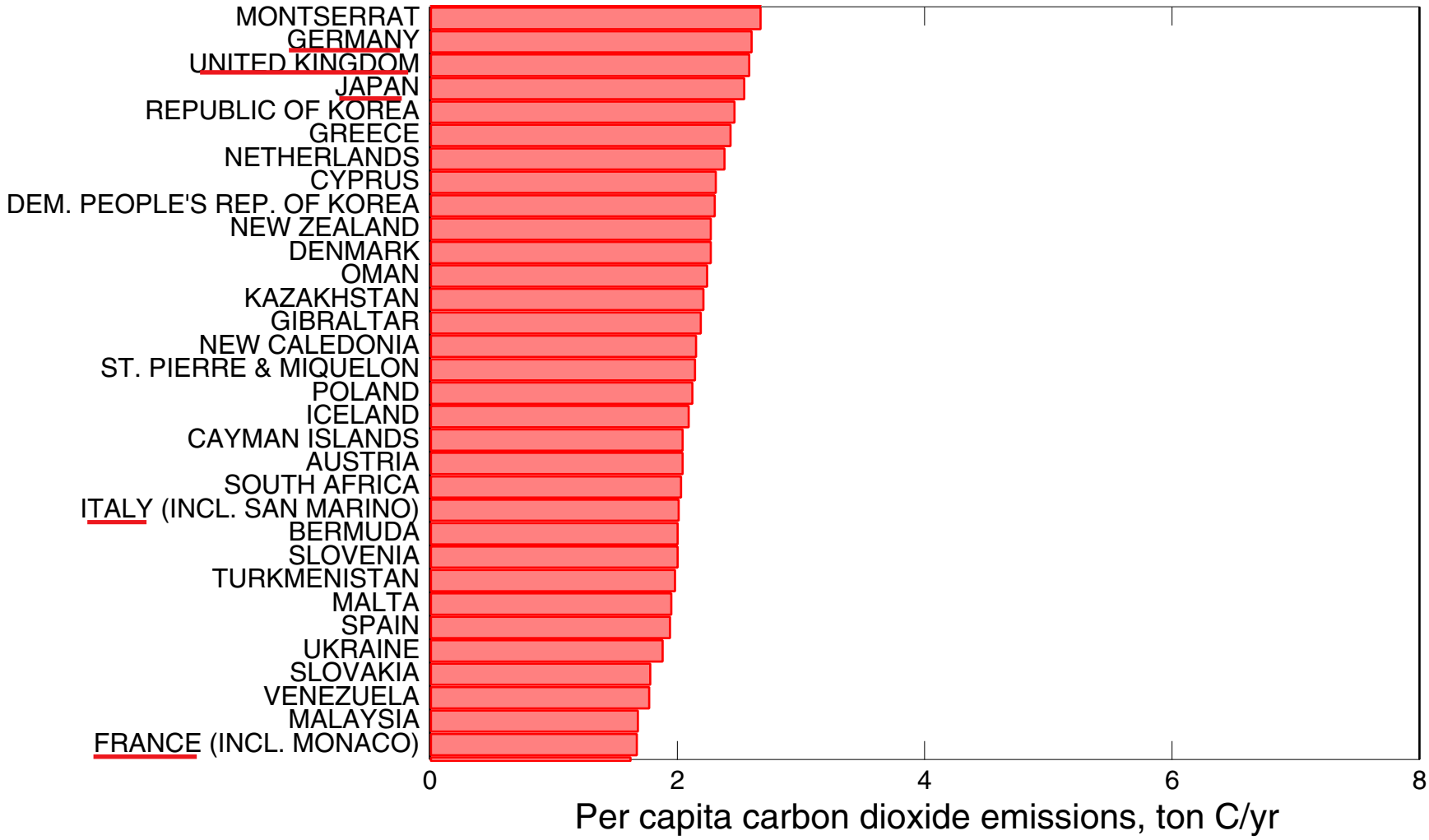
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

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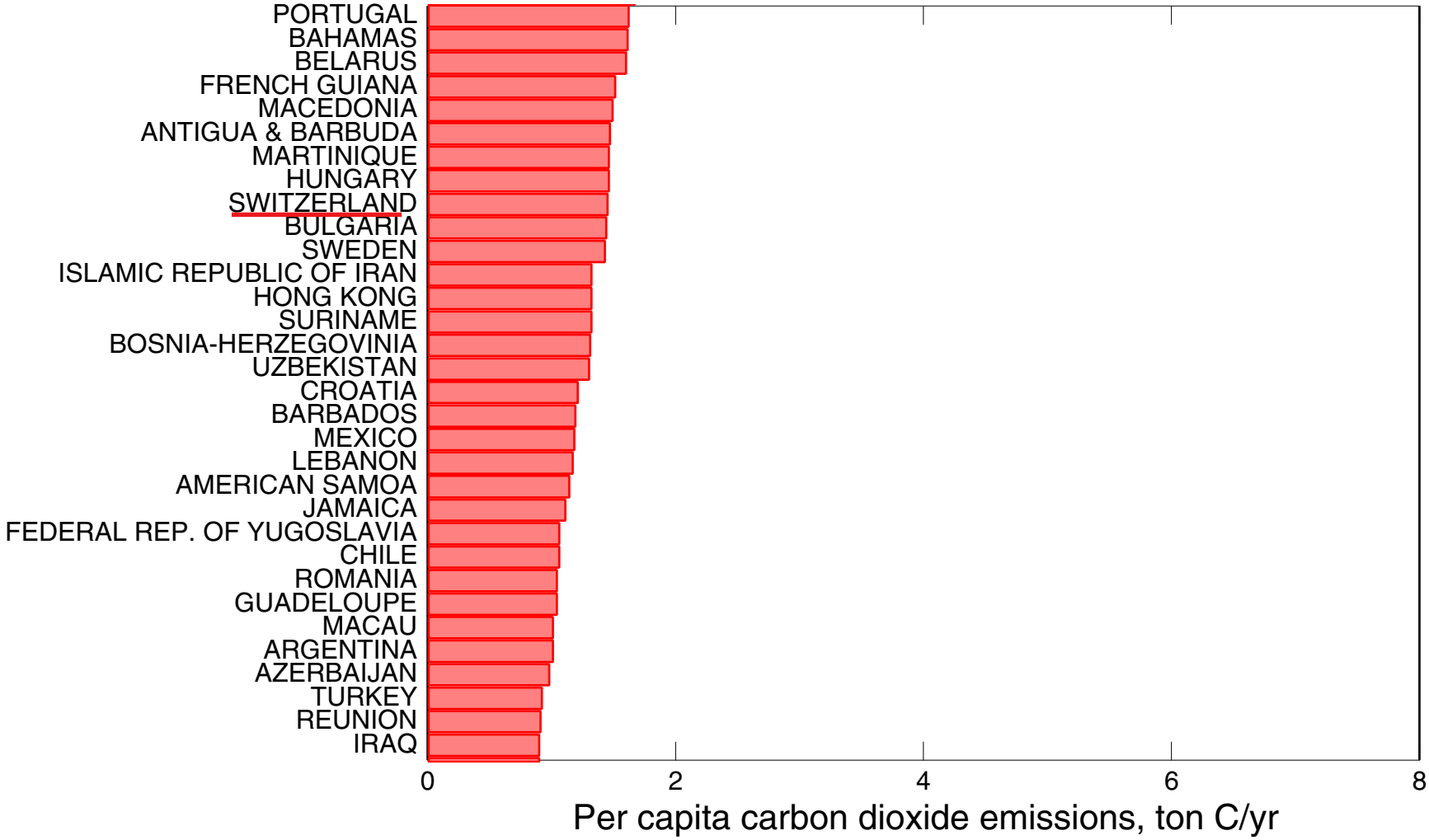
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



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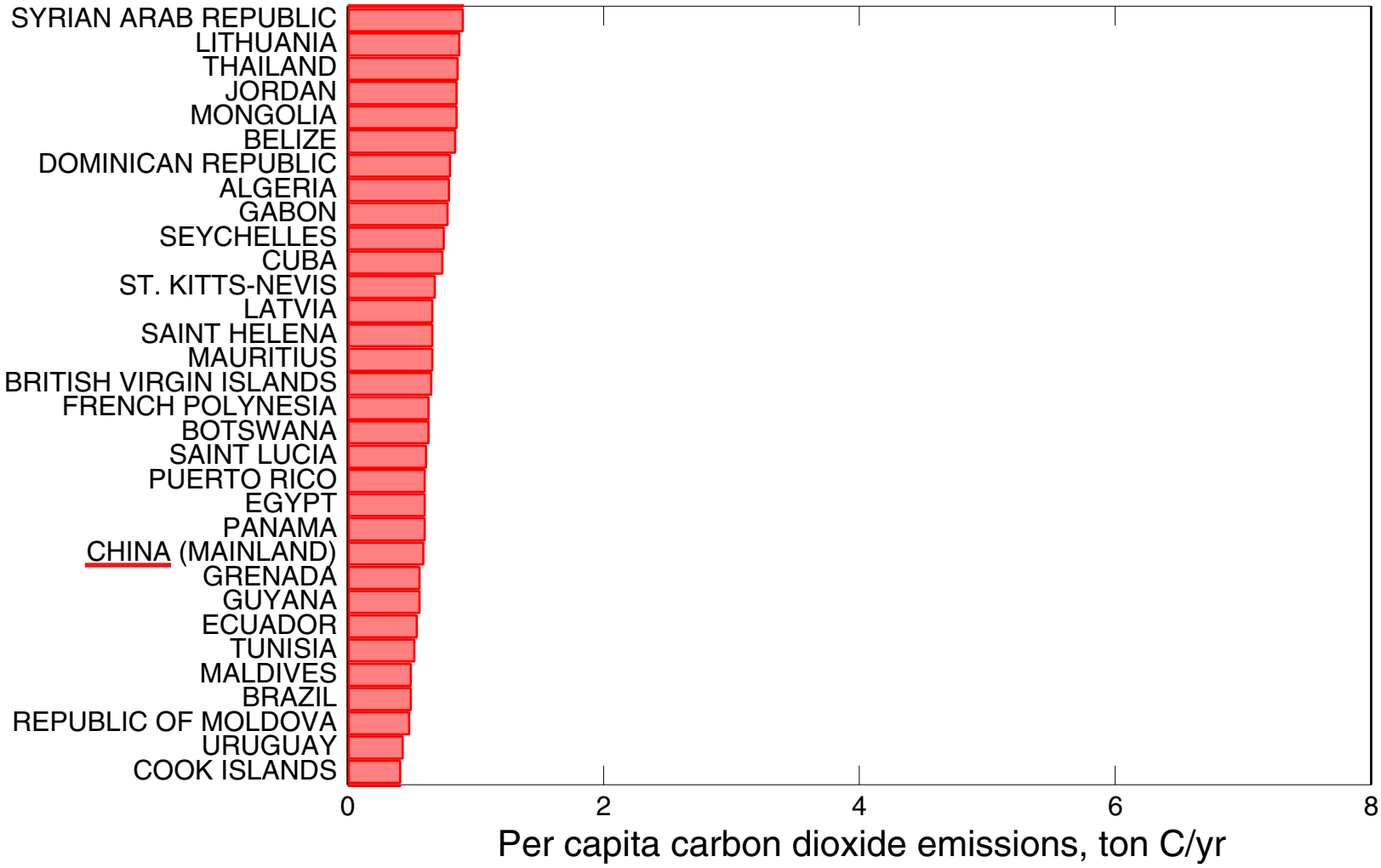
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



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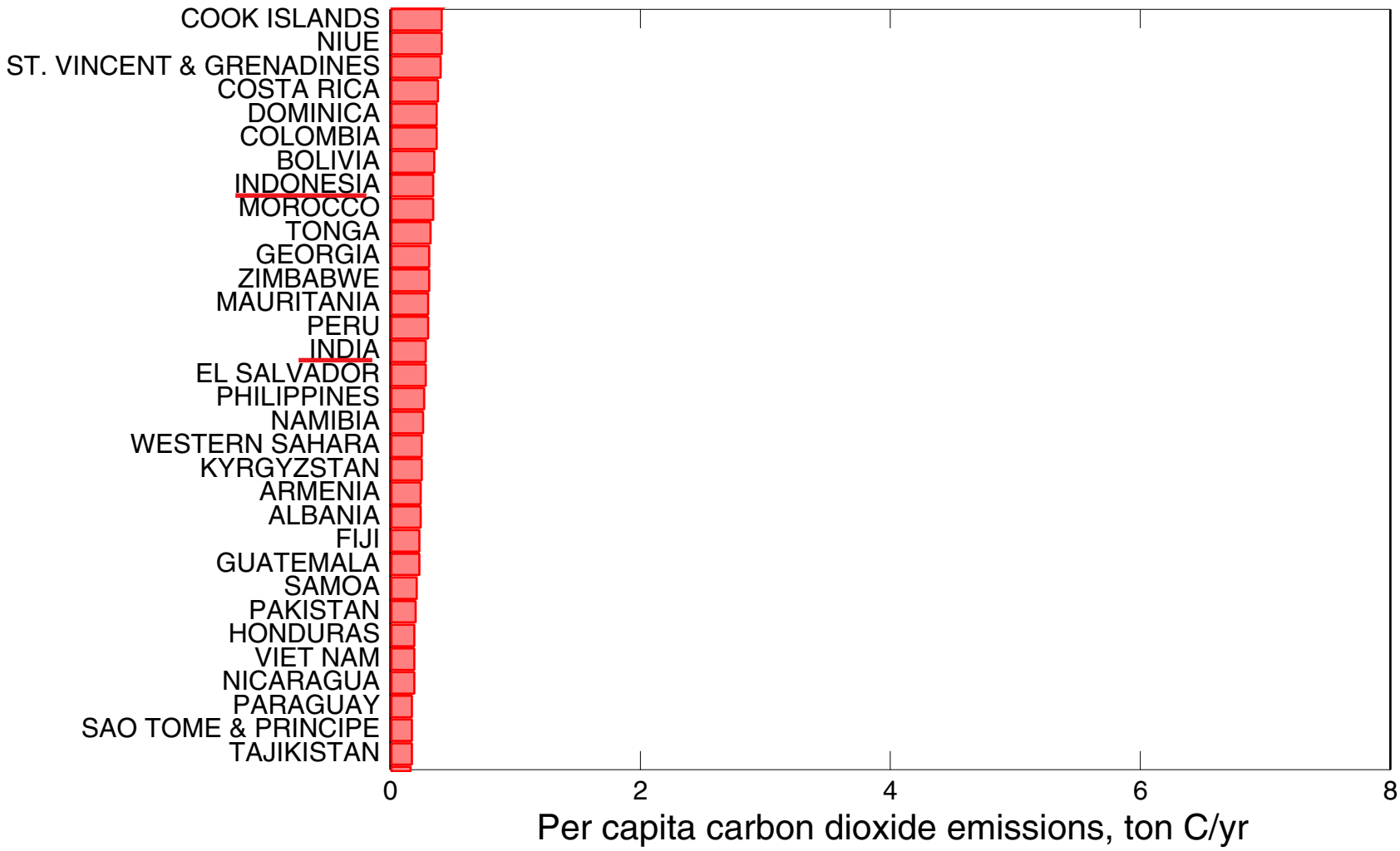

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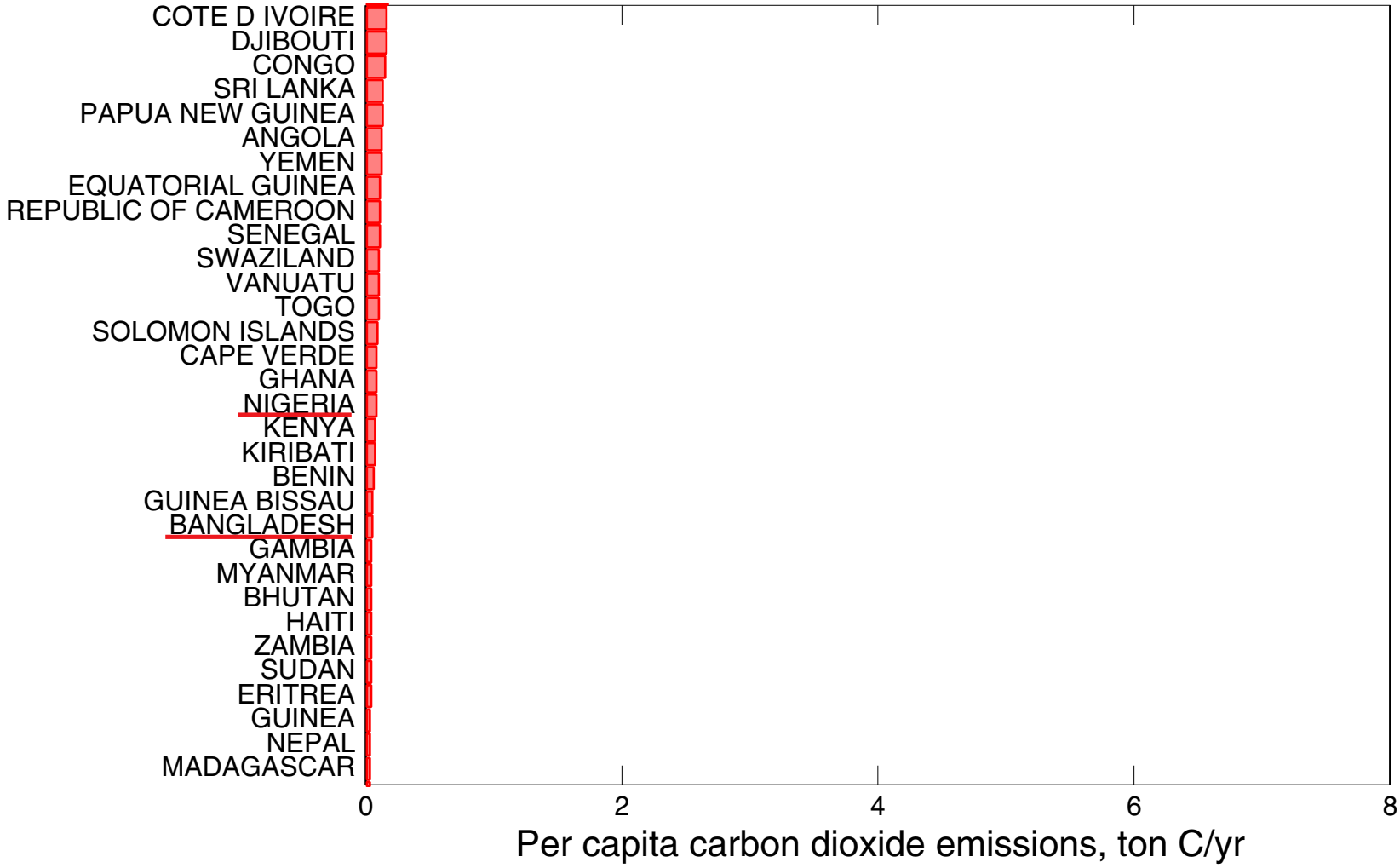
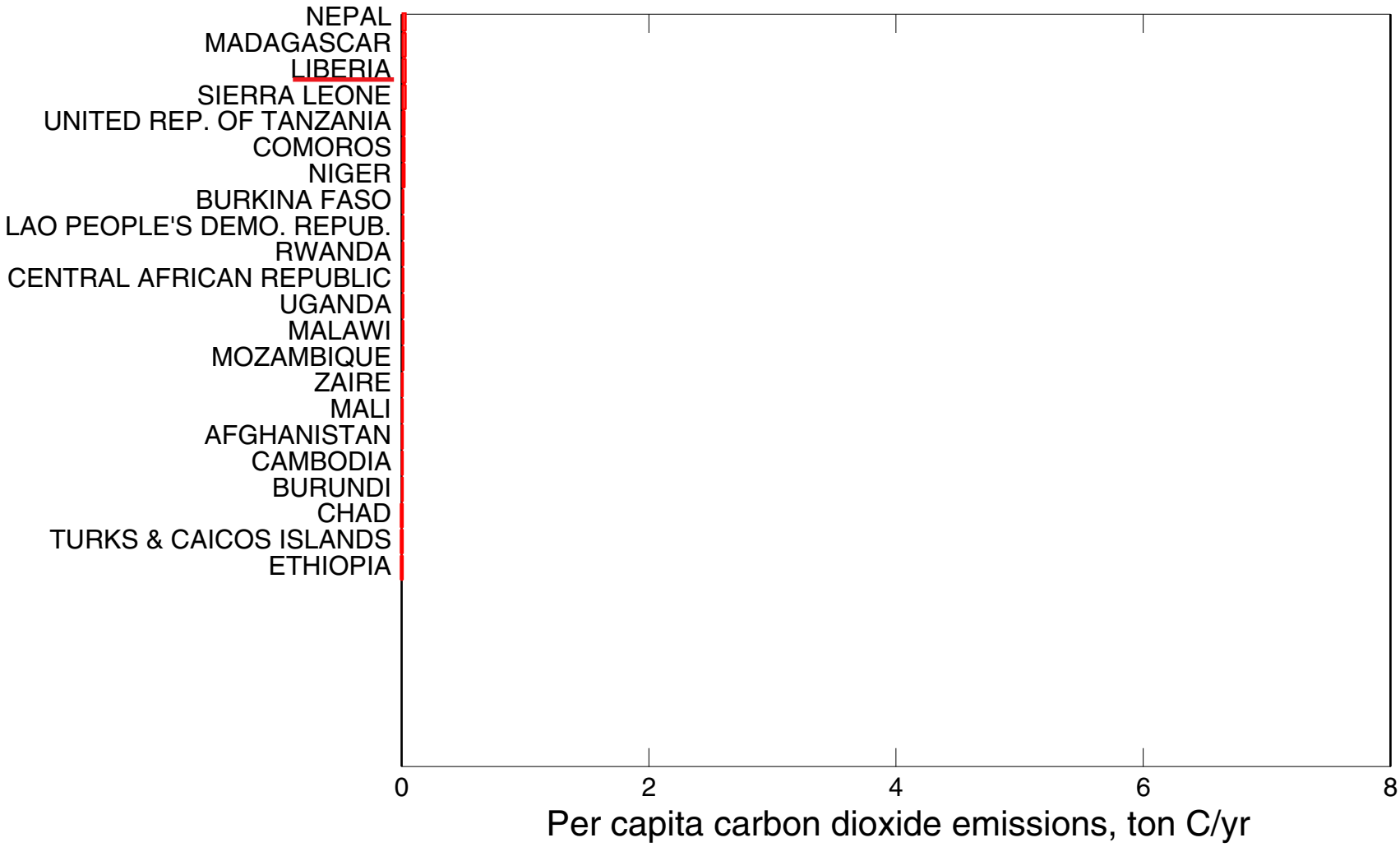
PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

PER CAPITA FOSSIL FUEL CO_2 EMISSIONS



By country, year 2000.

Data: G. Marland, Oak Ridge National Laboratory

WHERE IS ALL THIS CO_2 COMING FROM?

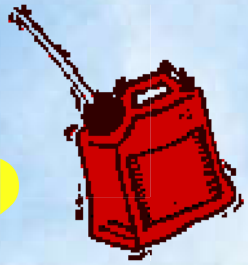
WHO IS RESPONSIBLE?

HOW MUCH CARBON IS IN A GALLON OF GASOLINE?

1 lb?

2 lbs?

3 lbs!?



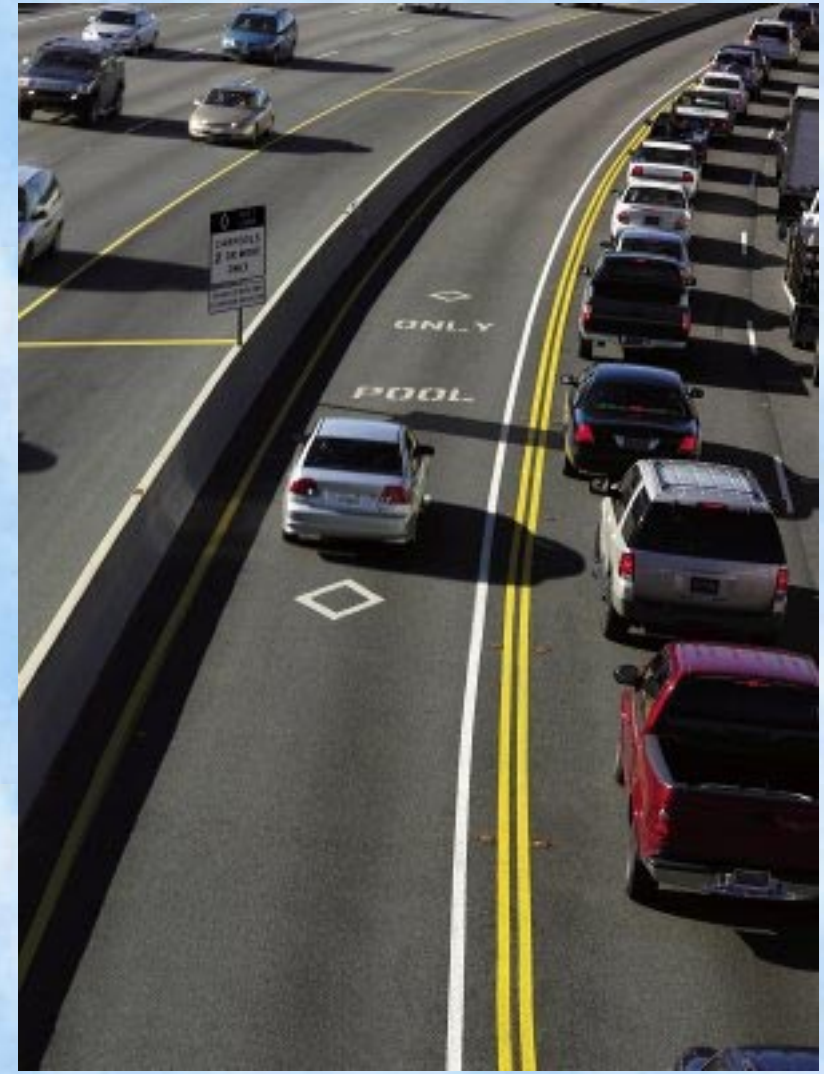
5 lbs!?!

All of this carbon goes into the atmosphere as carbon dioxide when you burn the gasoline in your car.

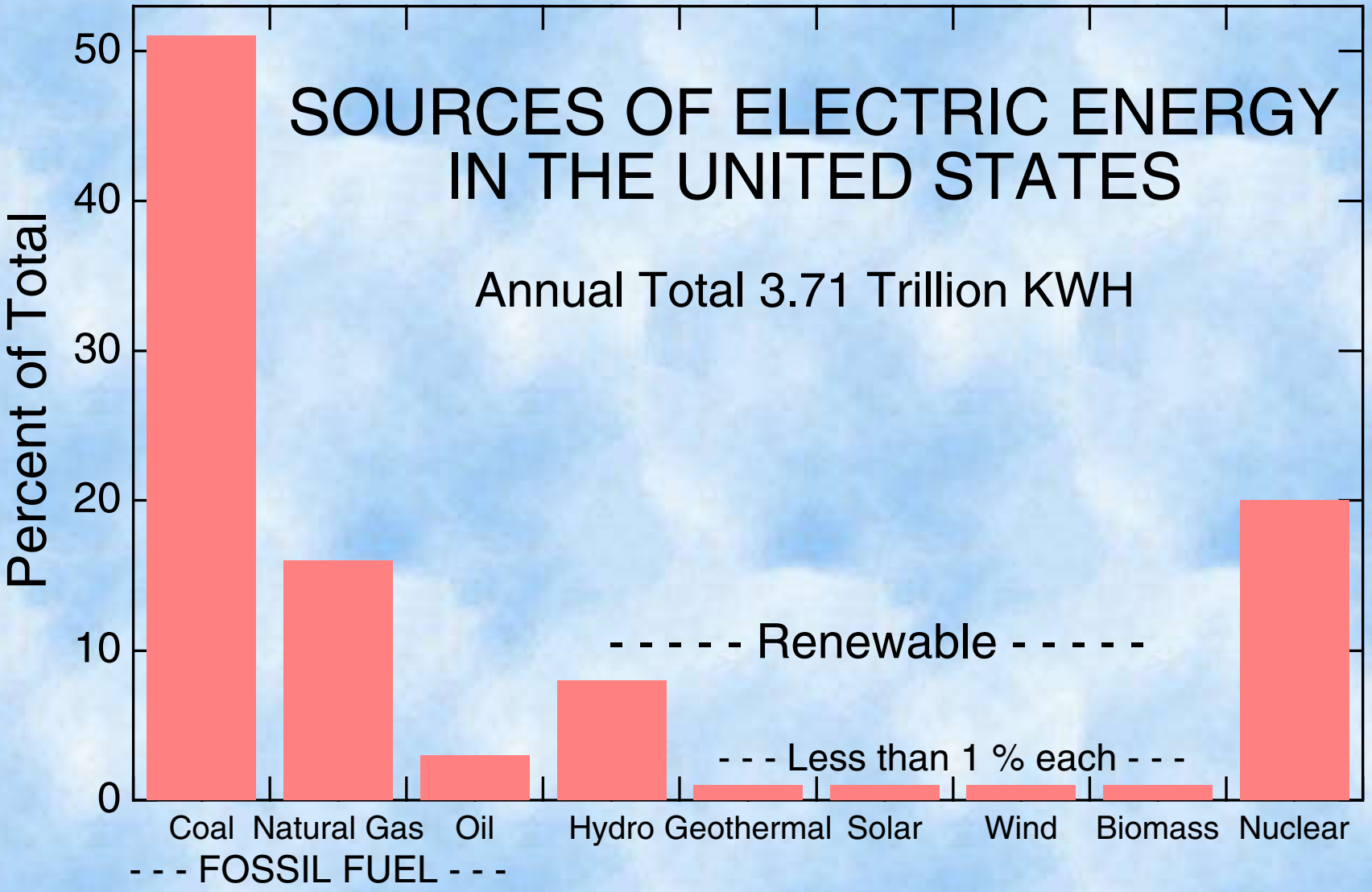
THE MOST EFFECTIVE WAY TO DOUBLE THE FUEL ECONOMY OF A CAR . . .

IS TO PUT TWO PEOPLE IN IT!

CARPOOLING CAN SAVE MORE THAN GAS

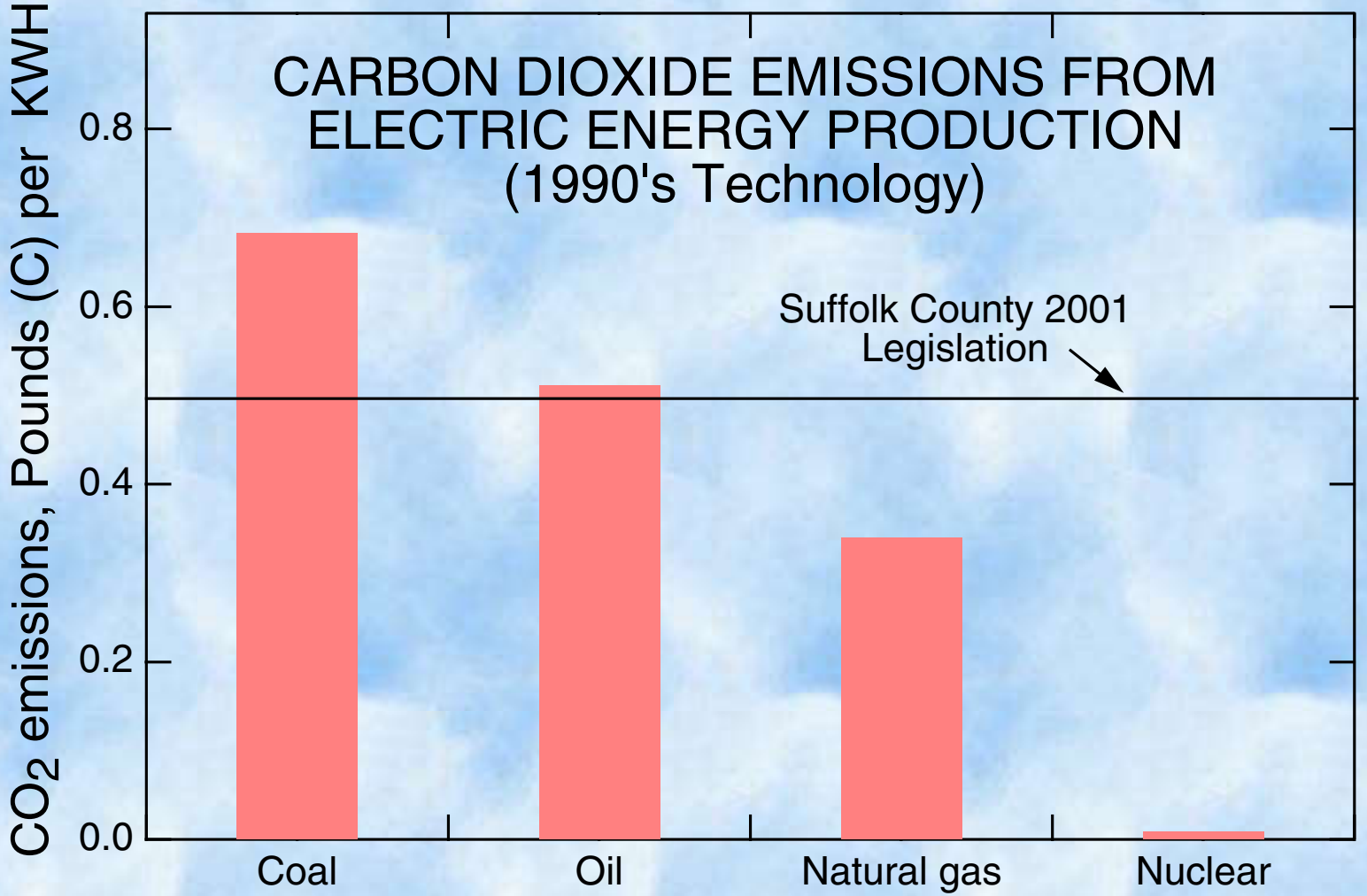


WHERE DOES YOUR ELECTRIC ENERGY COME FROM?



On Long Island most electric energy derives from combustion of oil.

YOUR FAMILY'S CONTRIBUTION TO THE GREENHOUSE EFFECT



A typical household using 1000 kilowatt hours of electricity per month is responsible for emission of 3 tons of carbon a year in the form of carbon dioxide.

How much does your household contribute?

YOUR CONTRIBUTION TO THE GREENHOUSE EFFECT

ELECTRIC SUPPLY AND DELIVERY FROM LIPA

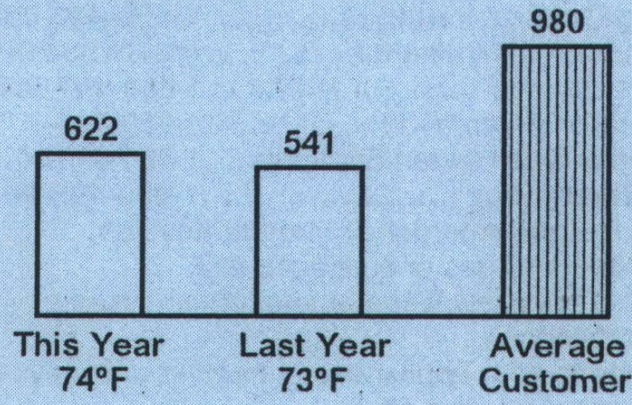
Meter Readings Meter # 15790134

	Jul 24	93155 Actual
	Jun 26	92533 Actual
Use	28 **Days**	622 **KWH**

Cost Rate 880 - Water and Home Heating

Basic Service: 28 Days @ 17.90¢	$5.01
Use: 233 KWH @ 12.49¢	29.10
140 KWH @ 13.67¢	19.14
249 KWH @ 9.78¢	24.35
Excess Fuel Price Surcharge	4.28
PILOTs and Credits	1.40
Shoreham Credit	-.59
Sales Tax: @ 1%	.83
Total	$83.52

Comparisons KWH



500 pounds of carbon per month
3 tons of carbon per year

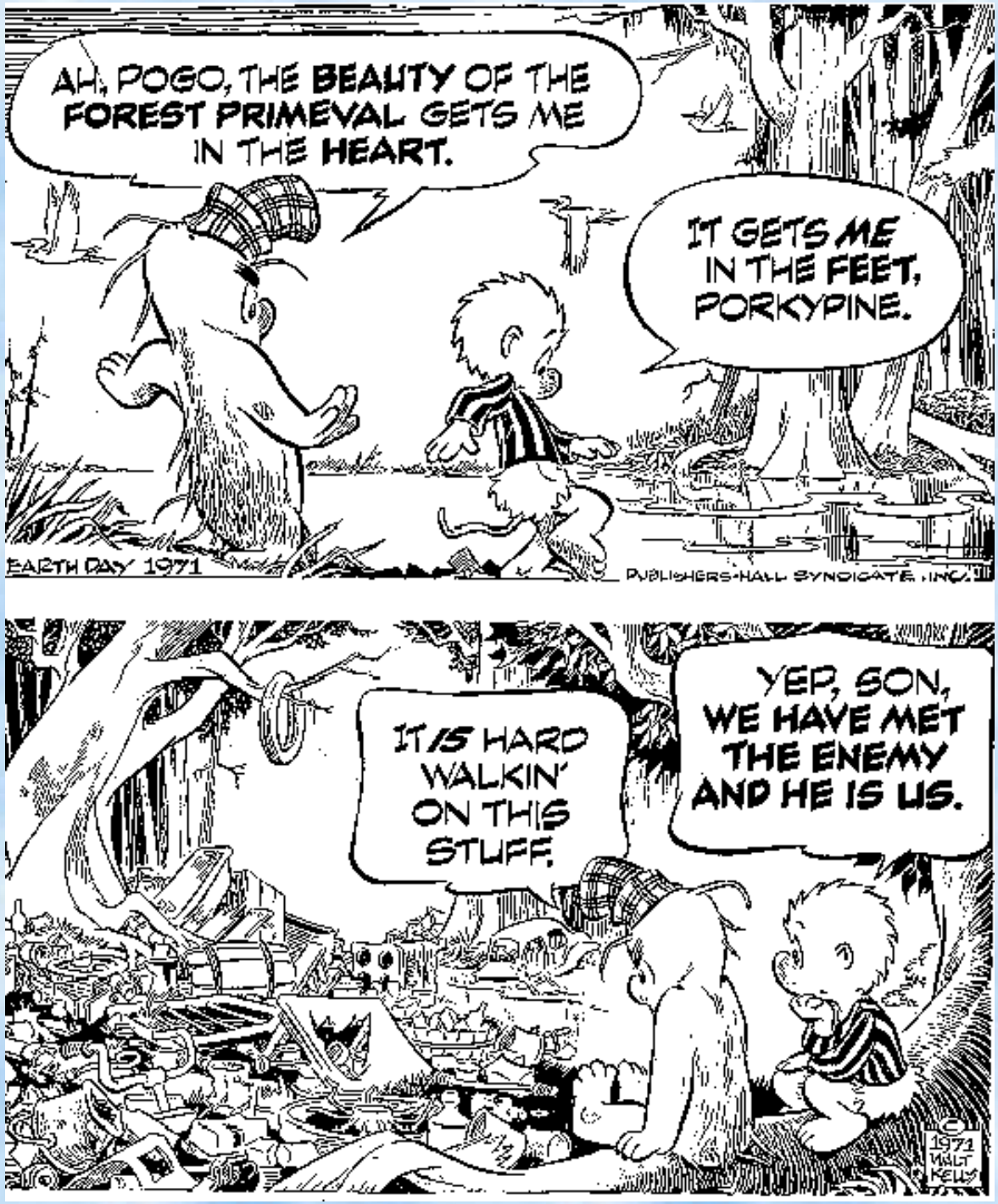
LIPA
Long Island Power Authority

Jul 25, 2001	927 20 1805 3 5	1-800-490-0025	See Back Of Bill
Date	Account Number	Any Questions?	Service Problems

At half a pound of carbon per KWH, the average household is responsible for emission of 500 pounds of carbon a month .

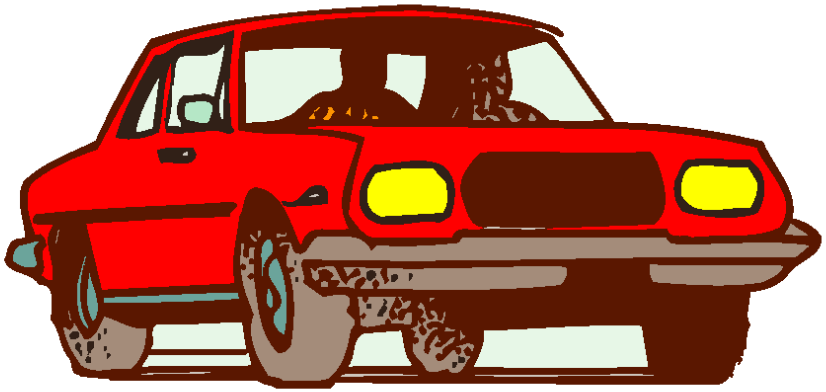
WHO IS RESPONSIBLE?

IT'S ALL OF US!



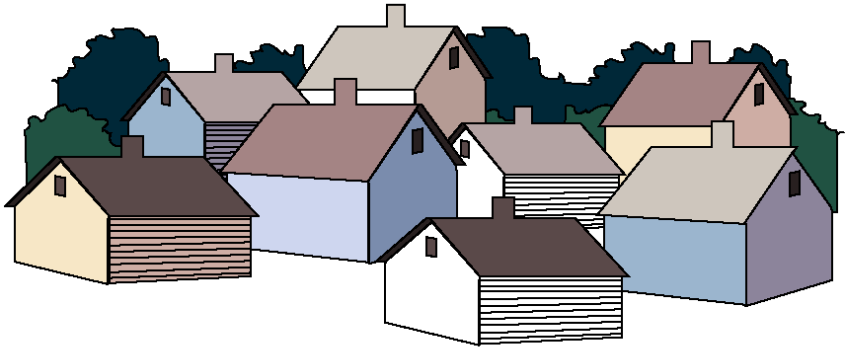
WHERE IS THIS CARBON DIOXIDE COMING FROM?

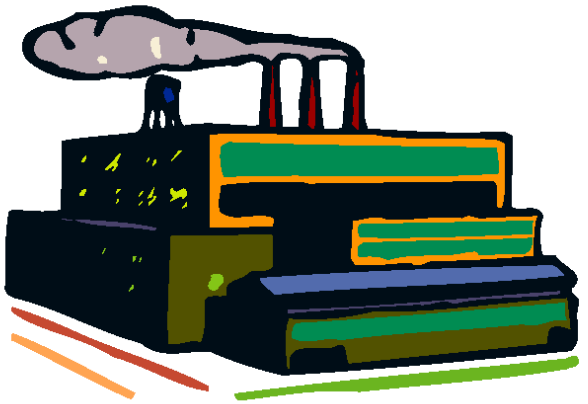
WE ARE ALL RESPONSIBLE.



Burning a gallon of gasoline in your car puts 5 pounds of carbon in the atmosphere as carbon dioxide (CO_2), and it will stay there for decades — maybe a century!

Other sources are home heating and electric power production.





Global Atmosphere, Global Warming

QUESTIONS ABOUT GLOBAL WARMING

- IS IT REAL?
- IS IT IMPORTANT?
- WHAT IS IT DUE TO?
- HOW MUCH MORE CAN WE EXPECT?
- ARE WE SEEING JUST THE TIP OF THE ICEBERG?

RESEARCH IS HELPING TO ANSWER THESE QUESTIONS.

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