A presentation from the 2009 Topical Symposium:

Energy Security: A Global Challenge

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INSS

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Terrestrial Energy

Power for the 21st Century

Matter and Energy are Interchangeable

$$E = mc^2$$

$$E = \frac{1}{2} mv^2$$

Energy Density

$$E = {}_{m}C^{2}$$

$$E = \frac{1}{2}\, m_{v^2}$$

$(186{,}000 \text{ miles/second})^2$

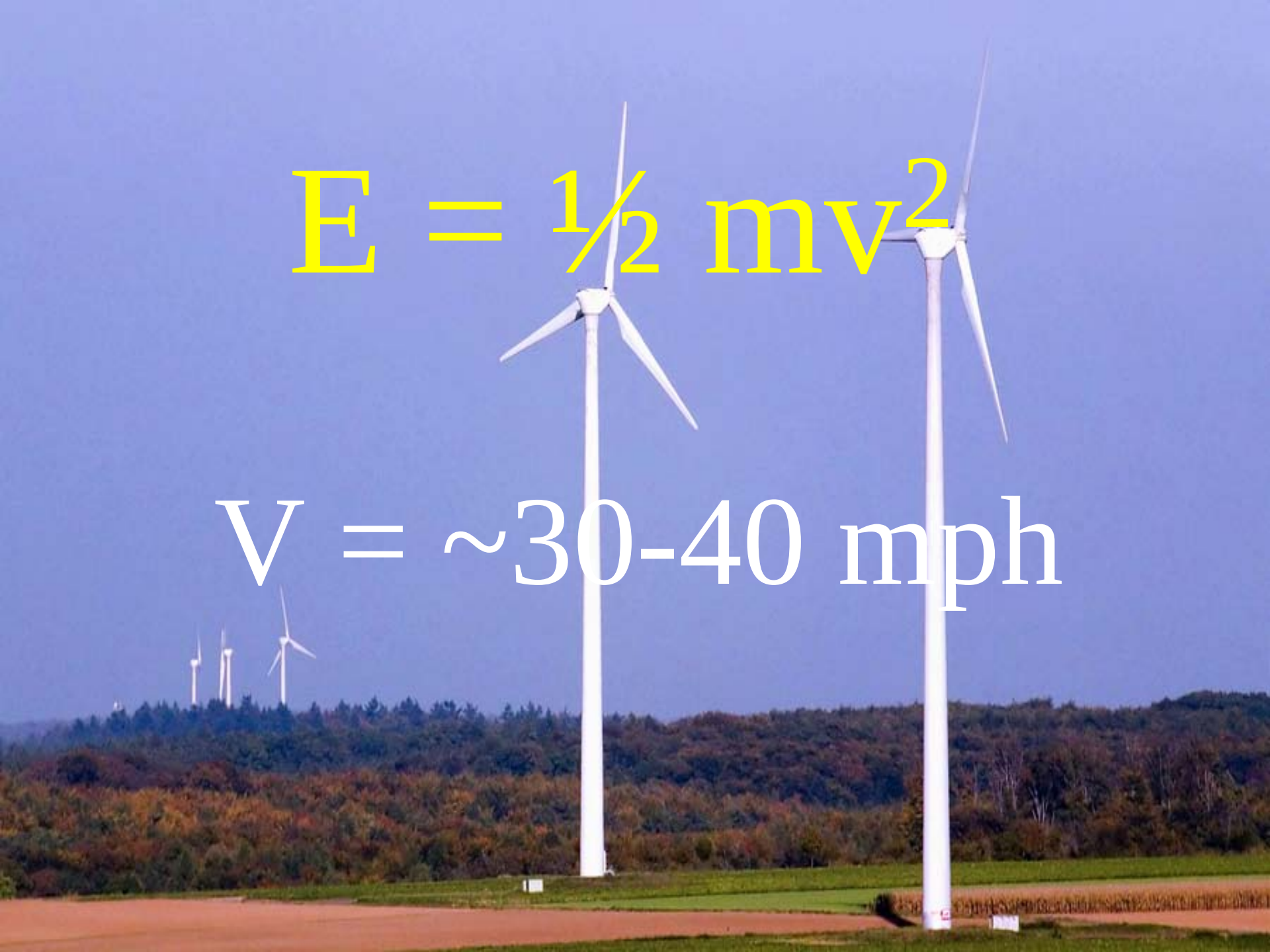
Ten quadrillion

A very, very small amount of matter transforms into a very, very large amount of energy.

$$E = \frac{1}{2} mv^2$$

V = ~ 40-50 mph

Lake Powell, behind Hoover Dam, covers 250 square miles to produce 1000 megawatts.



$$E = \frac{1}{2} mv^2$$

V = ~30-40 mph

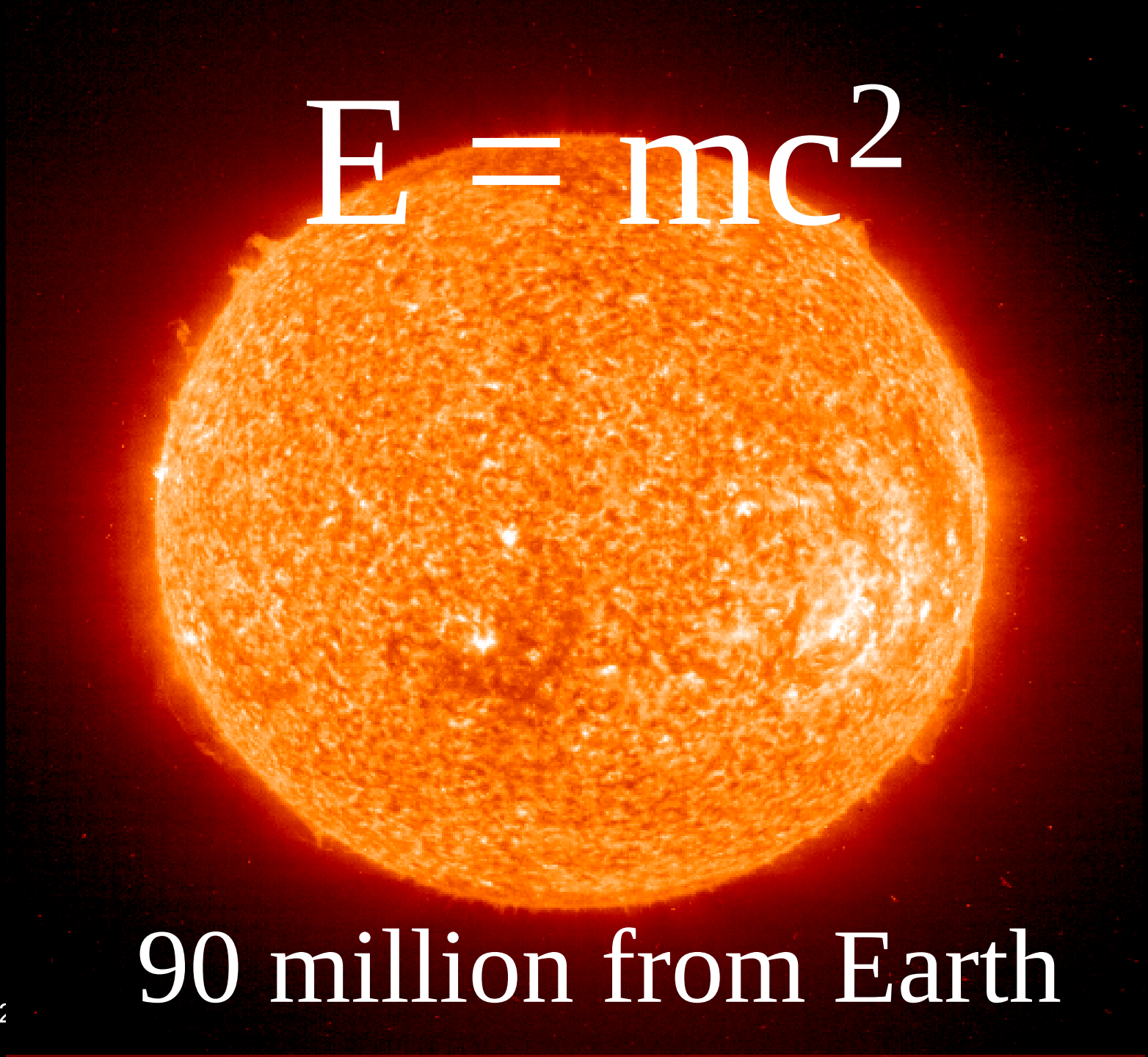
Biggest Ever?
125 square miles for 1000 MW

Tidal and Wave Energy

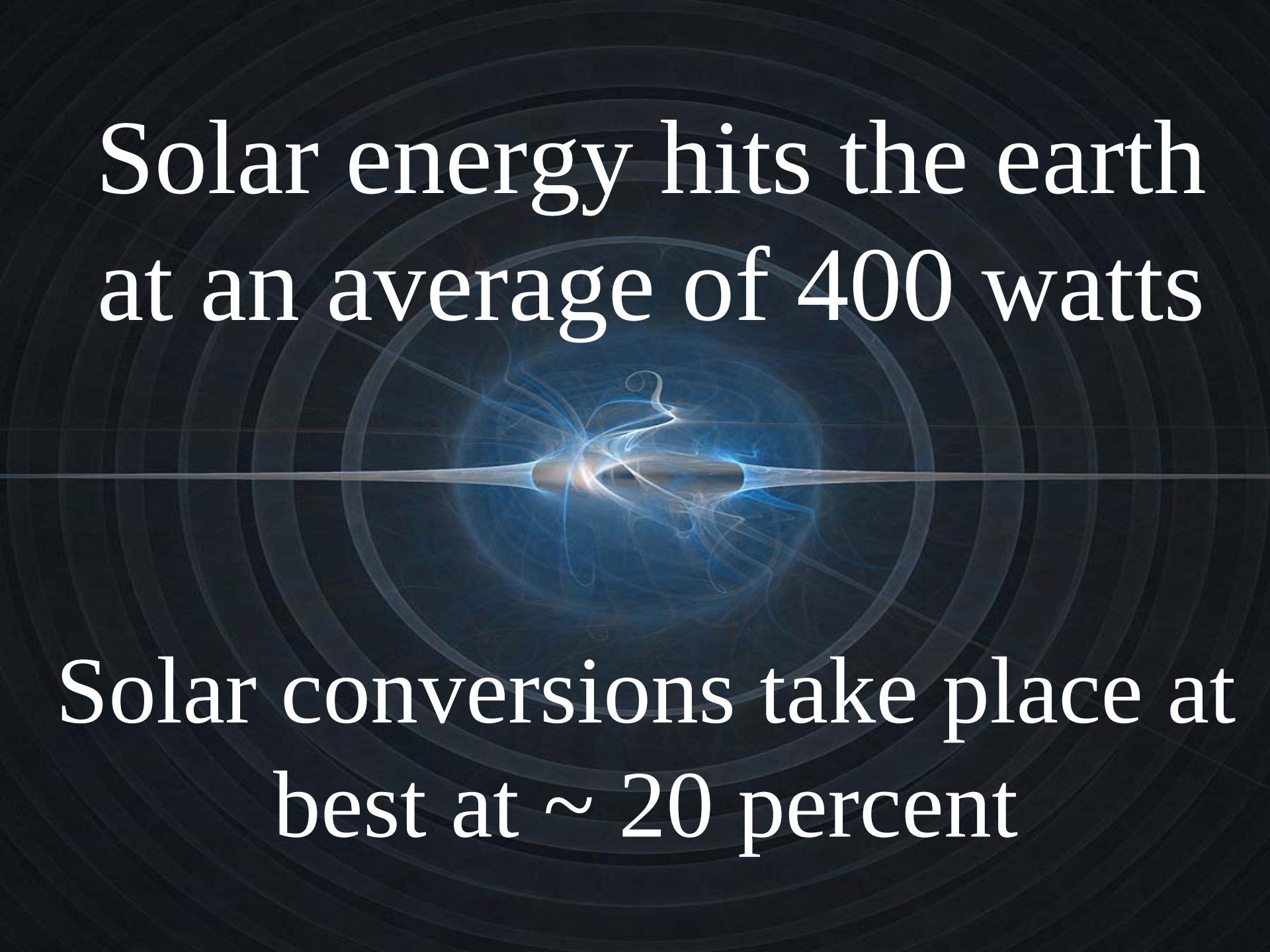
$$E = \frac{1}{2} mv^2$$

$$V = \sim 5\text{-}7 \text{ mph}$$

1000 mw =
Dozens of
miles of
coastline.


$E = mc^2$
90 million from Earth

Solar energy hits the earth at an average of 400 watts



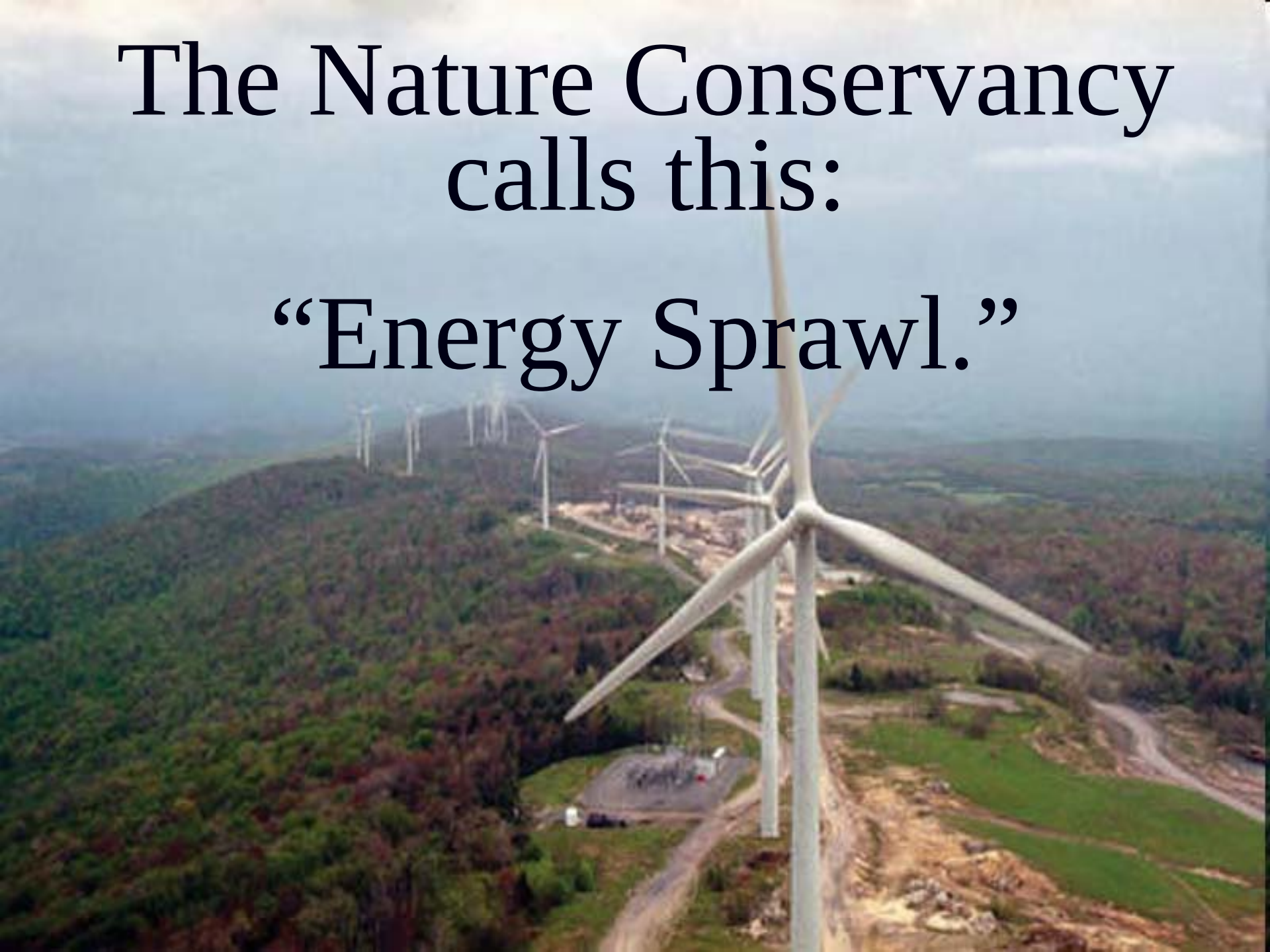
Solar conversions take place at best at ~ 20 percent

One 100-watt light
bulb per square meter.

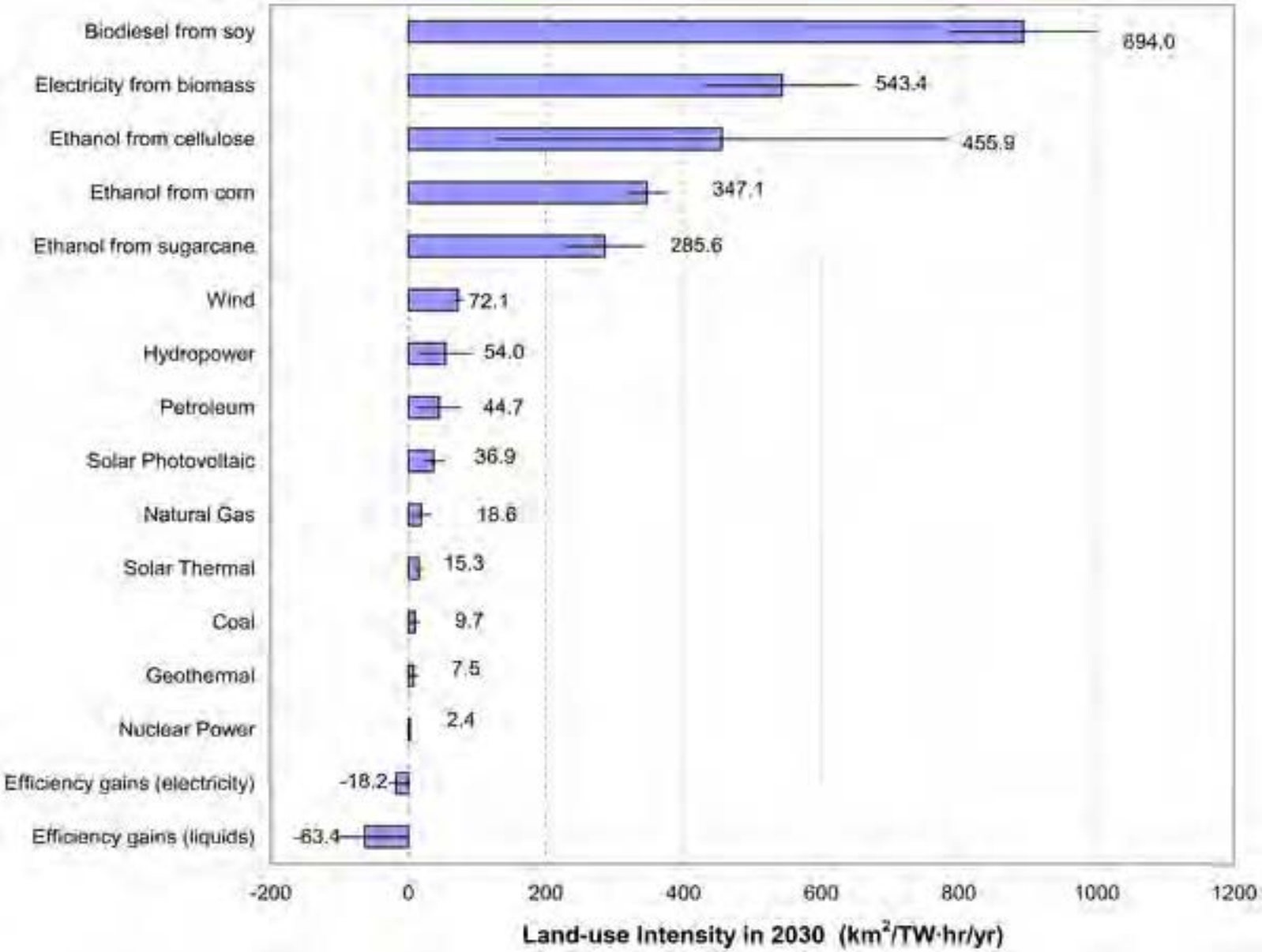
Solar Thermal

10 Megawatts – 1/5 sq. mile

46,000 square miles of western desert

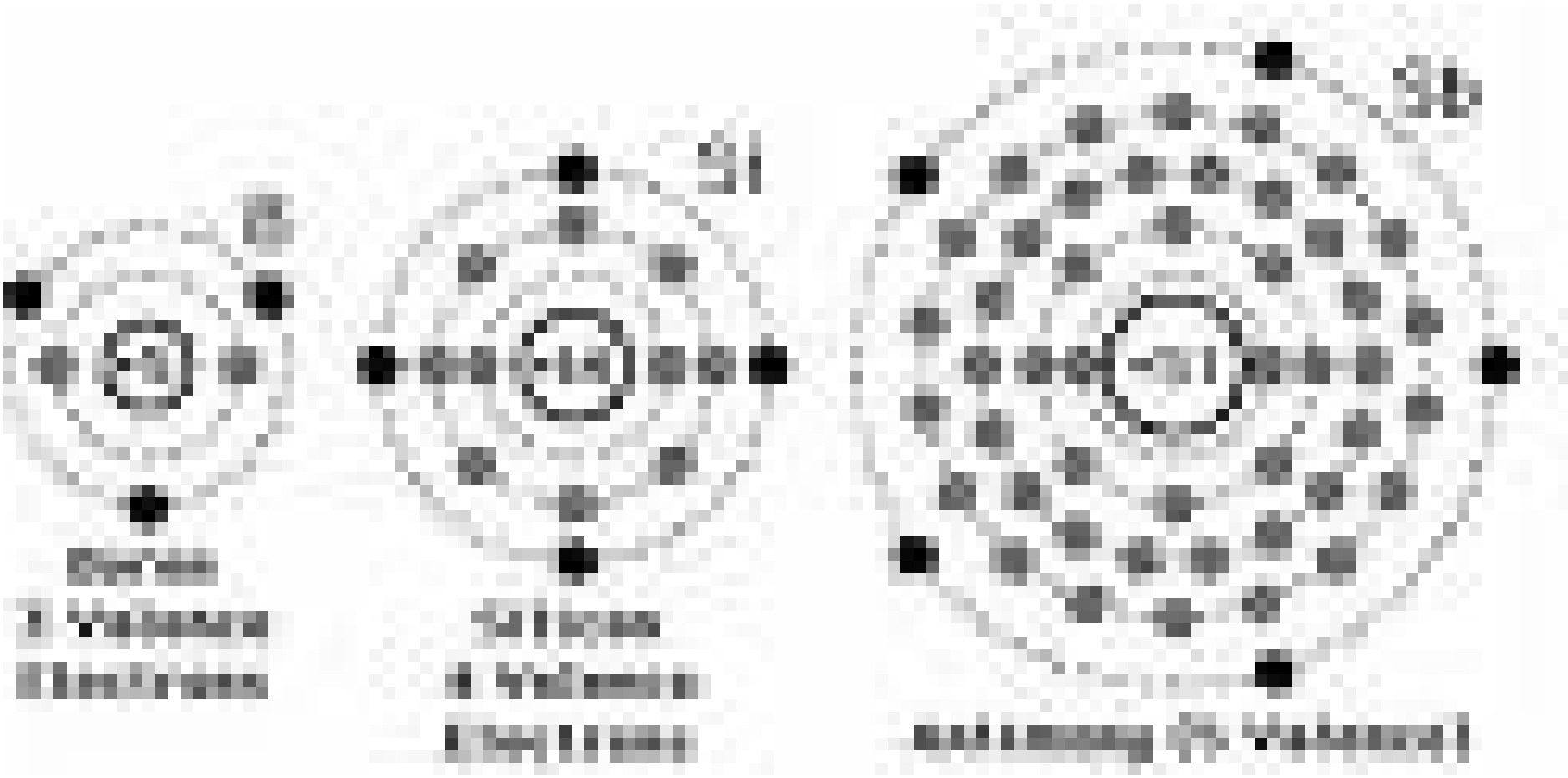

The Nature Conservancy calls this:
“Energy Sprawl.”

Energy Density

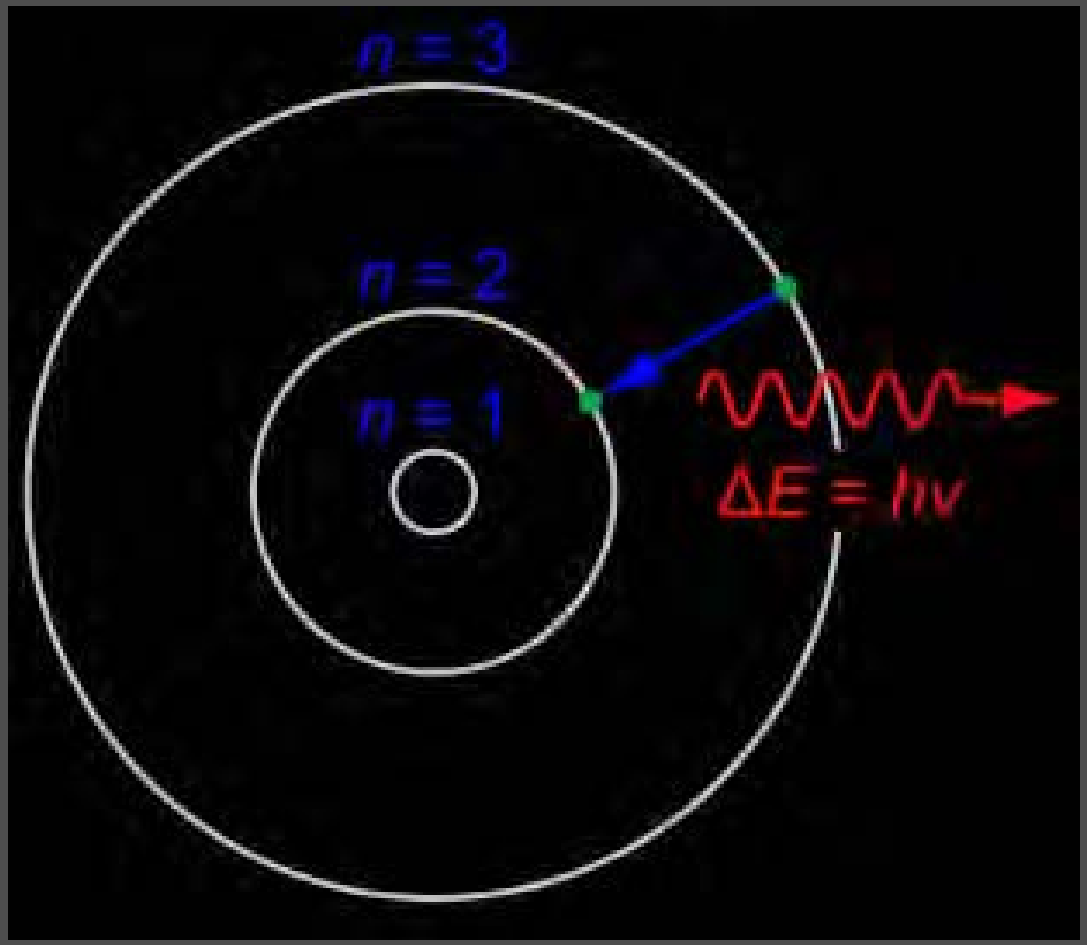


Is there any source of energy that involves. . .

Chemistry

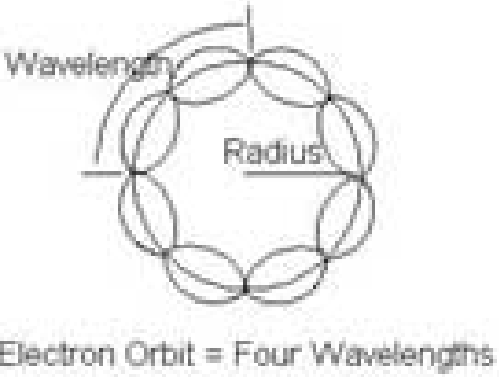


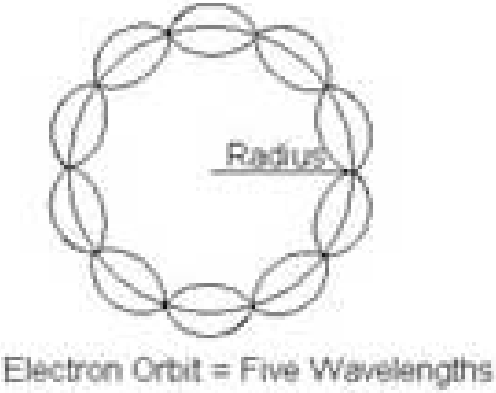
Quantum Theory



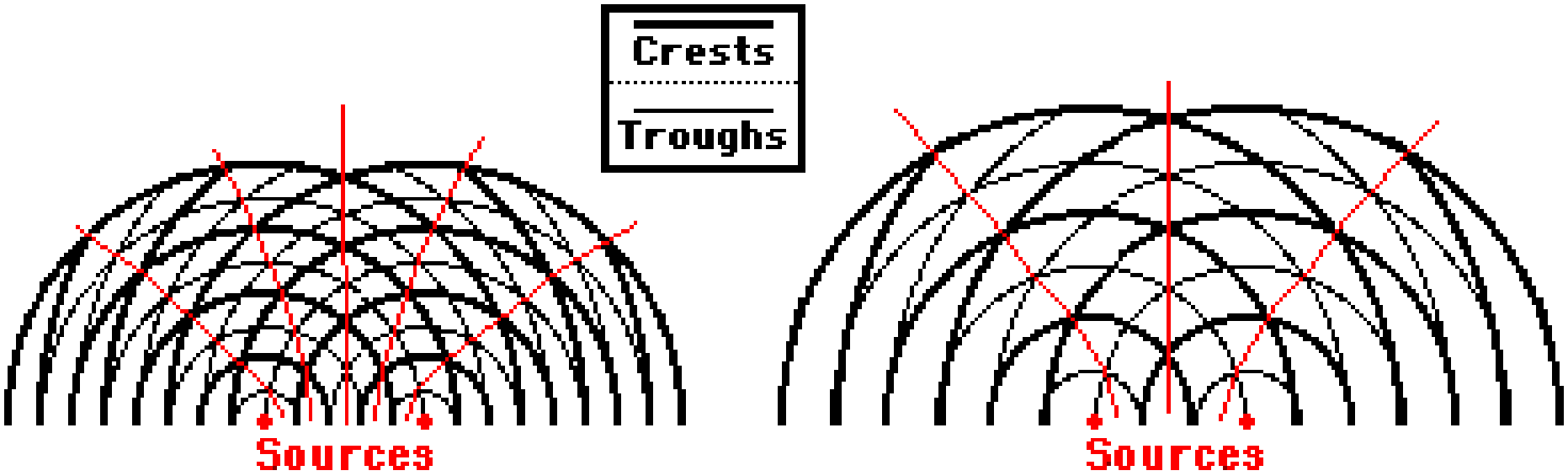
Niels Bohr 1885-1962

Electrons as Particle/Waves



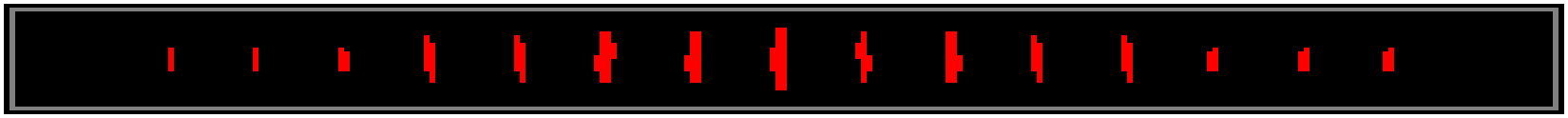


Louis de Broglie 1892-1987



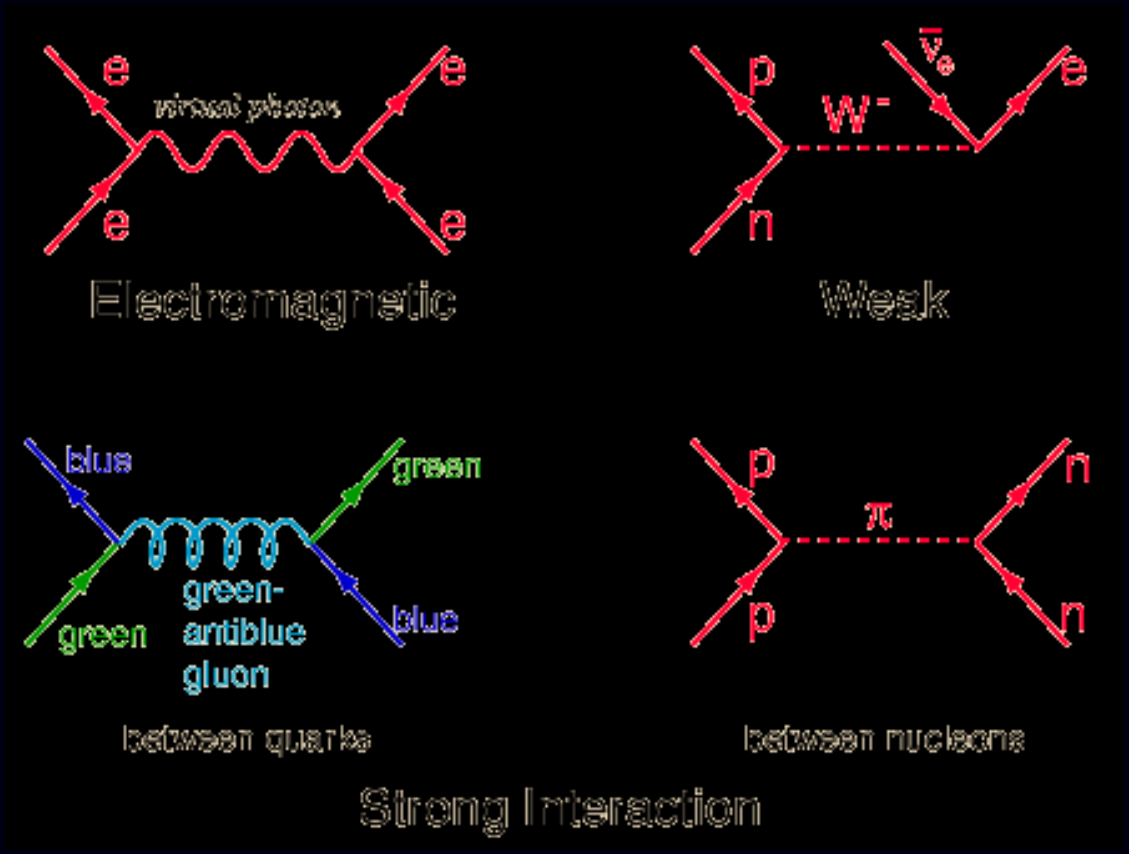
The proximity of the anti-nodal lines in a two-point source interference pattern is dependent upon the wavelength of the waves.

Two-Point Source Interference Pattern



The projection of an interference pattern onto a screen results in an alternating pattern of bright (anti-nodes) and dark (nodes) bands.

Matter = Energy



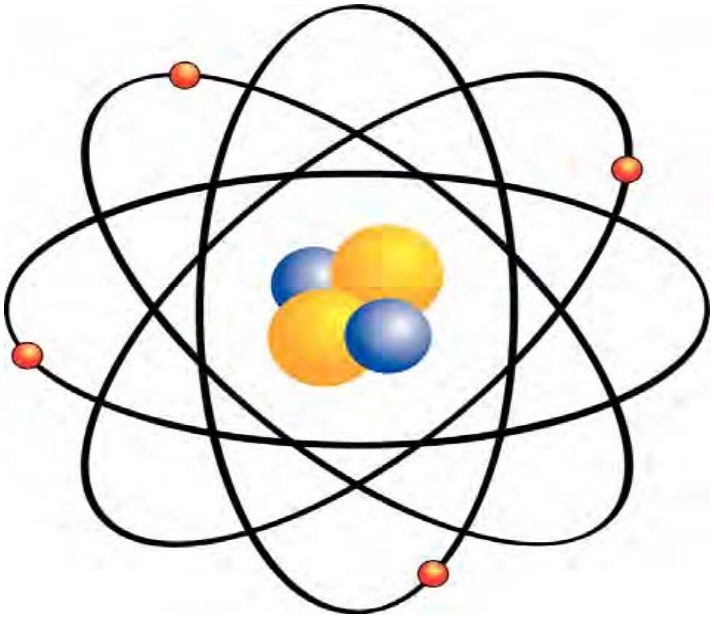
Richard Feynman 1918-1988

One billionth of the mass.

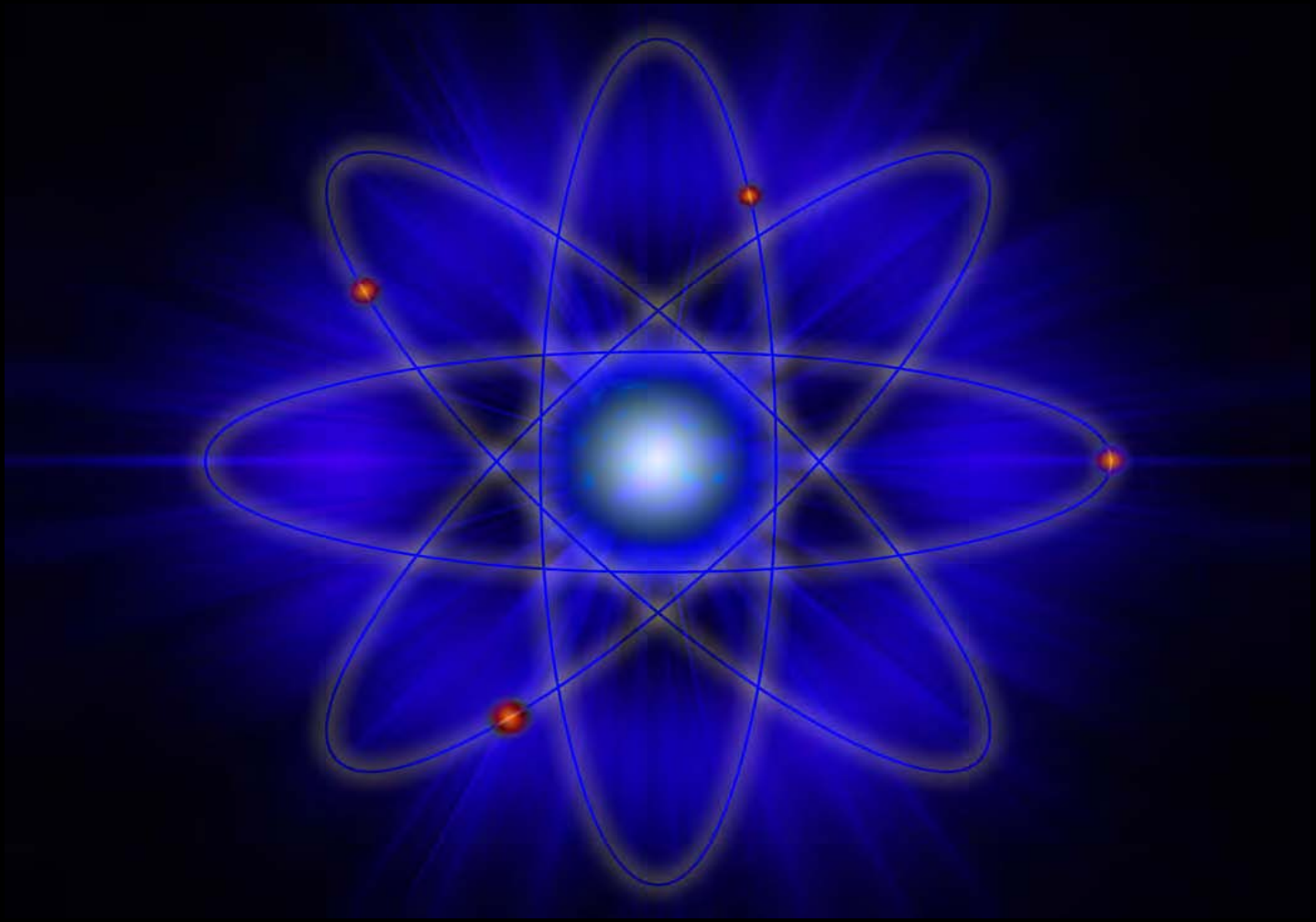
2000 pounds for 30 miles.

Is there any other concentration of matter in the universe other than the electron?

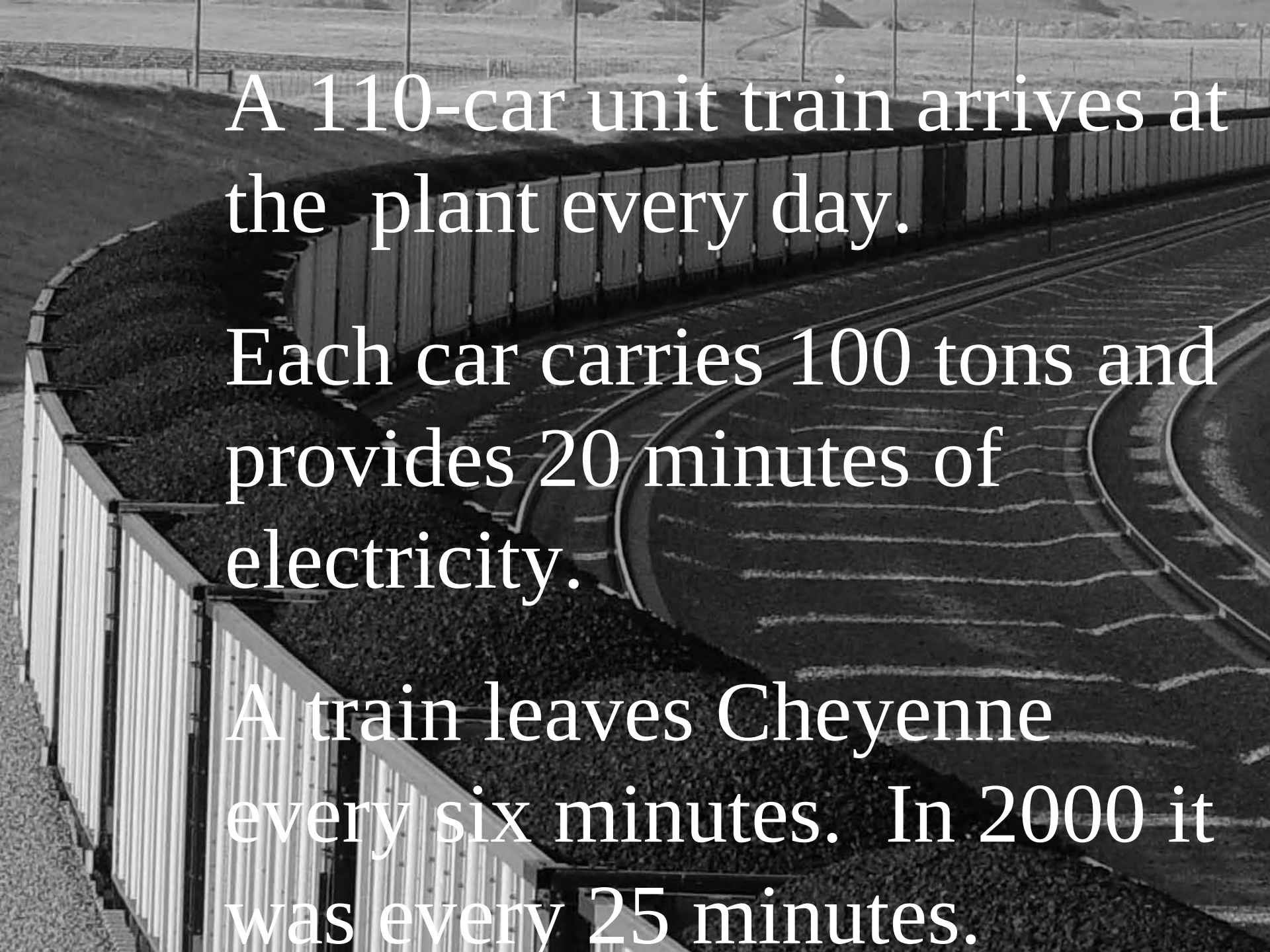
Only 1/1800th of the mass is in the electrons.



The remainder is in the nucleus.



The energy release from splitting a uranium atom is ***2 million*** eV.



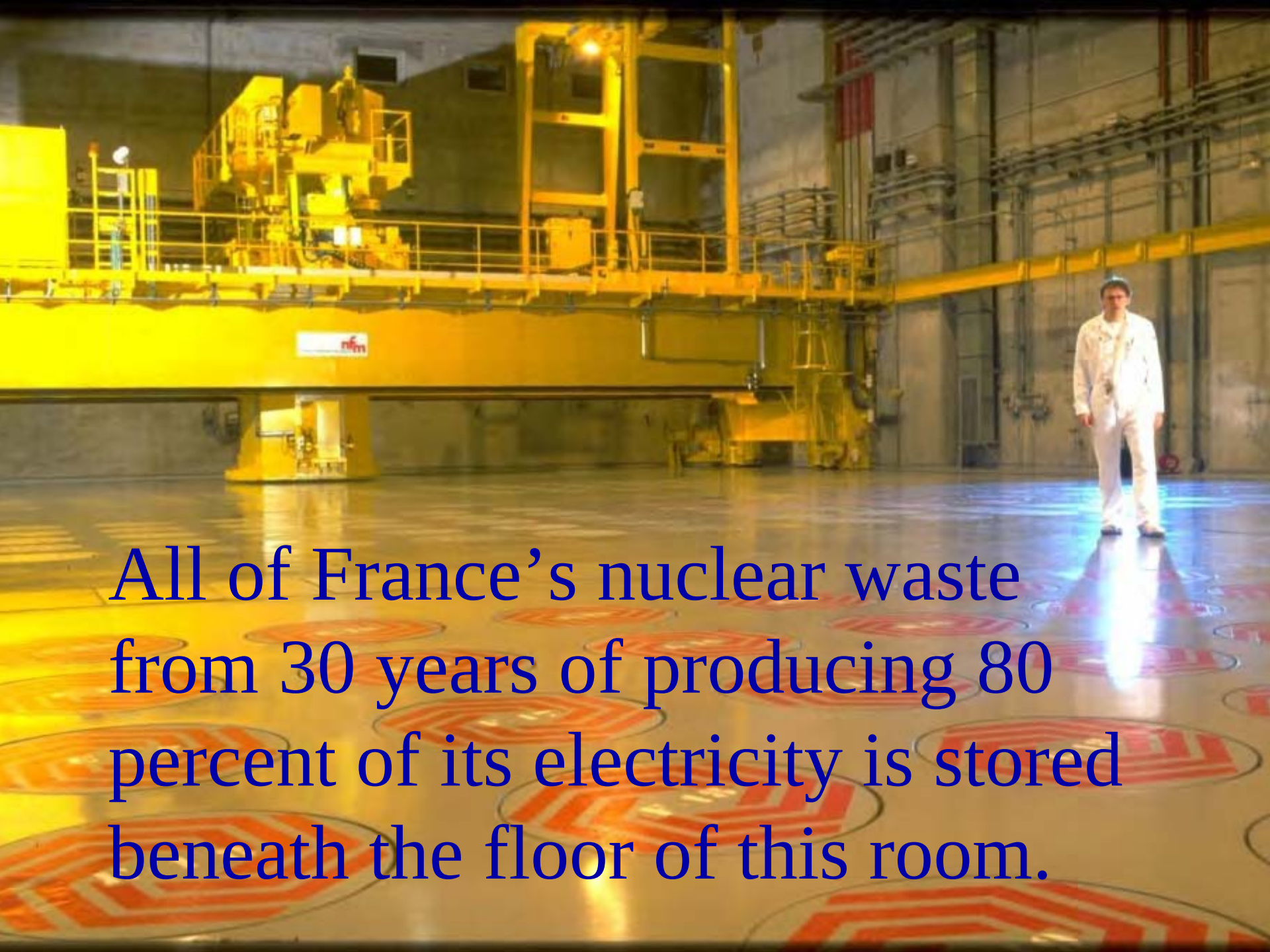
A 110-car unit train arrives at the plant every day.

Each car carries 100 tons and provides 20 minutes of electricity.

A train leaves Cheyenne every six minutes. In 2000 it was every 25 minutes.

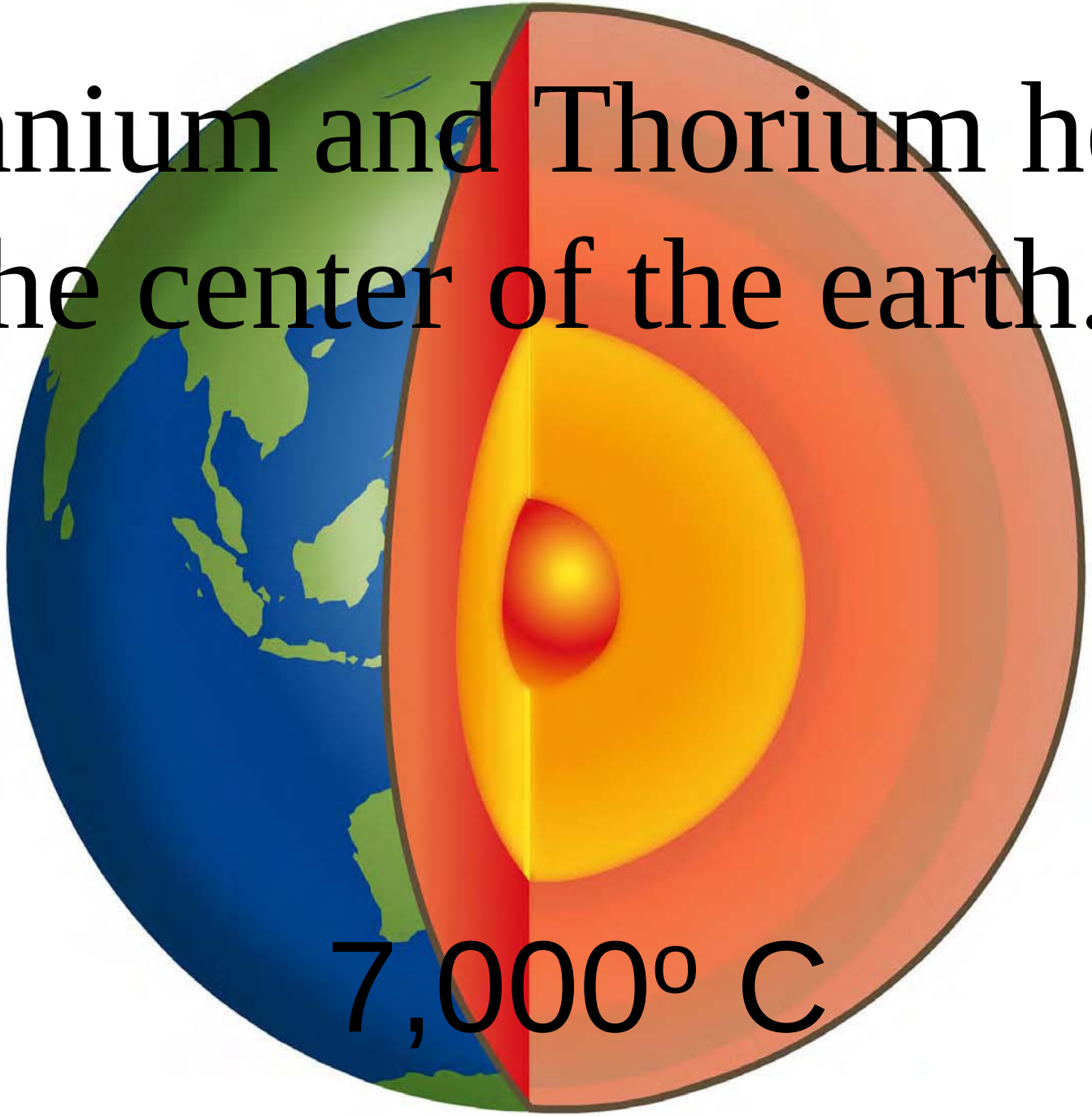
Two years worth of electricity.

Four years’ worth of nuclear waste.

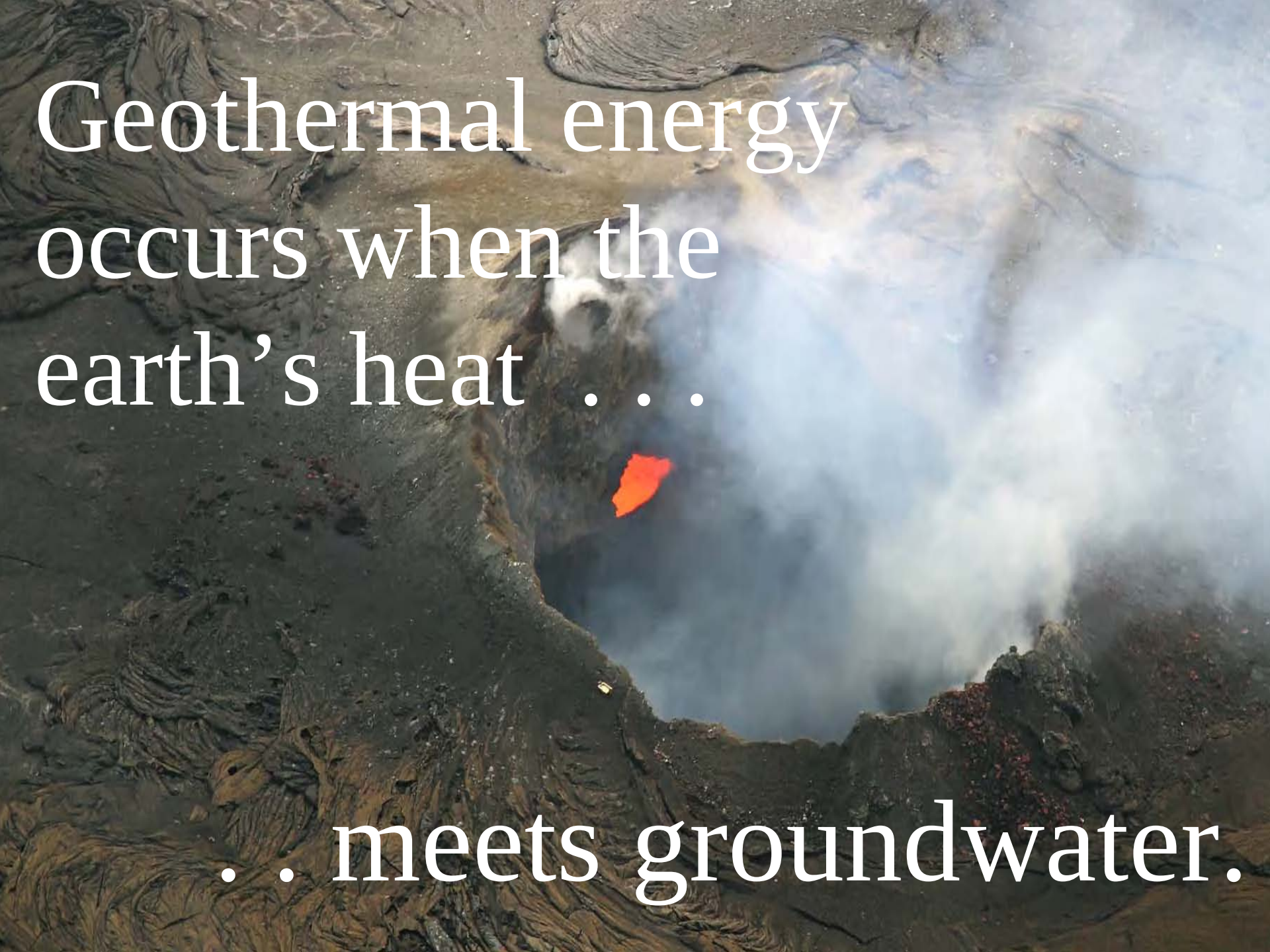


All of France’s nuclear waste from 30 years of producing 80 percent of its electricity is stored beneath the floor of this room.

Uranium and Thorium heat the center of the earth.



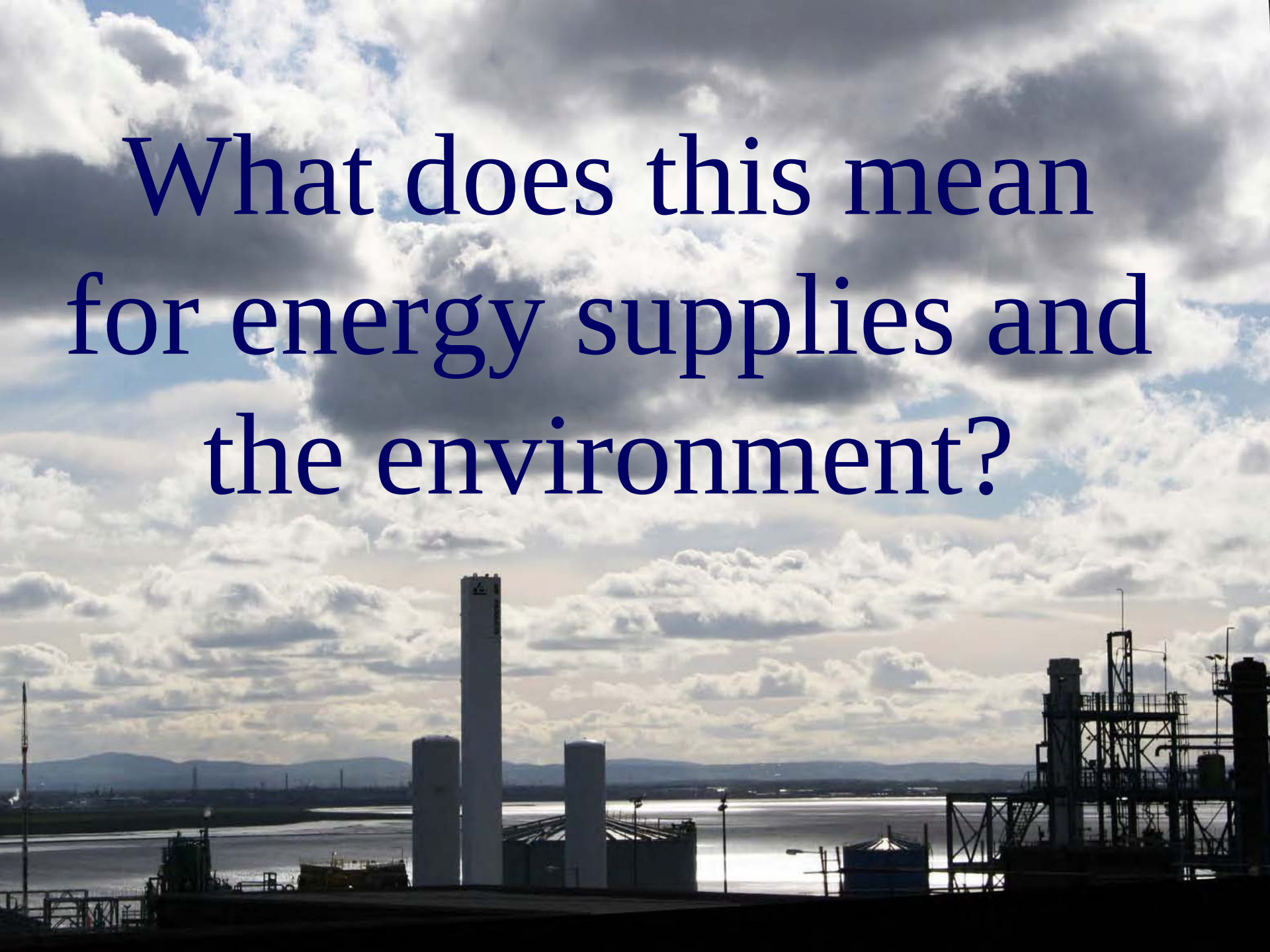
7,000^{o} C

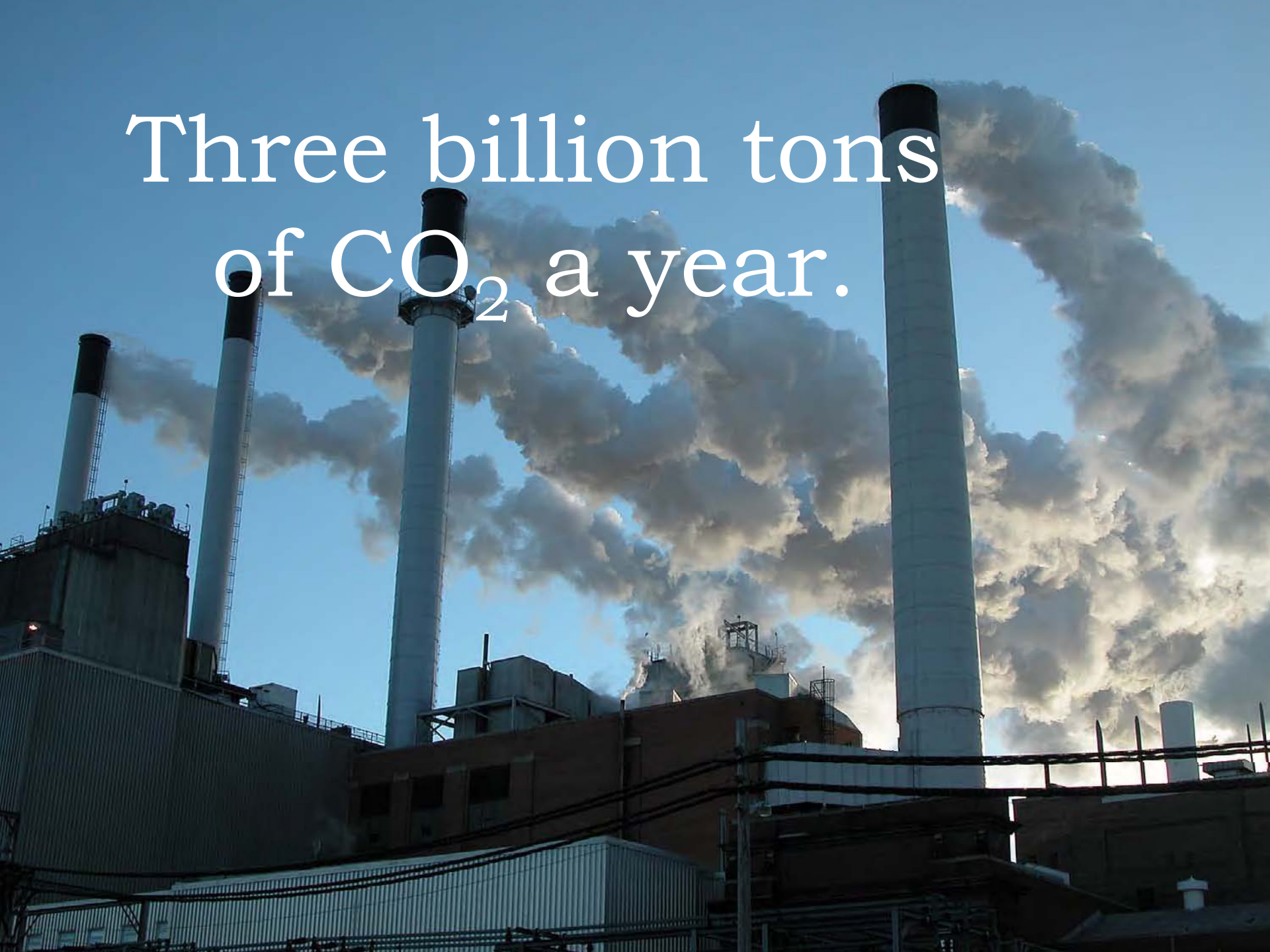

Geothermal energy
occurs when the
earth’s heat . . .
. . meets groundwater.

Geothermal energy - Iceland

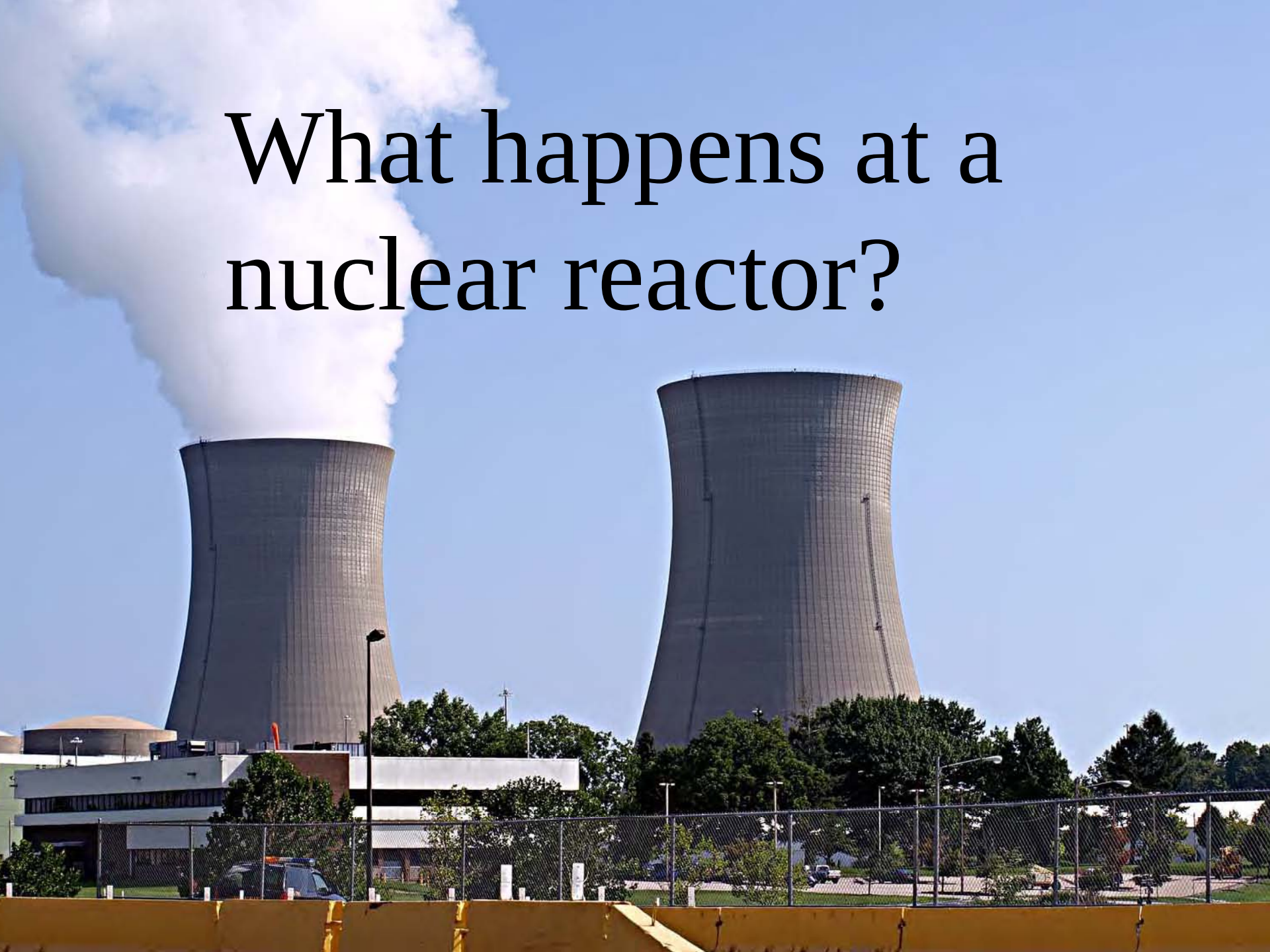
Terrestrial Energy

What does this mean for energy supplies and the environment?

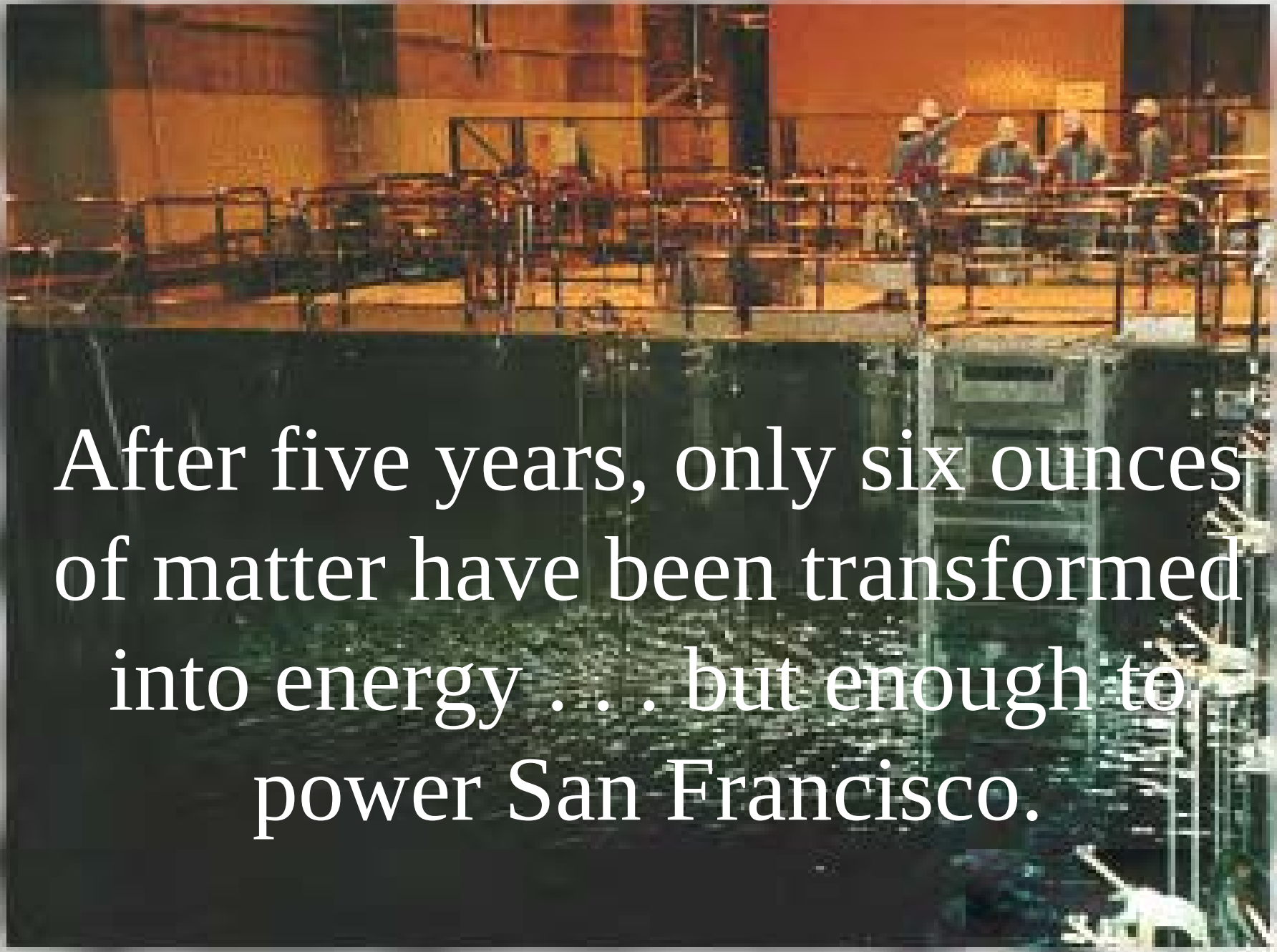



Three billion tons
of CO_2 a year.

What happens at a nuclear reactor?



No CO_2 emissions.



After five years, only six ounces of matter have been transformed into energy . . . but enough to power San Francisco.

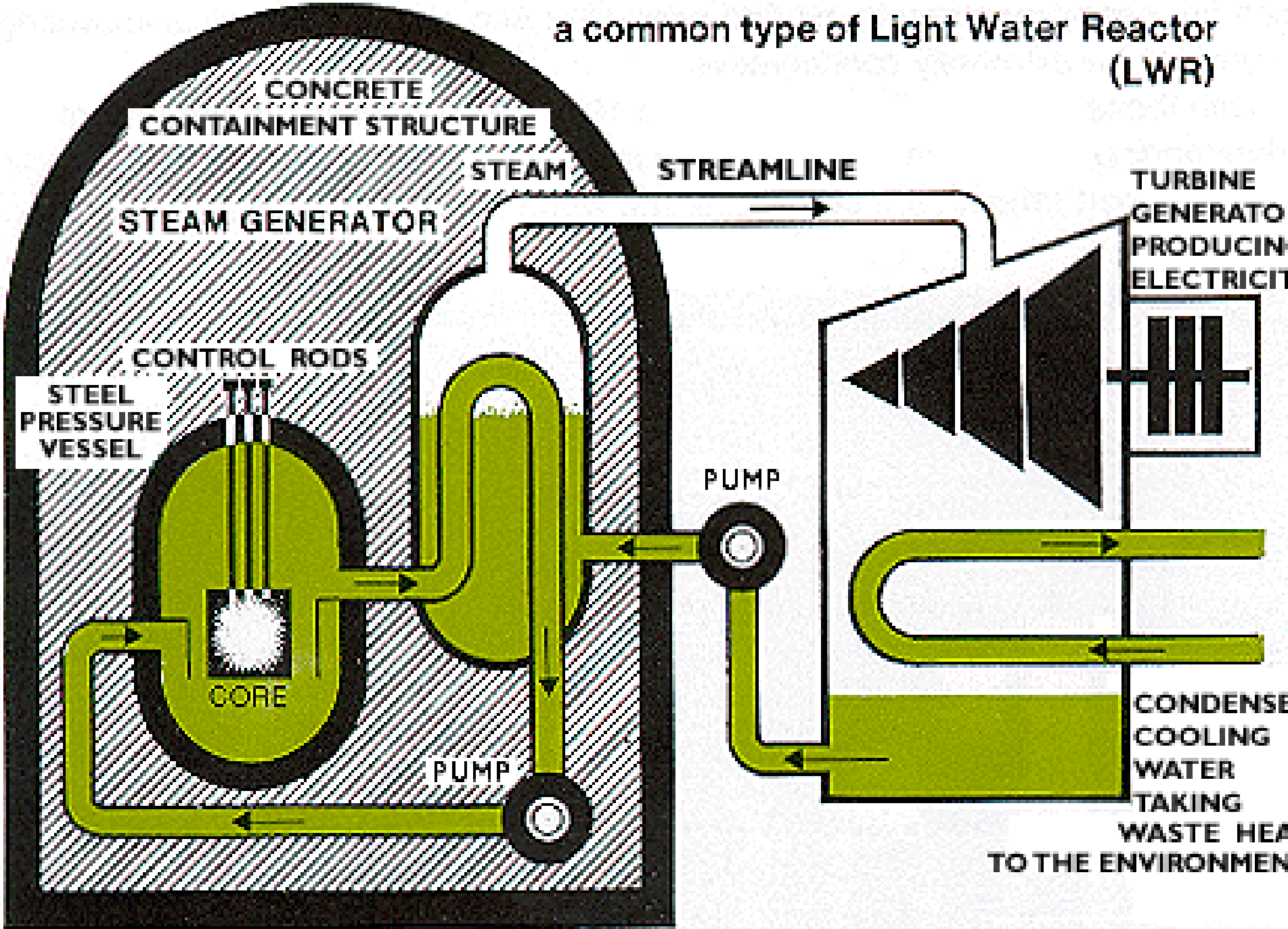
Report Of
The President's Commission On

THE ACCIDENT AT THREE MILE ISLAND

The Need For Change:
The Legacy Of TMI

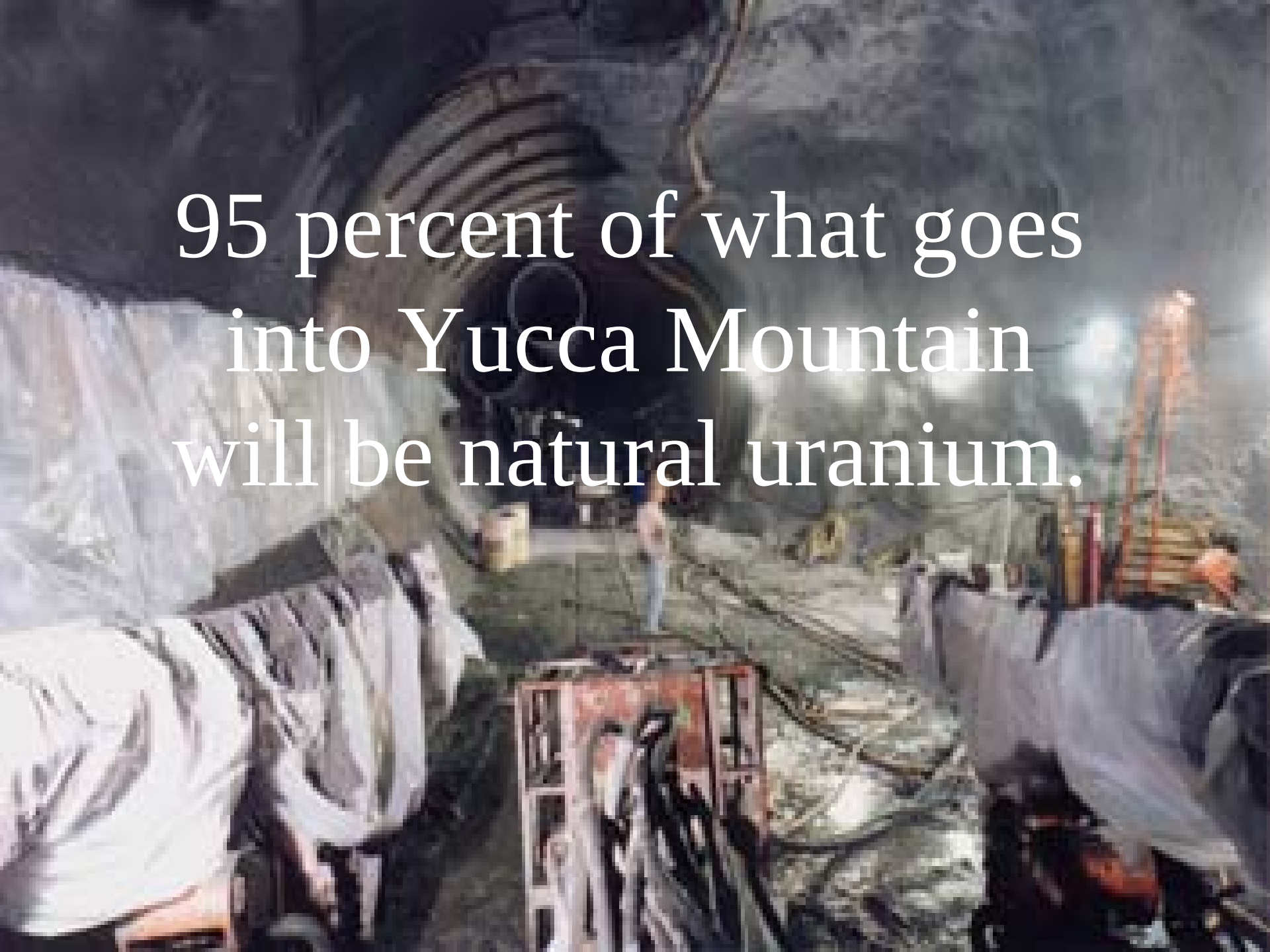
Pressurized water reactor—

a common type of Light Water Reactor (LWR)

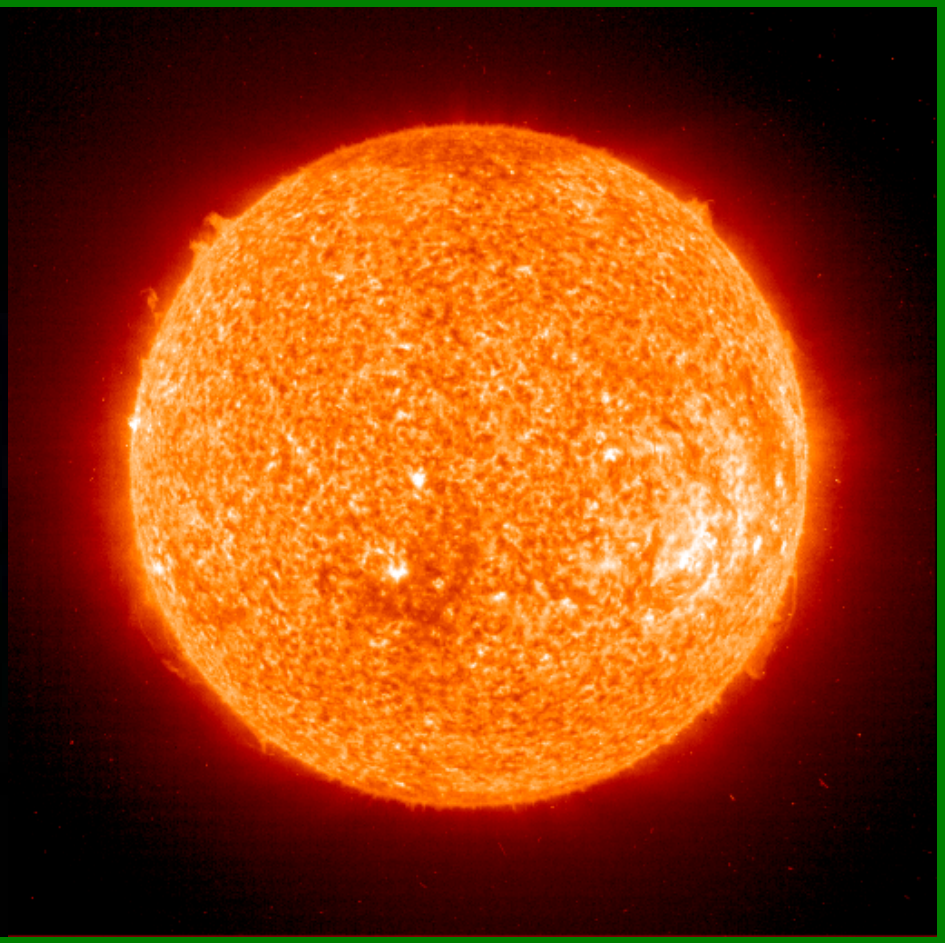


BELORUSSIA
WOLVES LAND
UKRAINE

“What are we going to do with the waste?”


95 percent of what goes
into Yucca Mountain
will be natural uranium.

The Marriage of Heaven and Earth



Energy for the 21st Century.