

Energy-2050™

PUBLIC AWARENESS

Geothermal Energy Utilization Associated with Oil and Gas Development
SMU Dallas June 17-18, 2008

This ENERGY-2050 presentation is not designed for this prestigious audience. It is designed to bring forward important information, a **VISION** and a **CHALLENGE**, to the public, the politicians, industry, investors, entrepreneurs & environmentalists.

Many of us have been witness to the public being unaware, uniformed or misled regarding “energy” issues, in particular to what “geothermal” is all about. We need to get the message out.

This ENERGY-2050 presentation of June 18, 2008 is not cut in stone. It will evolve and your input is invited and most welcome.



Please contact me: Mario.Messina@MessinaChemicals.com

Energy-2050

A quick review of the:

- Production
 - Transmission
 - Storage and
 - Use of energy today
- a VISION - where we need to be
- a CHALLENGE - how to get there
by year 2050

What is Vision?

- What lies in the imagination is reality
- Science Fiction = Science Fact
- Technical advances are governed by:
 - Evolution (more energy efficient, smaller, faster, etc.)
 - Extrapolation (economy-to-scale = cost reductions)
 - **Quantum Jumps (breakthroughs)**

The Vision is:

Renewable ENERGY

widely available, non-polluting, sustainable, inexpensive

VISION to REALITY

Atomic bomb - less that 10 years

Man on the moon - in less than 10 years

VISION +

A NEED then: Brain power + Quantum jumps in technology
+ Innovations + Incentives (money, praise, recognition)

= REALITY

The Challenge

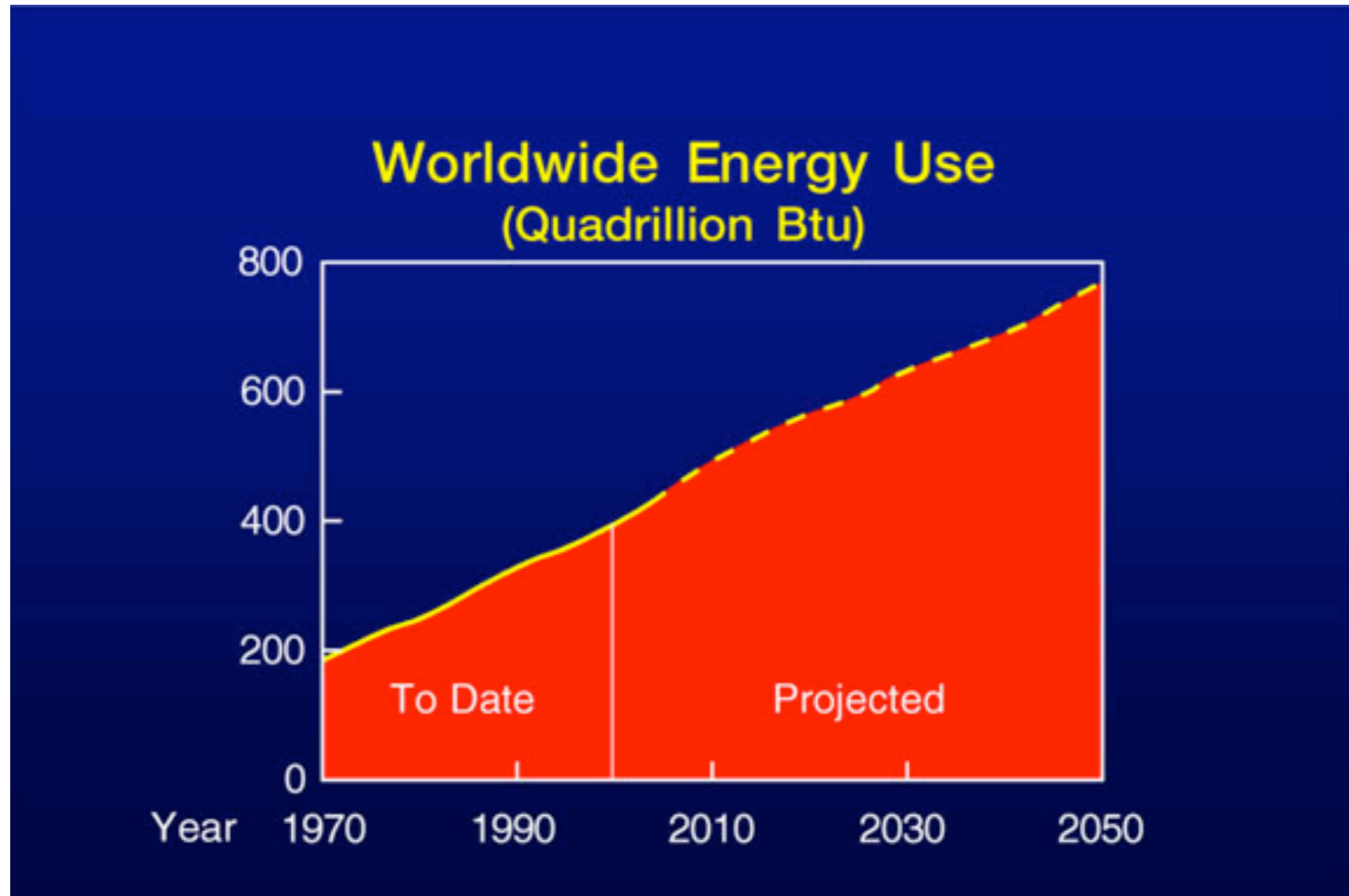
to achieve Renewable ENERGY

Stimulate quantum jumps - technical breakthroughs
- in nuclear, wind, and solar energy production
& in the transmission & storage of energy

Recognise & Support GeoThermal &
GeoExchange - systems of proven green
energy sources

Eliminate the **SIN** of burning Hydrocarbons
for energy, heat, transportation, etc.,
by the year 2050

The World's energy requirements will be doubled by 2050

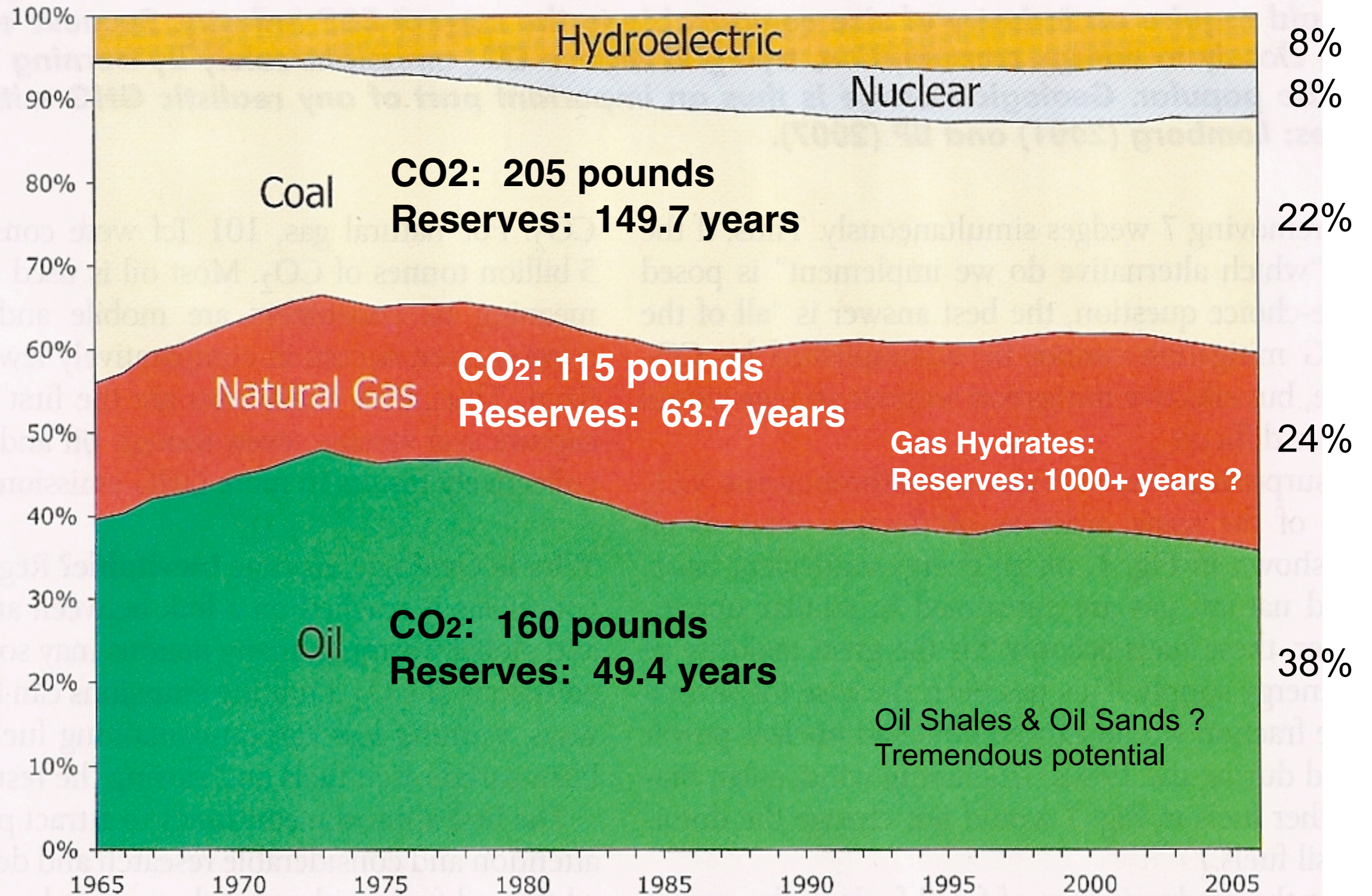


What will be the consequences if our growing energy needs are also met by fossil fuels?

Energy Production

Distribution of Global Energy Consumption by Fuel Type (Energy-Equivalent Basis)

CO₂: per million BTU energy content Reserves at current use at current use



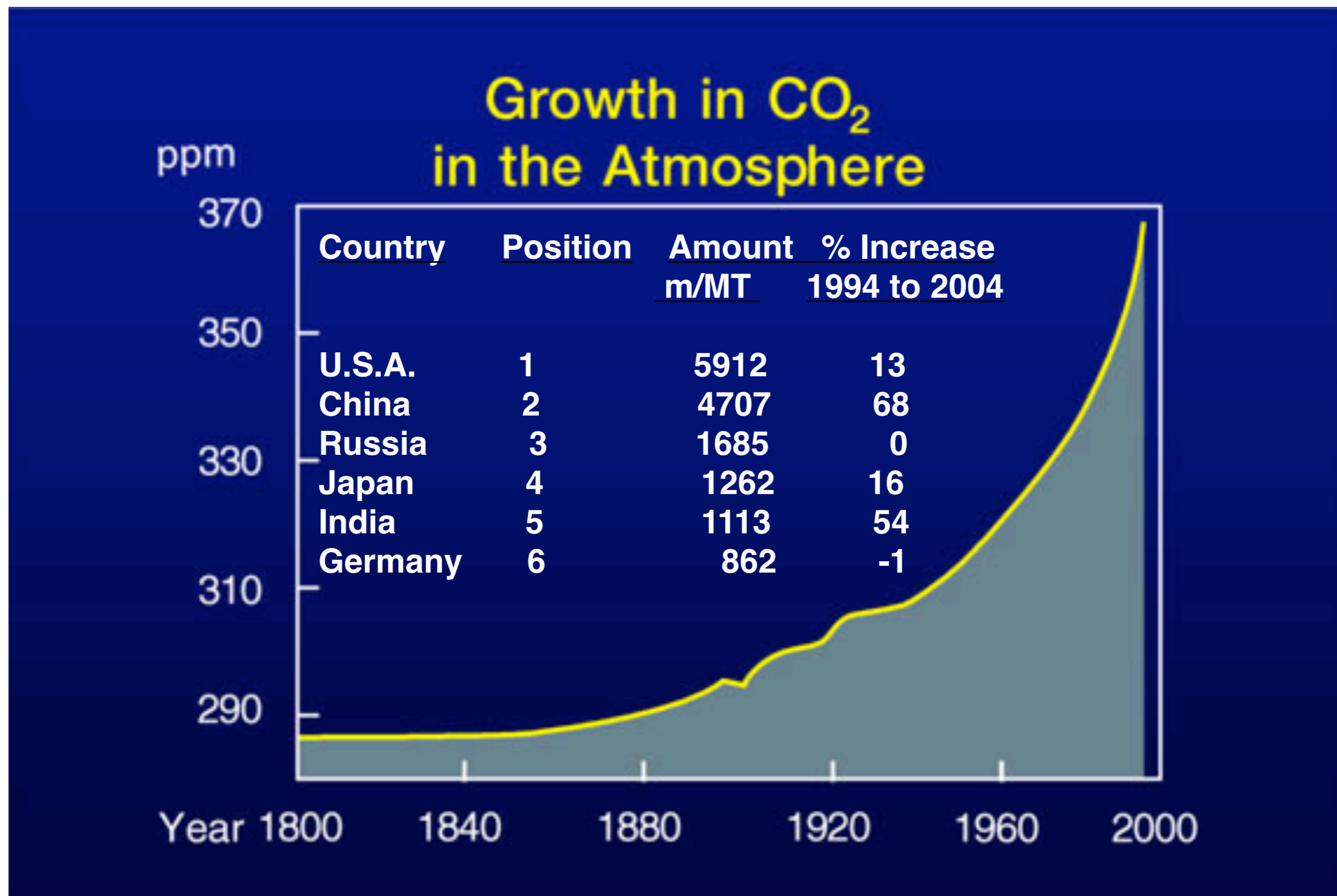
Awakening facts !

- Coal generates 41% of the world's man made CO₂ emissions
- By 2020 China will consume 34 per cent of world coal and 14 per cent of oil, surpassing United States as the world's largest energy consumer. China & India will build more than 1000 coal-fed plants within the next 5 years.
- U.S. coal mining tears up our countryside. So inexpensive, a few years ago sold at \$45 ton, that European utilities paid \$50 ton to ship it across the Atlantic.
 - Coal use has grown 27% since 2002, 3 times as fast as the use of oil.
 - Earlier U.S. Wells producing 200 bbl/day now produce 5 -10 bbl/day. In Iraq, wells were shut in if they did not produce 10,000 bbl/day!
- Total U.S. oil production peaked at 10m bbl/day in 1970 but now is about 5m bbl/day. We import 16m bbl/day.

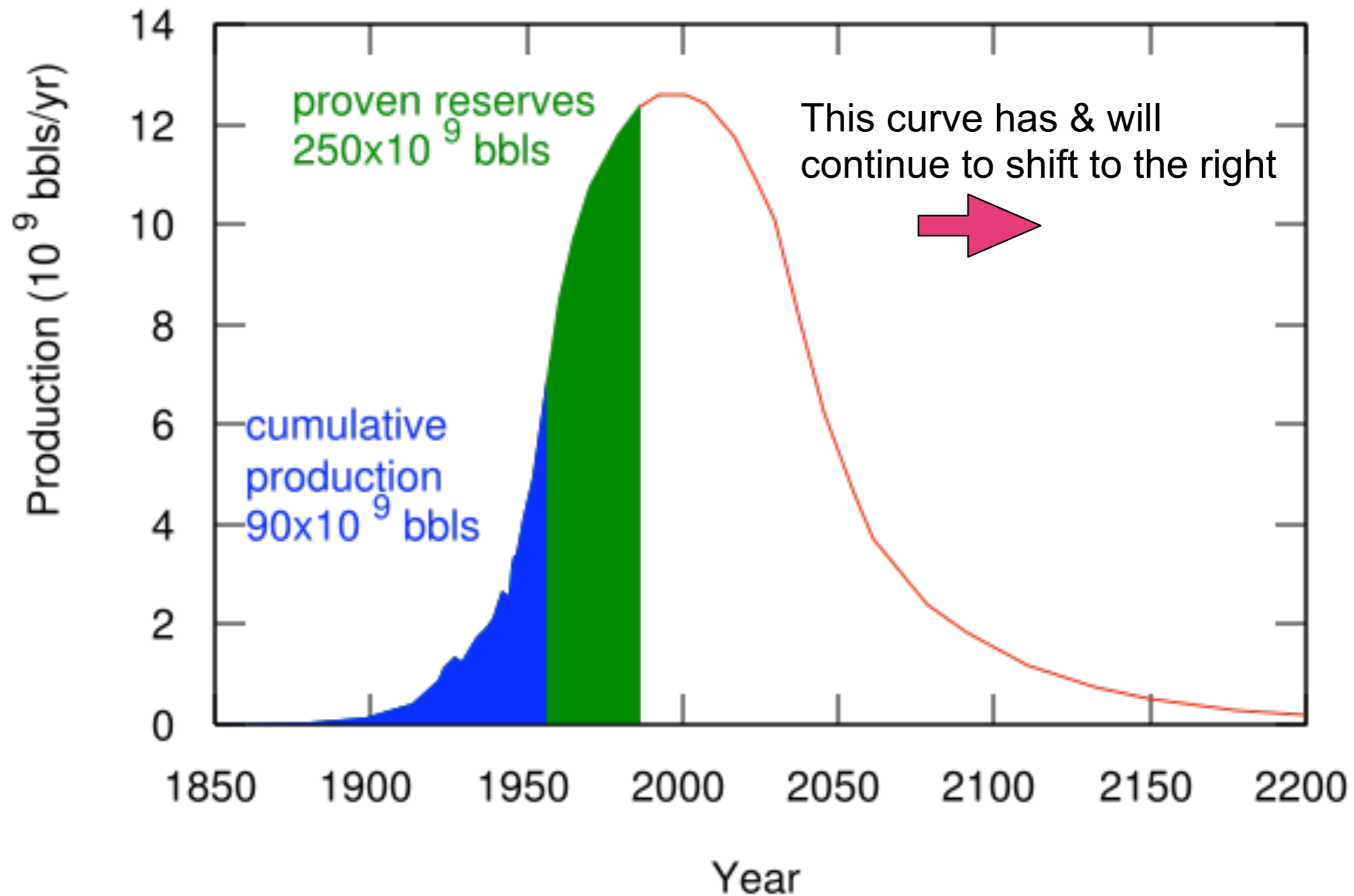
Total world production: 84m bbl/day. Demand: 85m bbl/day

Currently the U.S. consumes 21m bbl/day or 25% of the world's production with only 4.5% of the world's population!

Burning Hydrocarbons increases CO₂

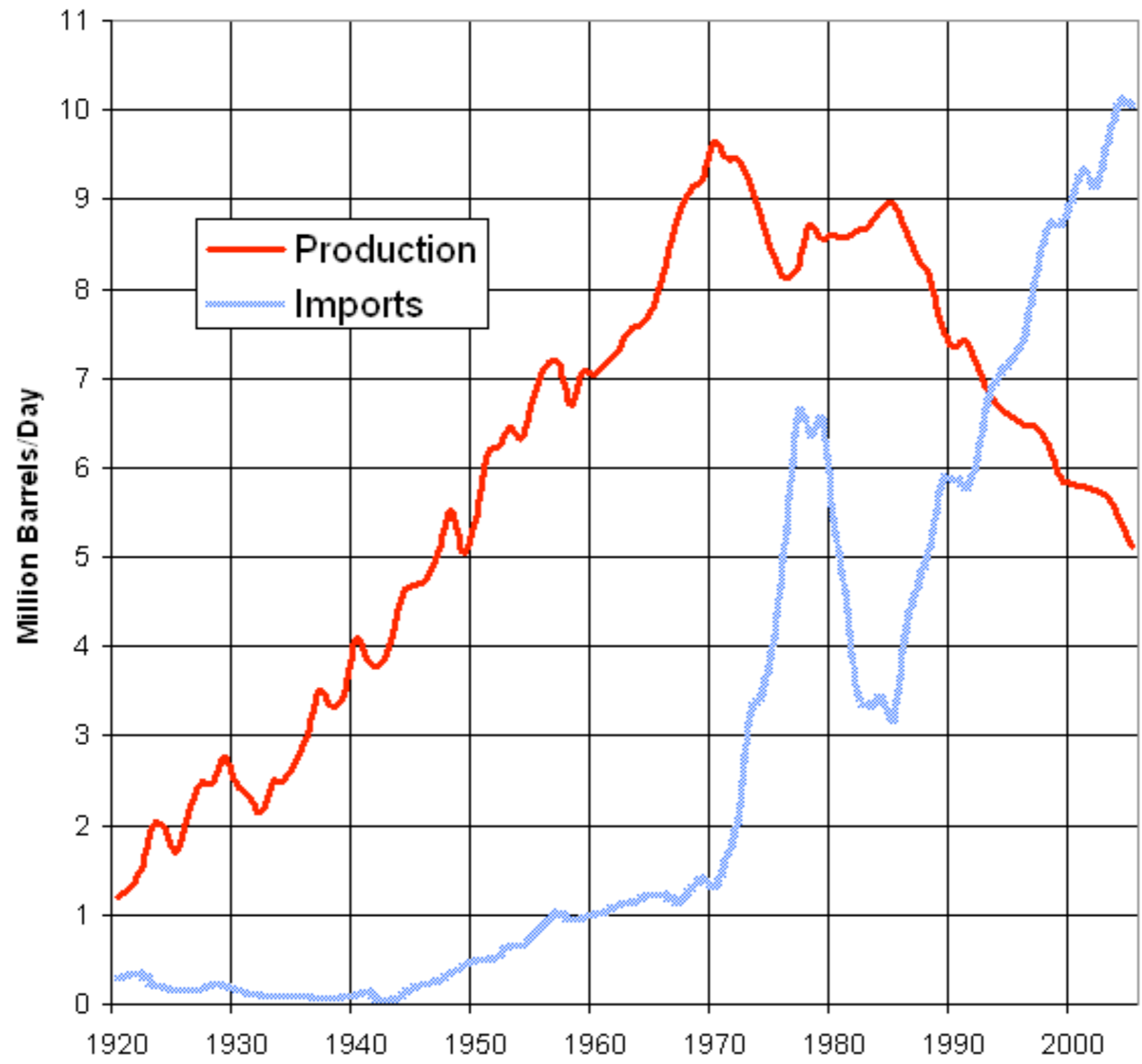


CO₂ Emissions/person/ton: USA 19.4 • Russia 11.8 • EEC 8.6 • China 5.1 • India 1.8



Utah & Colorado have 800 billion bbls of oil tied up in oil shales, 3 x that of Saudi's reserves.
1 ton of oil shale = 1 bbl of oil

US Oil Production and Imports



Share of global reserves based on current production rates

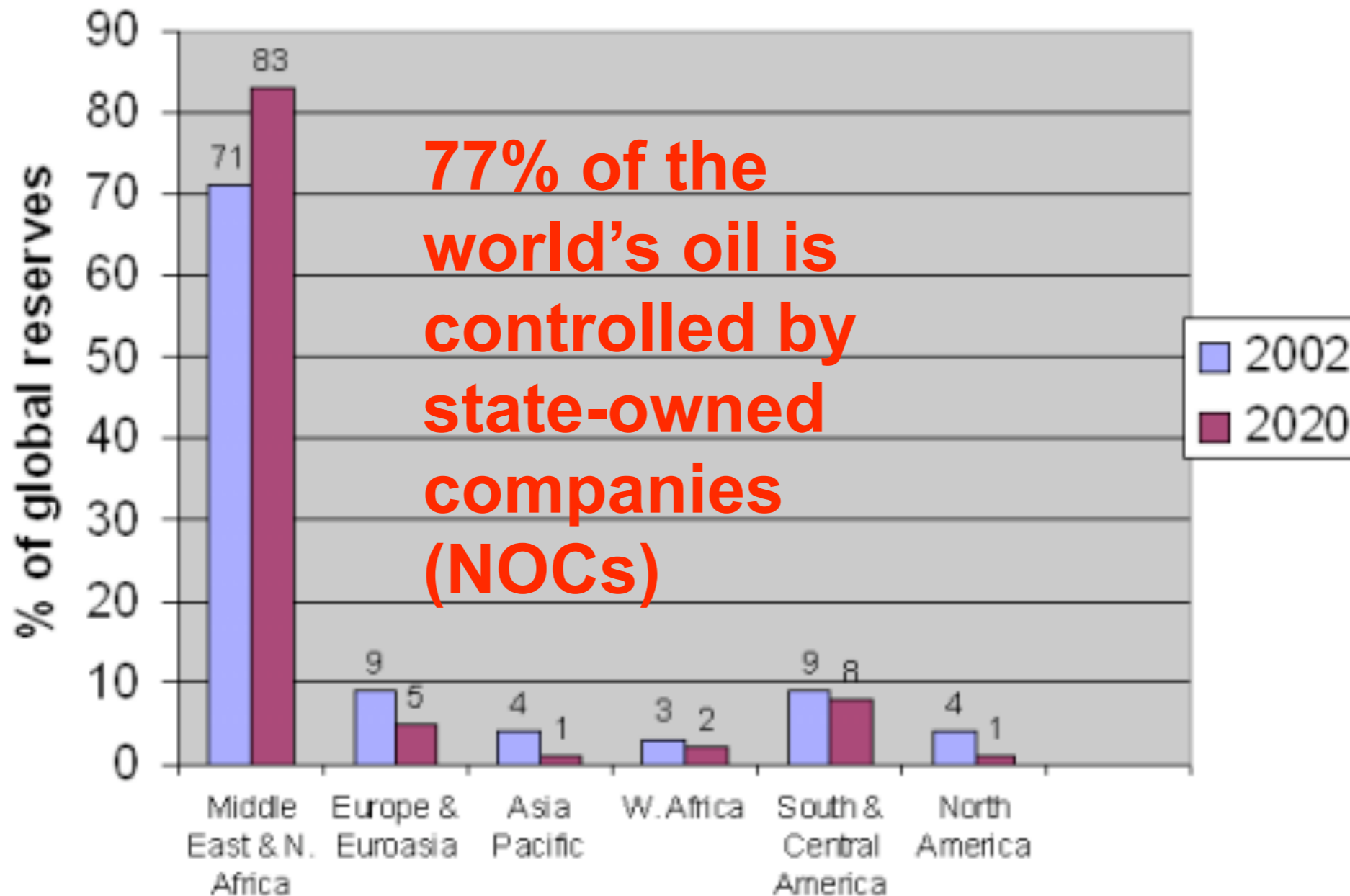
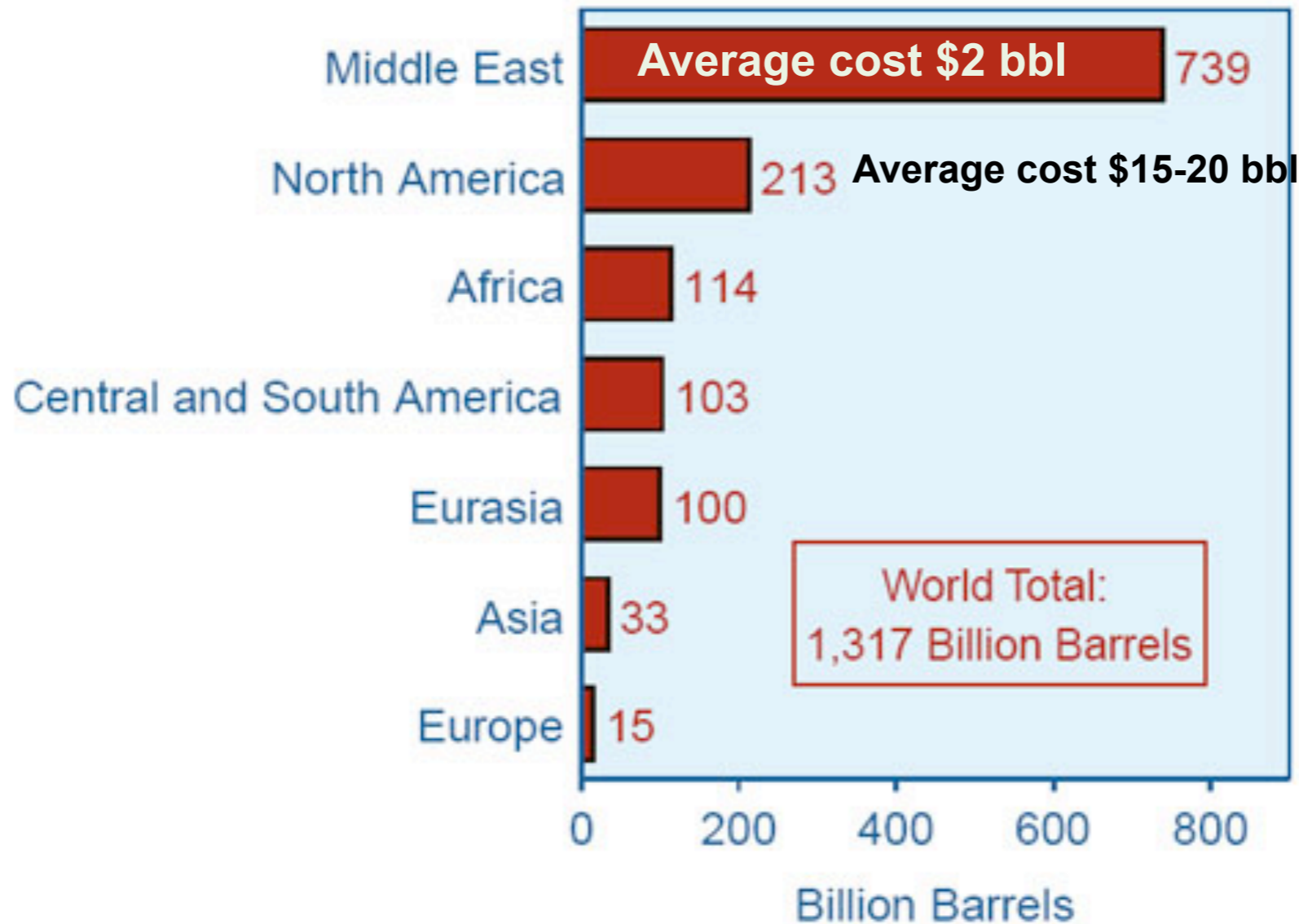


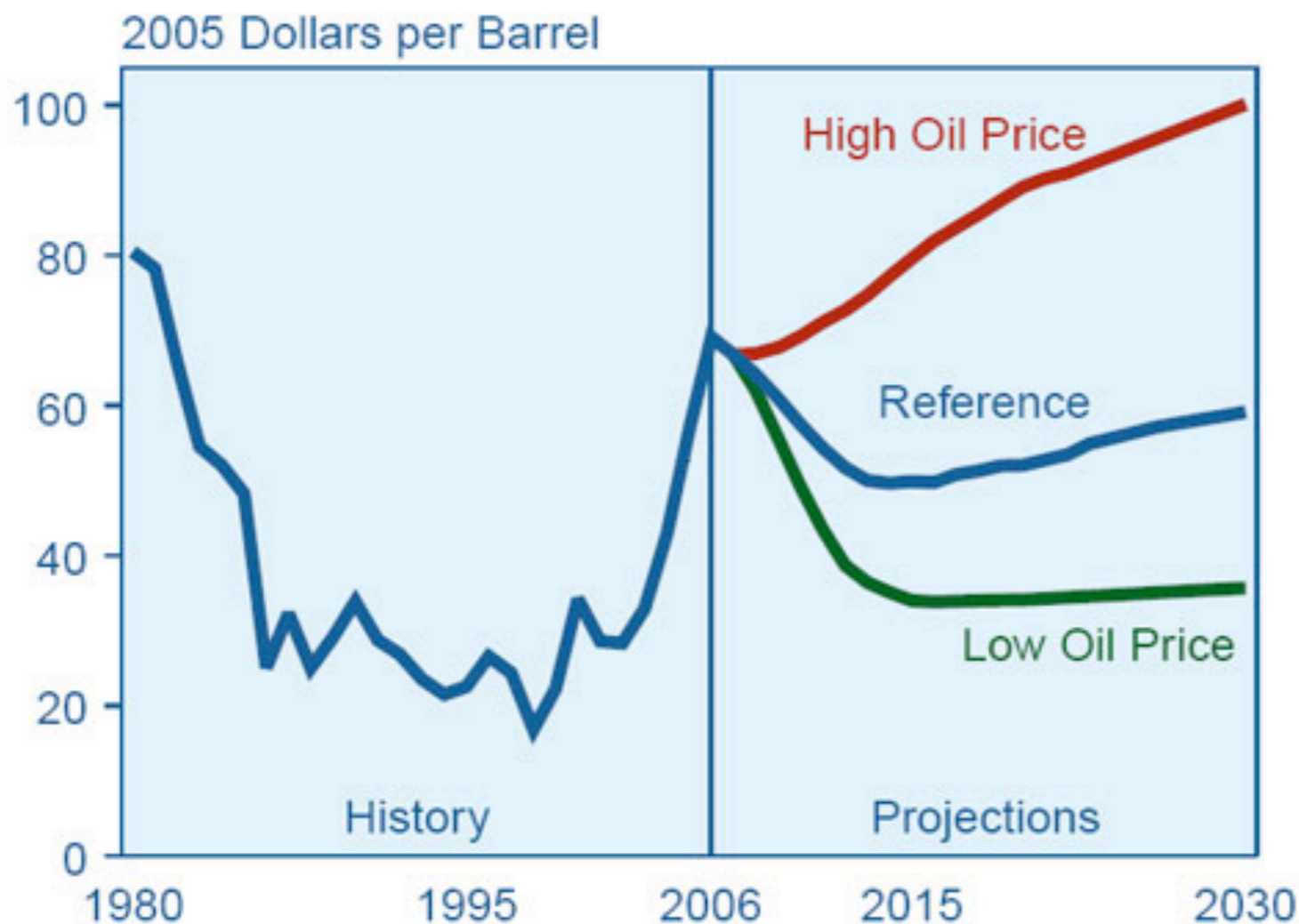
Figure 39. World Proved Oil Reserves by Geographic Region as of January 1, 2007



Middle East has 1.27 times more oil reserves than all others combined

Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 104, No. 47 (December 18, 2006), pp. 24-25.

Figure 35. World Oil Prices in Three Cases, 1980-2030



Gasoline \$ per gallon

UK:	8.56	
U.S.:	3.99	
India:	5.15	
China:	2.80	
Indonesia:	2.46	Look for major unrests when fuel subsidies ended
S. Arabia:	0.47	
Iran:	0.42	
Venezuela:	0.19	

Oil at \$130 bbl = \$3.09 gal

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2004* (May-July 2006), web site www.eia.doe.gov/iea. **Projections:** EIA, *Annual Energy Outlook 2007*, DOE/EIA-0383(2007) (Washington, DC, February 2007).

The price of oil is governed by
SUPPLY & DEMAND + POLITICS (Nationalism)
These people have a great effect on the price of oil



Mahmoud Ahmadinejad

133,300,000,000 barrels



Hugo Chavez

75,590,000,000 barrels



King Abdullah of Saudi Arabia

262,700,000,000 barrels



Dick Cheney & George W. Bush

22,450,000,000 barrels



Nuri al-Maliki

Iraq 112,500,000,000



Vladimir Putin

69,000,000,000 barrels

6/08 Mbb/D: OPEC 35.43 Total Supply: 84.59 Total Demand: 85.35 US demand: 20.78



**But...If you really want to know what the price of oil will be,
look into the crystal ball**

ENERGY PRODUCTION

HYDROCARBONS: Oil, gas, coal, biogases, biofuels, etc., are very dirty. Resources not sustainable nor carbon neutral. Major sources of greenhouse gases.

HYDRO: Very green - proven constant energy, relatively cheap but costly to build & changes the ecosystem.

NUCLEAR: Cheap green energy, however, extremely costly & time-consuming to build - radiation leaks & waste disposals major problems. A switch from nuclear fission to fusion is a dream to be fulfilled. 440 Plants = 12,000 tons radioactive waste

For 1kg: firewood = 1 kwh, coal = 3 kwh, oil = 3 kwh uranium = 50,000 kwh

WIND: Very green but not constant - noisy, an eyesore, not eco-friendly. Great innovations could be made.

SOLAR: Very green but not constant. Expensive & takes up a lot of surface area. Long time to pay off & break even. Major breakthroughs forthcoming. Major advantage is conversion from sun direct to electricity, bypassing turbines & generators

GEOHERMAL & GEOEXCHANGE:

Wind Turbines - New Designs!

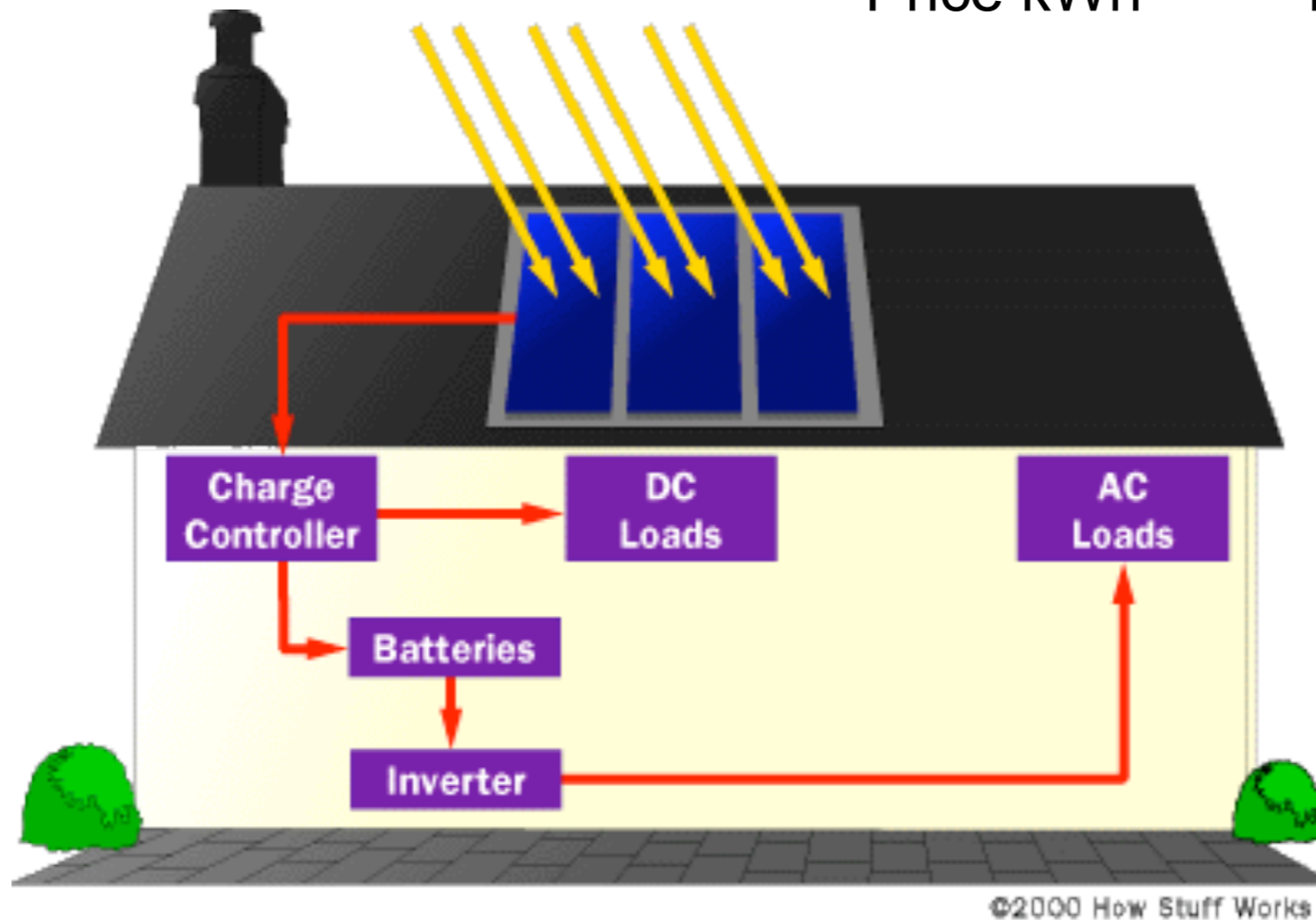


The Quietrevolution QR5 is an innovative new wind turbine designed to work well in the urban environment, where wind directions change frequently and quiet, vibration free operation is critical.

More efficient cells on the drawing board

Solar Cells

	<u>2007</u>	<u>2050</u>
Efficiency %	10	14
Installed cost	\$4/w	\$1.20/W
Price kWh	16¢	5¢



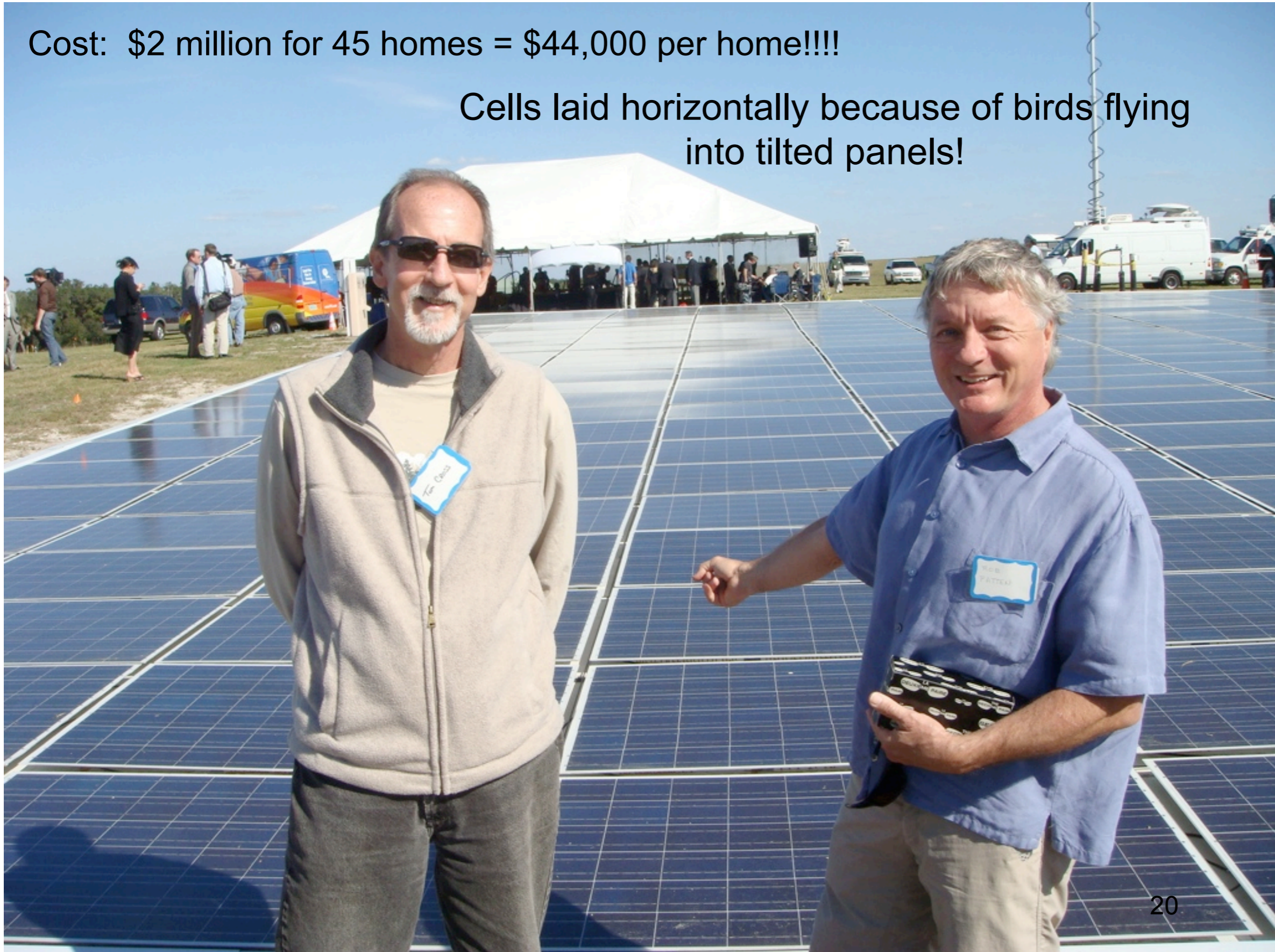
New plastic "could allow up to 30 % of the sun's radiant energy to be harnessed, compared to 6 % in today's best plastic solar cells," The plastic material uses nanotechnology and contains the first solar cells able to harness the sun's invisible, infrared rays. The breakthrough has led theorists to predict that plastic solar cells could one day become five times more efficient than current solar cell technology.

Borrowing the balance at today's interest rates would mean repayments of roughly \$600 a month for ten years, even after setting the interest charges against tax. And all that just to feel good about saving \$75 of electricity a month. Better to buy a couple of tons worth of carbon offsets each year for \$70 and have done with it.

Rob Patton (right & responsible for the construction of FPL's Solar Park)
at Governor Crist's opening of the Park on February 11, 2008

Cost: \$2 million for 45 homes = \$44,000 per home!!!!

Cells laid horizontally because of birds flying
into tilted panels!



SOLAR THERMAL: 12 to 14 cents per KW hour



A solar thermal power plant, located south of Las Vegas

It is not the kind that features shiny panels bolted to the roofs of houses. This type involves covering acres of desert with mirrors that focus intense sunlight on a fluid, heating it enough to make steam. The steam turns a turbine and generates electricity.



On sunny afternoons, those 10 plants would produce as much electricity as three nuclear reactors, but they can be built in as little as two years, compared with a decade or longer for a nuclear plant. Some of the new plants will feature systems that allow them to store heat and generate electricity for hours after sunset.

Geothermal

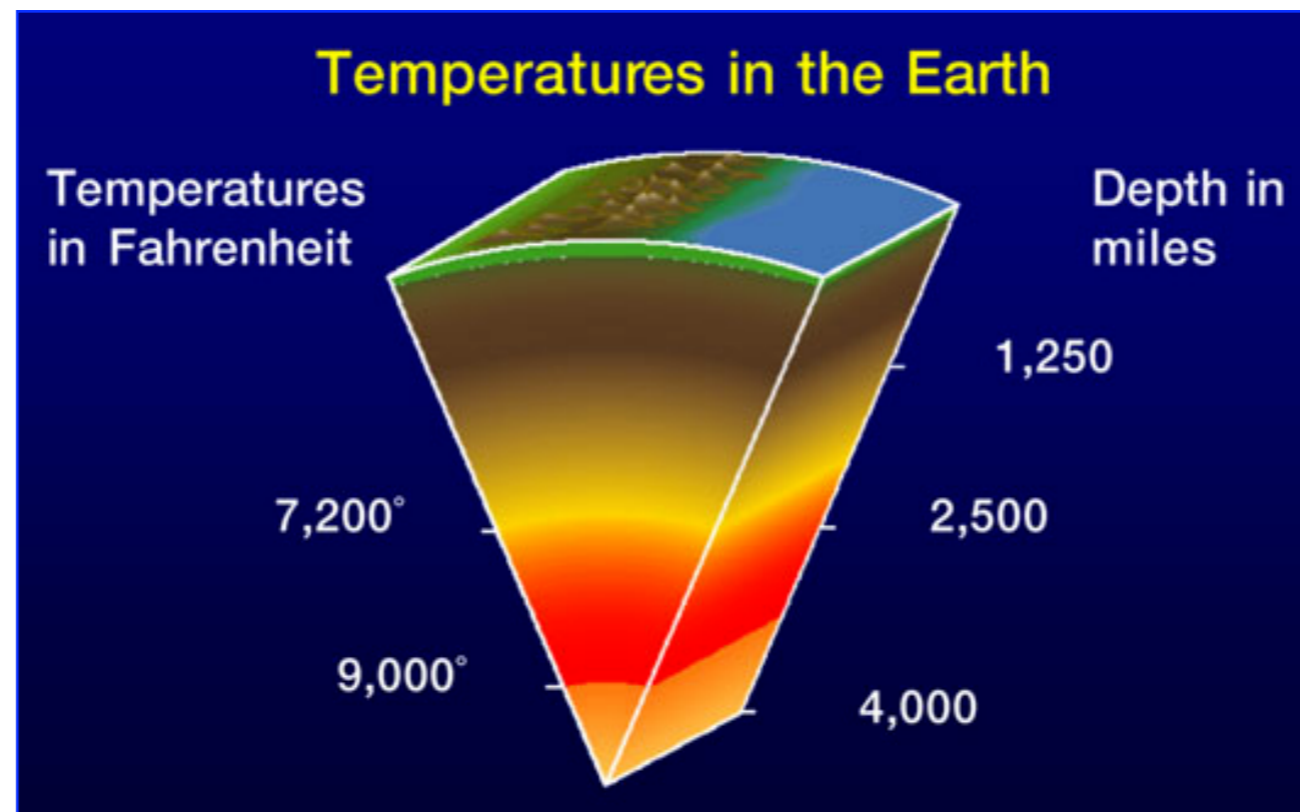
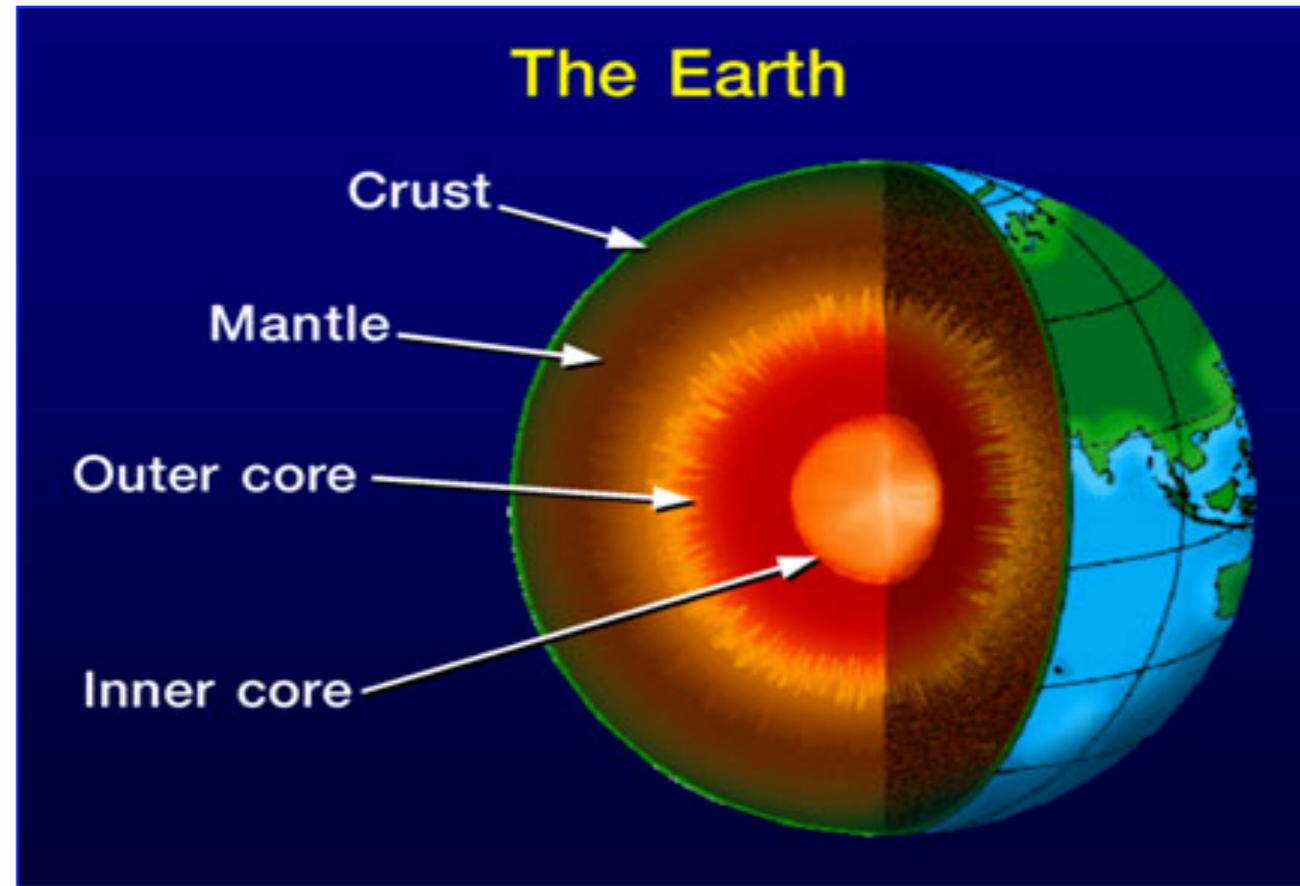
All the energy we would ever need lies
within 10 km of where we stand -
STRAIGHT DOWN

Earth is a **HOT PLANET**
heat increases with depth - this is
called the

GEO THERMAL GRADIENT

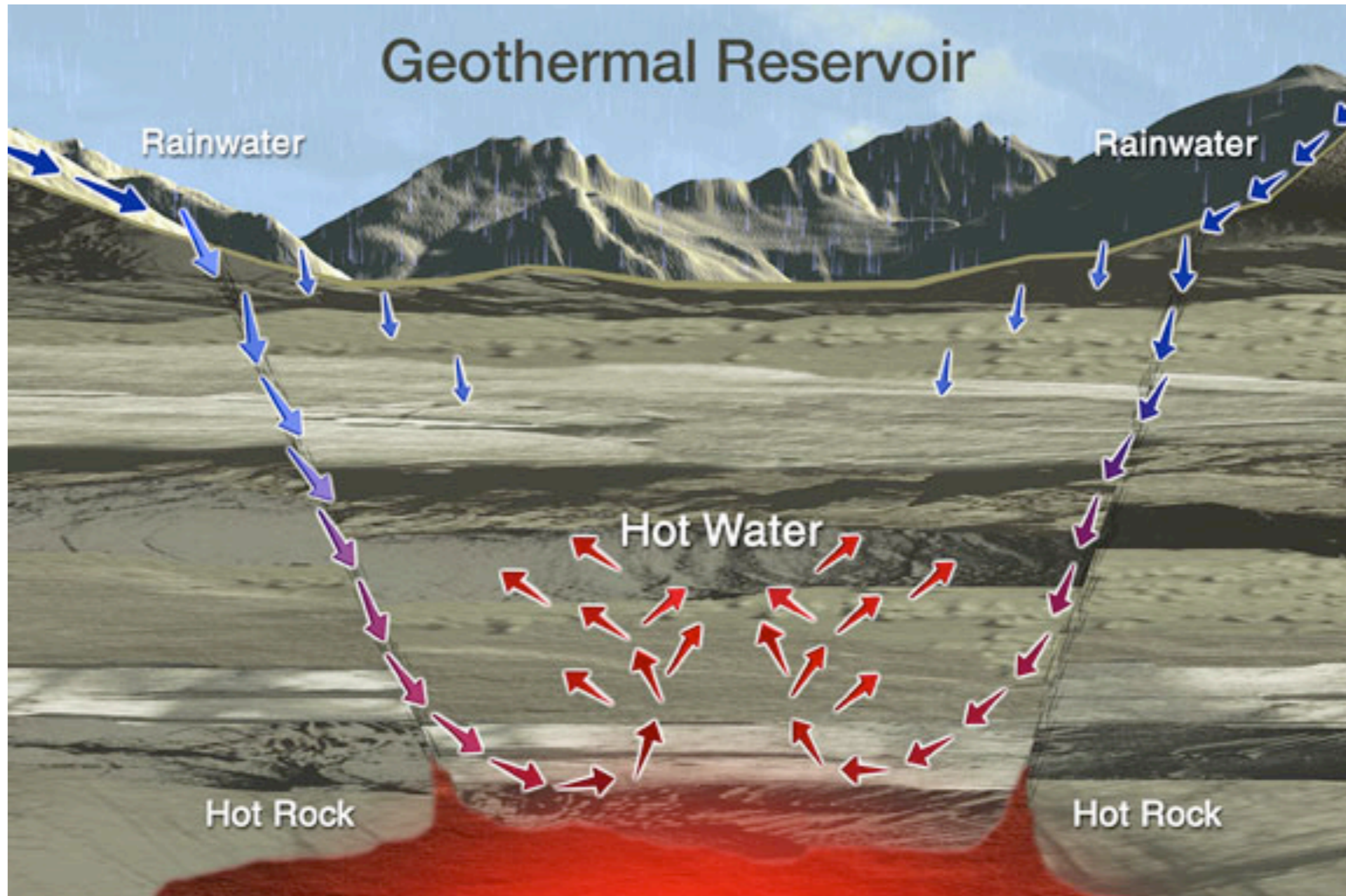
Mining earth's heat

Geothermal Energy from Earths' Heat



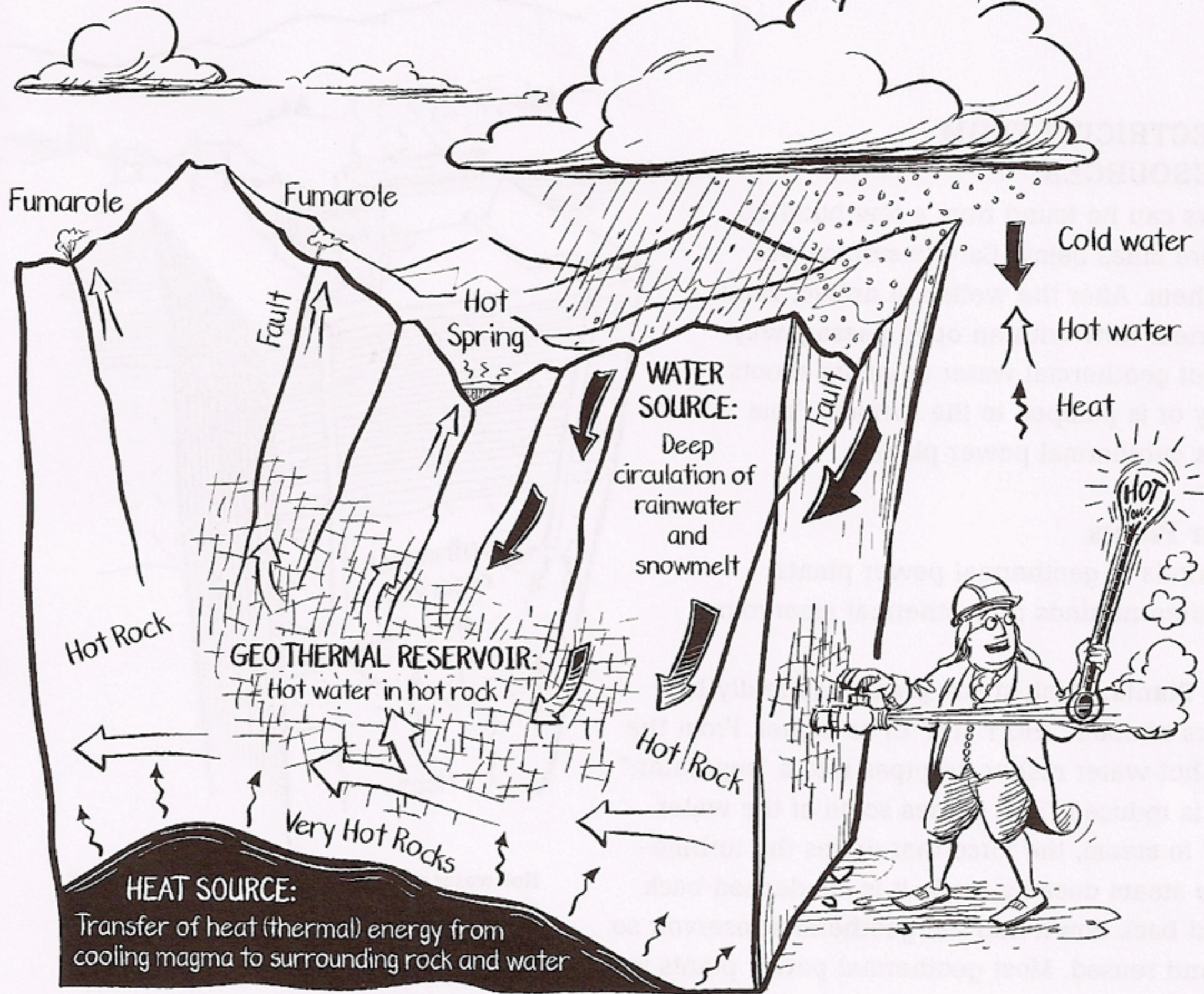
An idealist geothermal reservoir

(Chevron's TV ad is misleading)



When the rising hot water and steam is trapped in permeable and porous rocks under a layer of impermeable rock, it can form a geothermal reservoir.

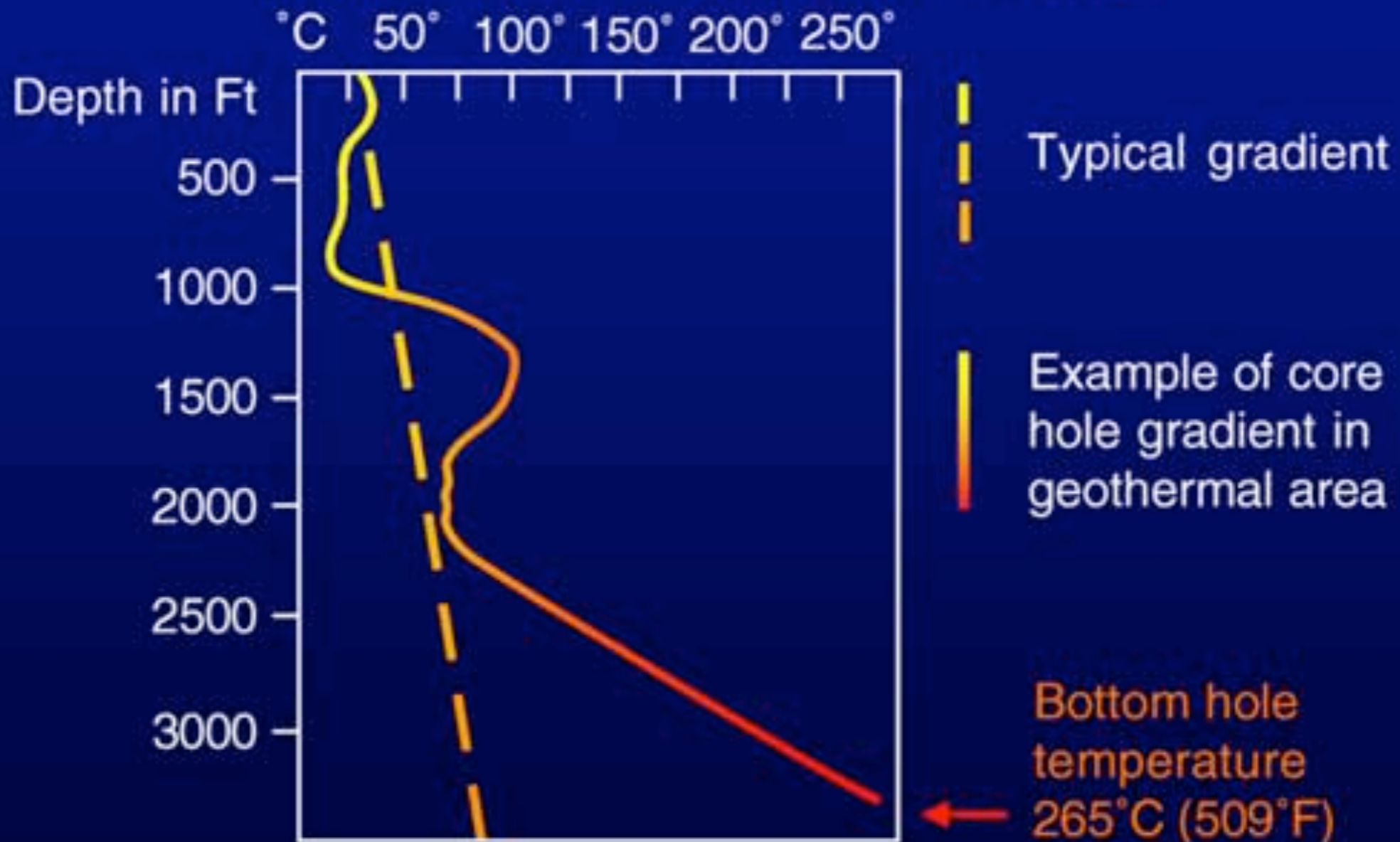
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A geothermal reservoir is a large underground area of hot permeable rock saturated with superheated water.

Temperature results like this would definitely encourage the drilling of a larger, deeper well to try to find a hydrothermal reservoir.

Temperature Gradient Data



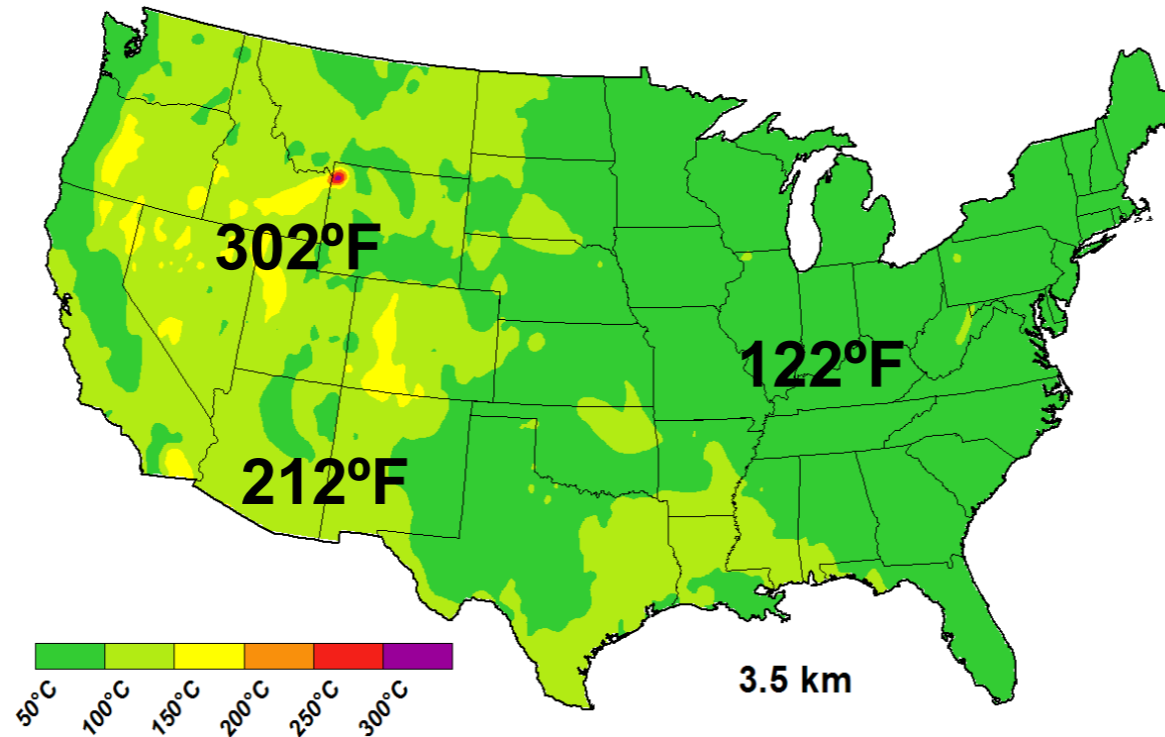
SMU Geothermal Lab Temperature Maps

Temperatures at depth

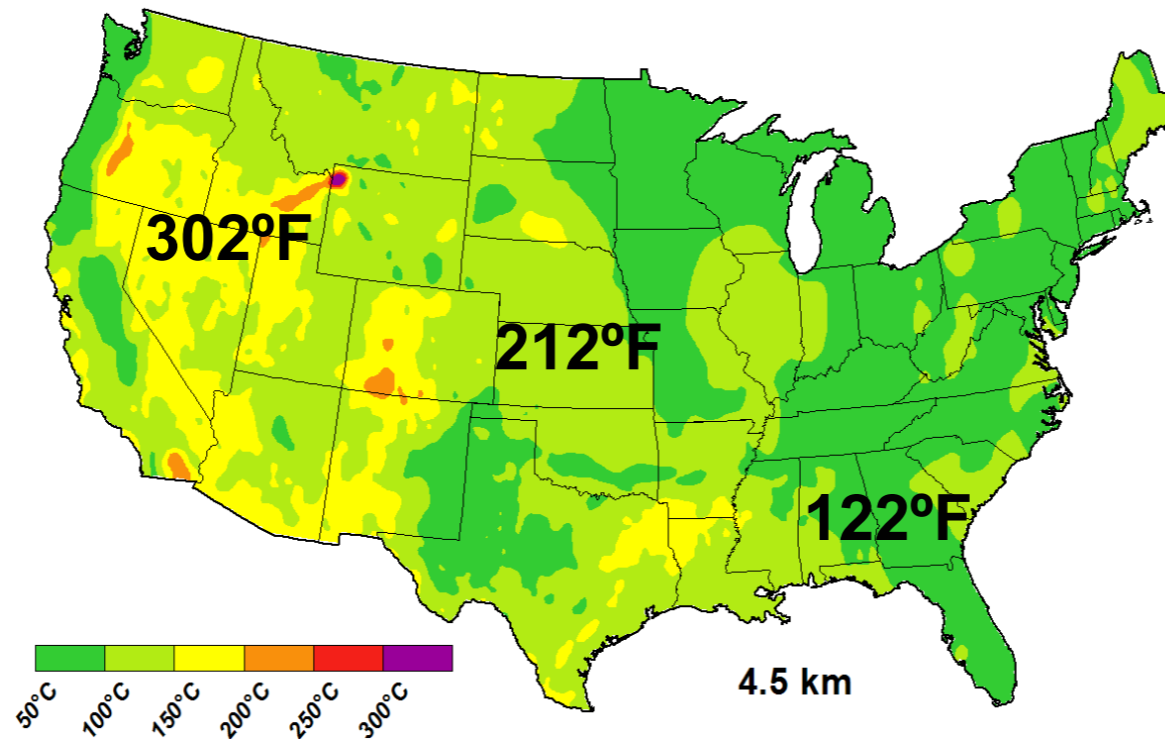
Borrowed/stolen by Mario Messina

SMU Geothermal Lab Temperature Maps for Depth 3.5 - 10 km.

C° to F°
50 = 122
100 = 212
150 = 302
200 = 392
250 = 482
300 = 572



11,500 ft
3.5 km



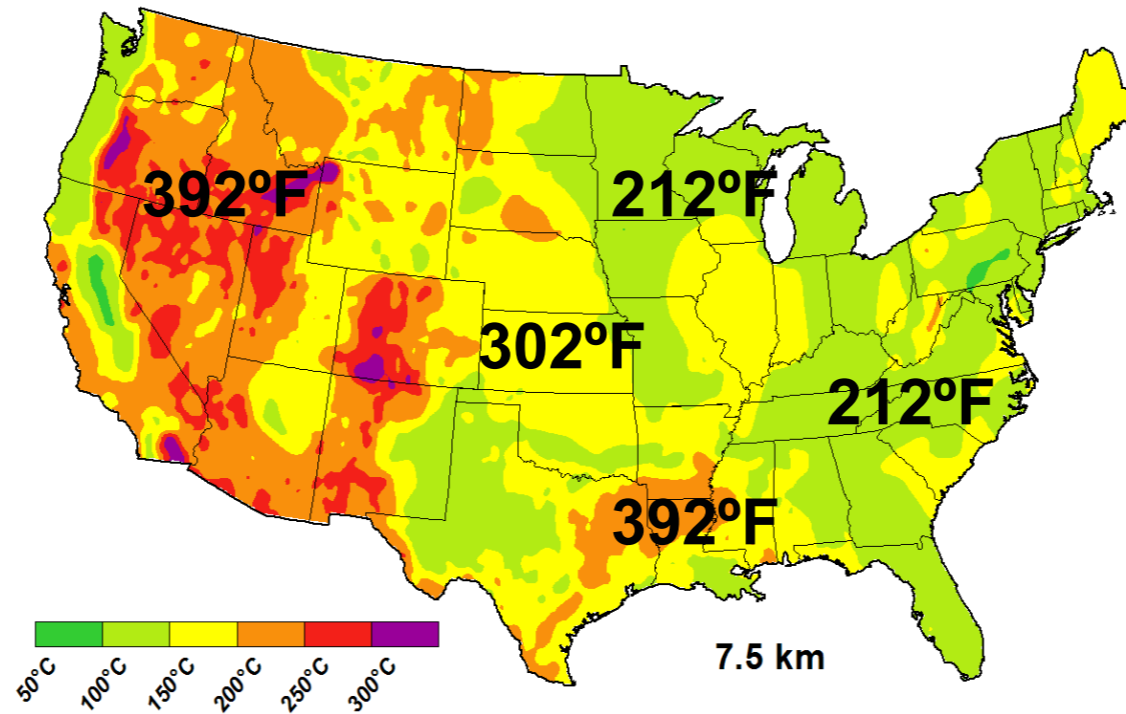
14,700 ft
4.5 km

SMU Geothermal Lab Temperature Maps

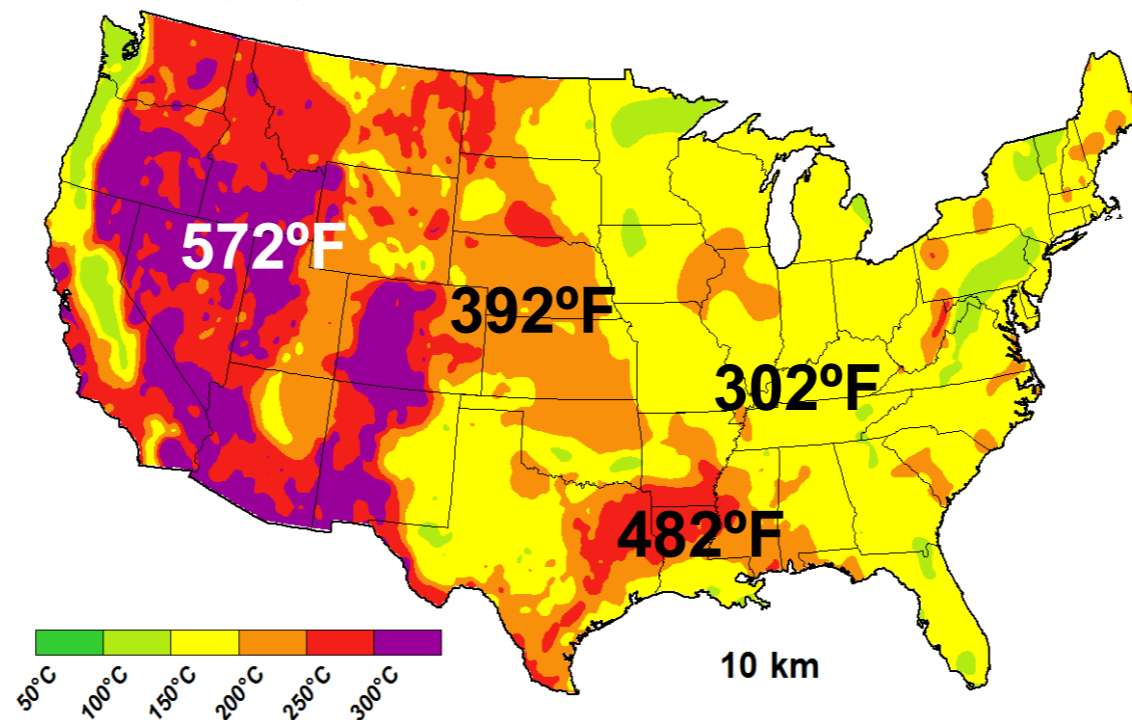
Temperatures at Depth

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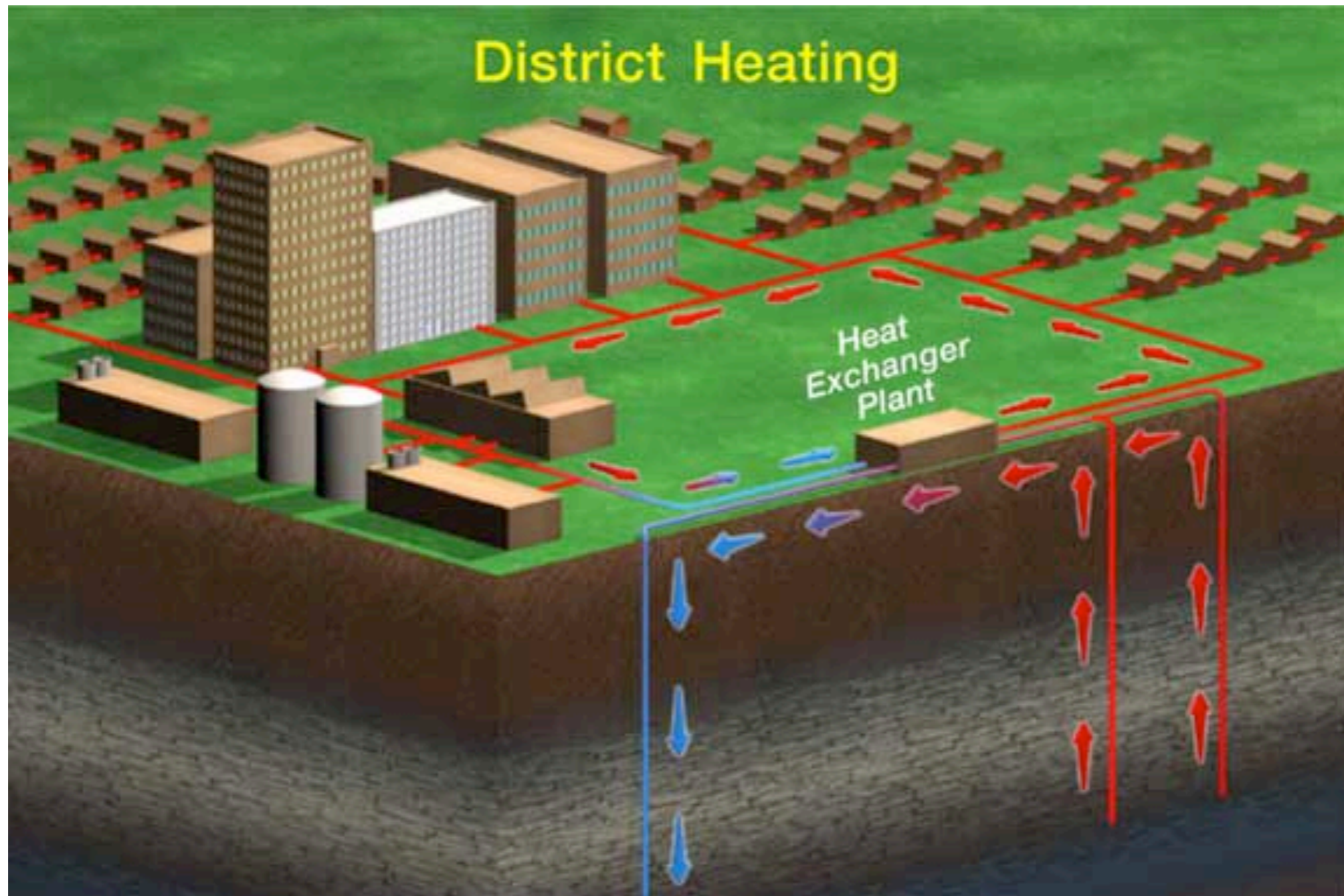
C° to F°
50 = 122
100 = 212
150 = 302
200 = 392
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300 = 572



24,600 ft
7.5 km



32,800 ft
10 km



Hot water from one or more geothermal wells is piped through a heat exchanger plant to heat city water in separate pipes. Hot city water is piped to heat exchangers in buildings to warm the air.

Excellent Website: Ormat Technologies, Inc.

Energy Production - Geothermal

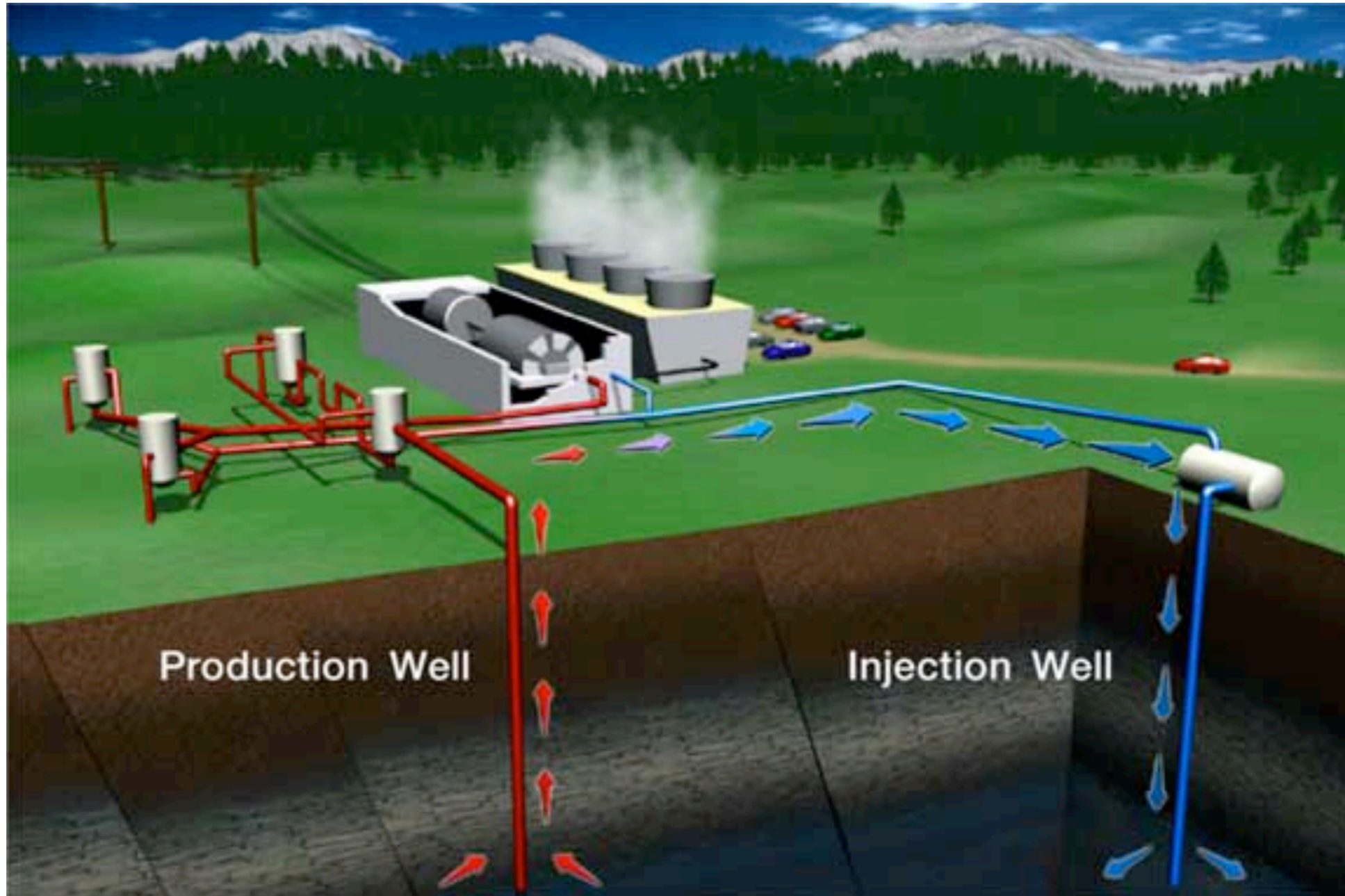
Production-sized wells require large drill rigs like these. Geothermal wells can be drilled many miles deep. Some oil wells are now being drilled to over 7 miles!



- Rigs running in the U.S. 1901 total: 79% gas, & 21% oil
 - International: 1,260
- Most drilling for oil & gas - could be utilized to drill geothermal
 - JOBS to be gained, not lost.

Geothermal Energy Production

Water injected into hot reservoir to produce super heated water then to steam



Natural steam from the production wells power the turbine generator. The steam is condensed by evaporation in the cooling tower and pumped down an injection well to sustain production. 31

A working Geothermal site in Mexico

CFE is a Mexican utility company that provides services of generation, transmission and distribution of electrical power services to 25.1 million customers, nearly 80 million Mexicans. Messina Inc. provides drilling mud products.



Messina Inc. provides drilling fluid products to this operation

MEXICALI



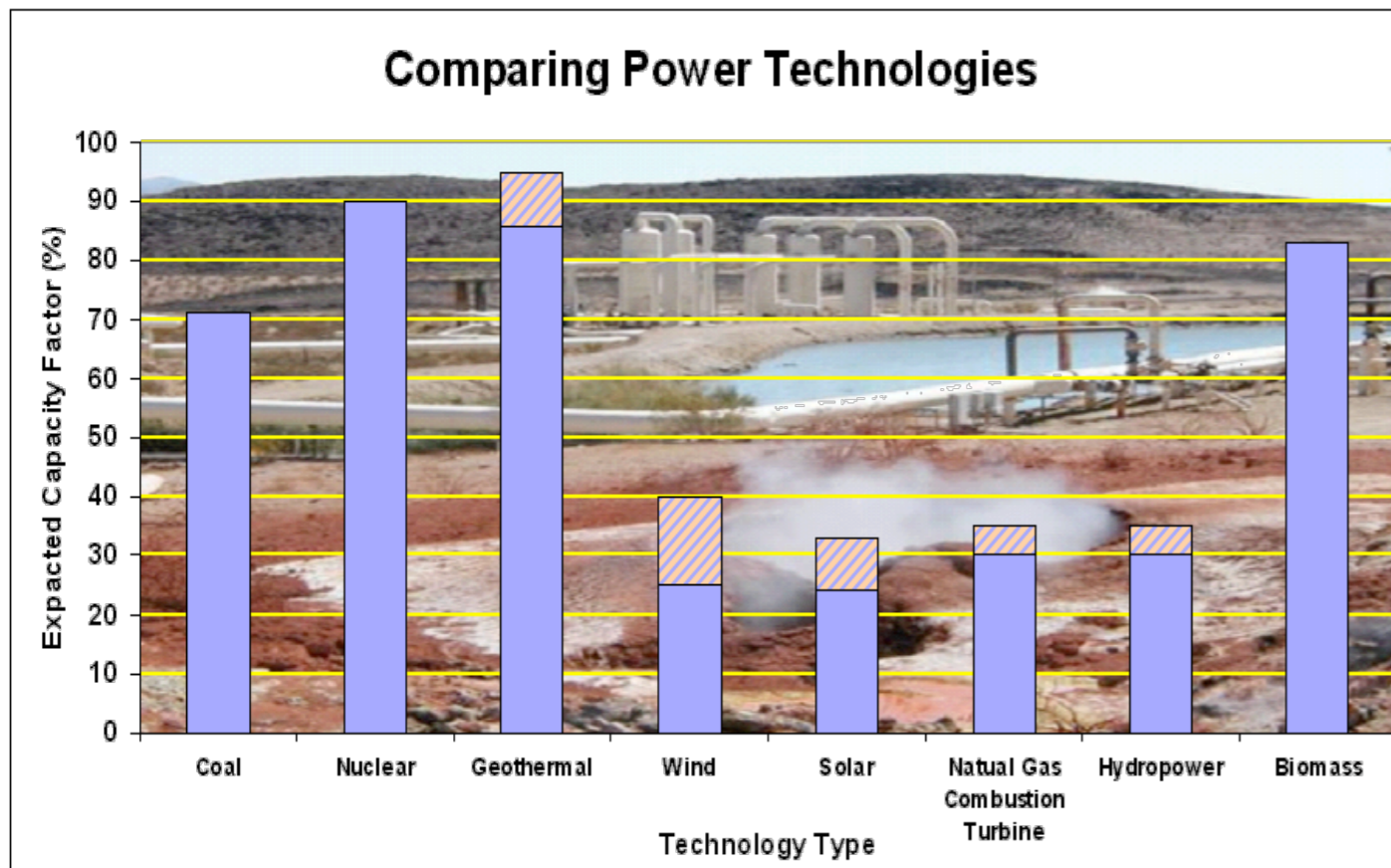
Geothermal Energy Importance

Electric Generation

Comparing Power Technologies	
Technology	Expected Capacity Factor (%)
Coal	71
Nuclear	90
Geothermal	86 - 95
Wind	25 - 40
Solar	24 - 33
Natural Gas Combustion Turbine	30 - 35
Hydropower	30 - 35
Biomass	83

◆ **A major importance of geothermal power production is that it has a high capacity factor.**

The **capacity factor** of a [power plant](#) is the ratio of the actual output of a power plant over a period of time and its output if it had operated a full capacity of that time period



◆ **Thus geothermal impacts base load electrical demand.**

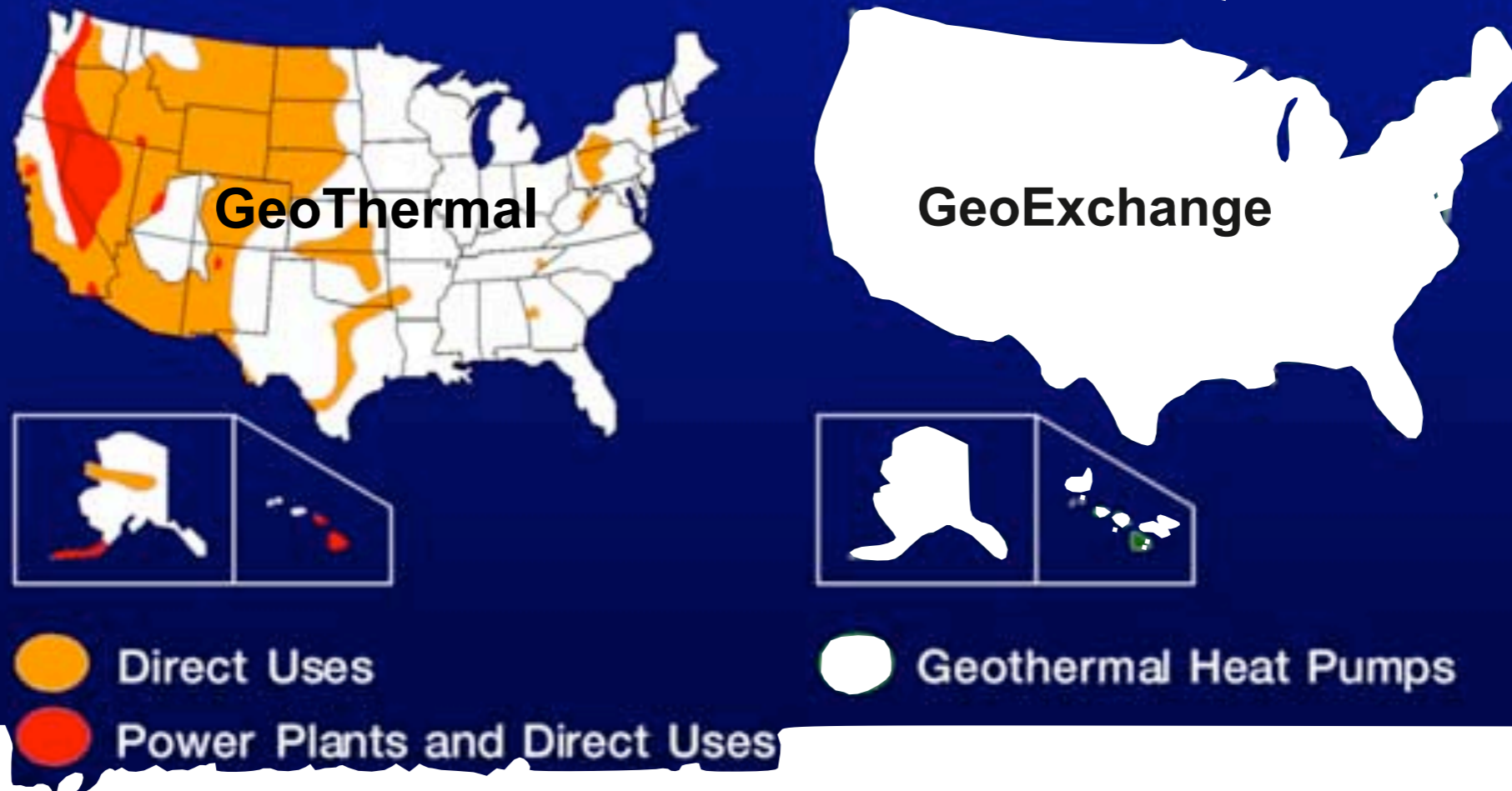
Benefits of Geothermal Power

- Clean and safe energy - using little land
- Renewable and sustainable
- Continuous, reliable “baseload” power
- Conserves fossil fuels & contributes to diversity of energy sources
- Avoids importing fossil fuels & benefits local communities
- Offers modular, incremental development & village power to remote sites

Geothermal power has many local & global benefits

Recommended Websites available

U.S. Geothermal Potential



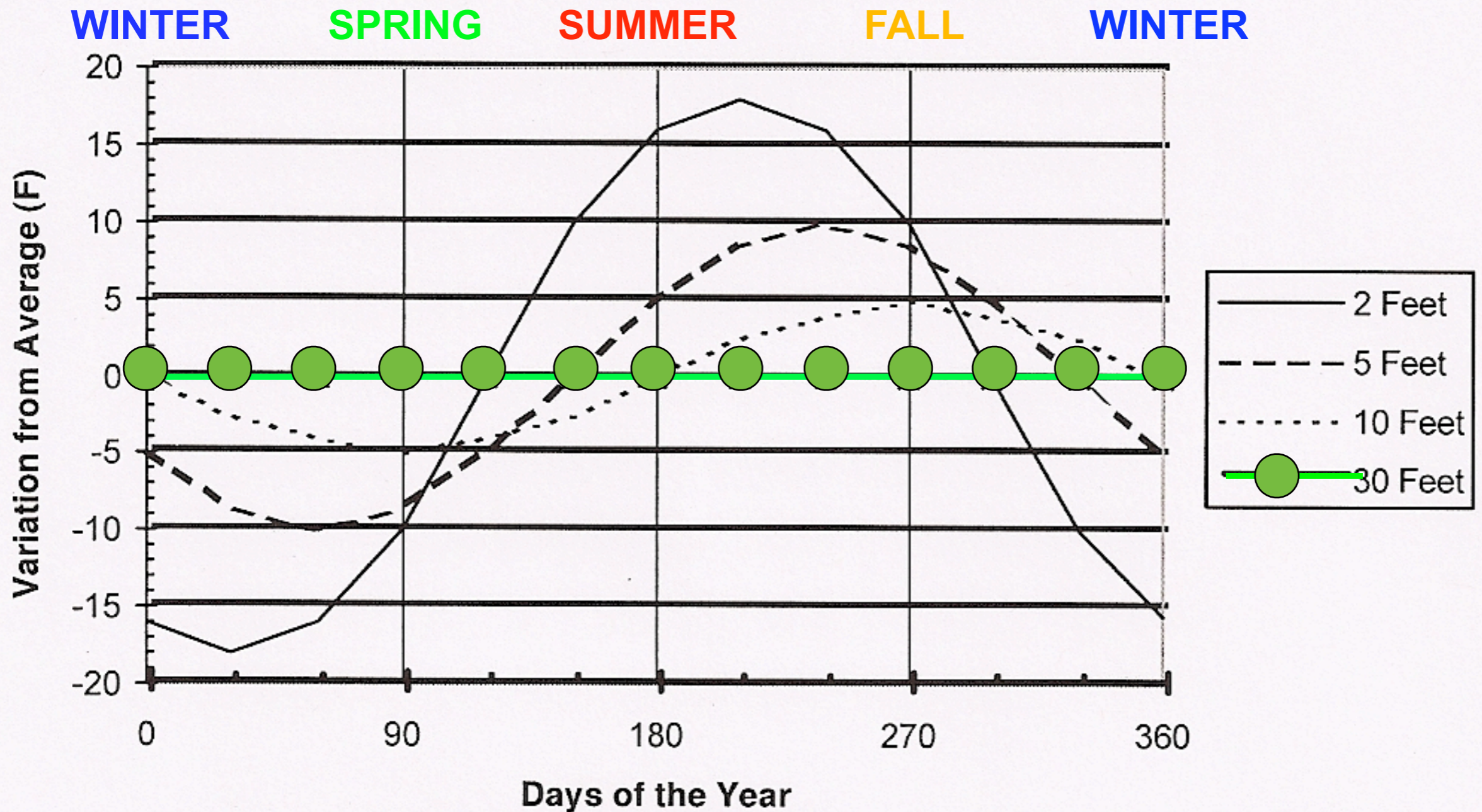
www.Geoexchange.org

The entire U.S. (and most other areas of the world) are suitable for geothermal heat pumps (Geo-Exchange systems). In the U.S., geothermal reservoirs occur primarily in western states.

GeoExchange

Ground Temperature Variation in Average Soil with Depth & Season

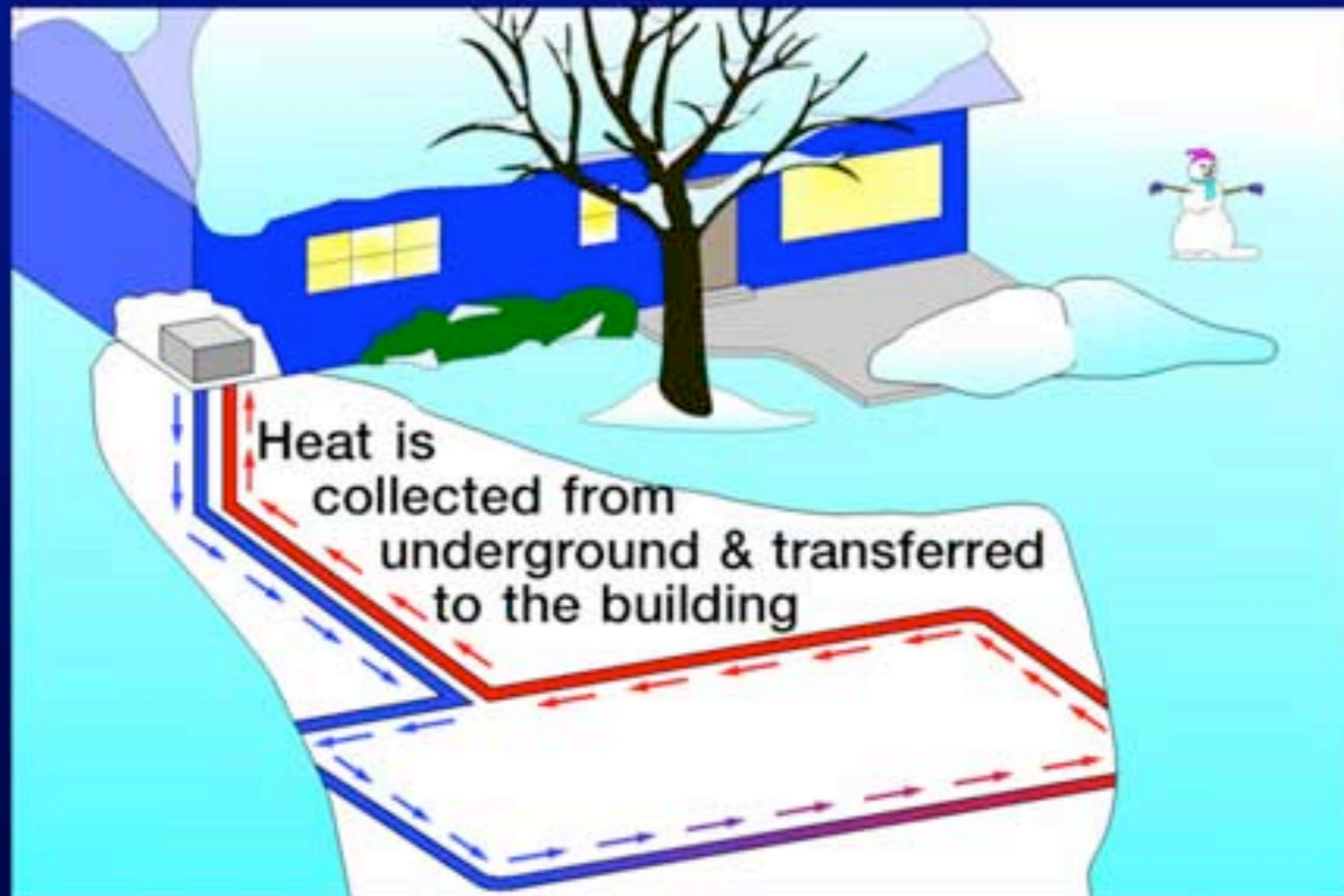
Annual Ground Temperature Swing (F)



Shallow Ground Temp. = Deep Ground Temp. + Swing

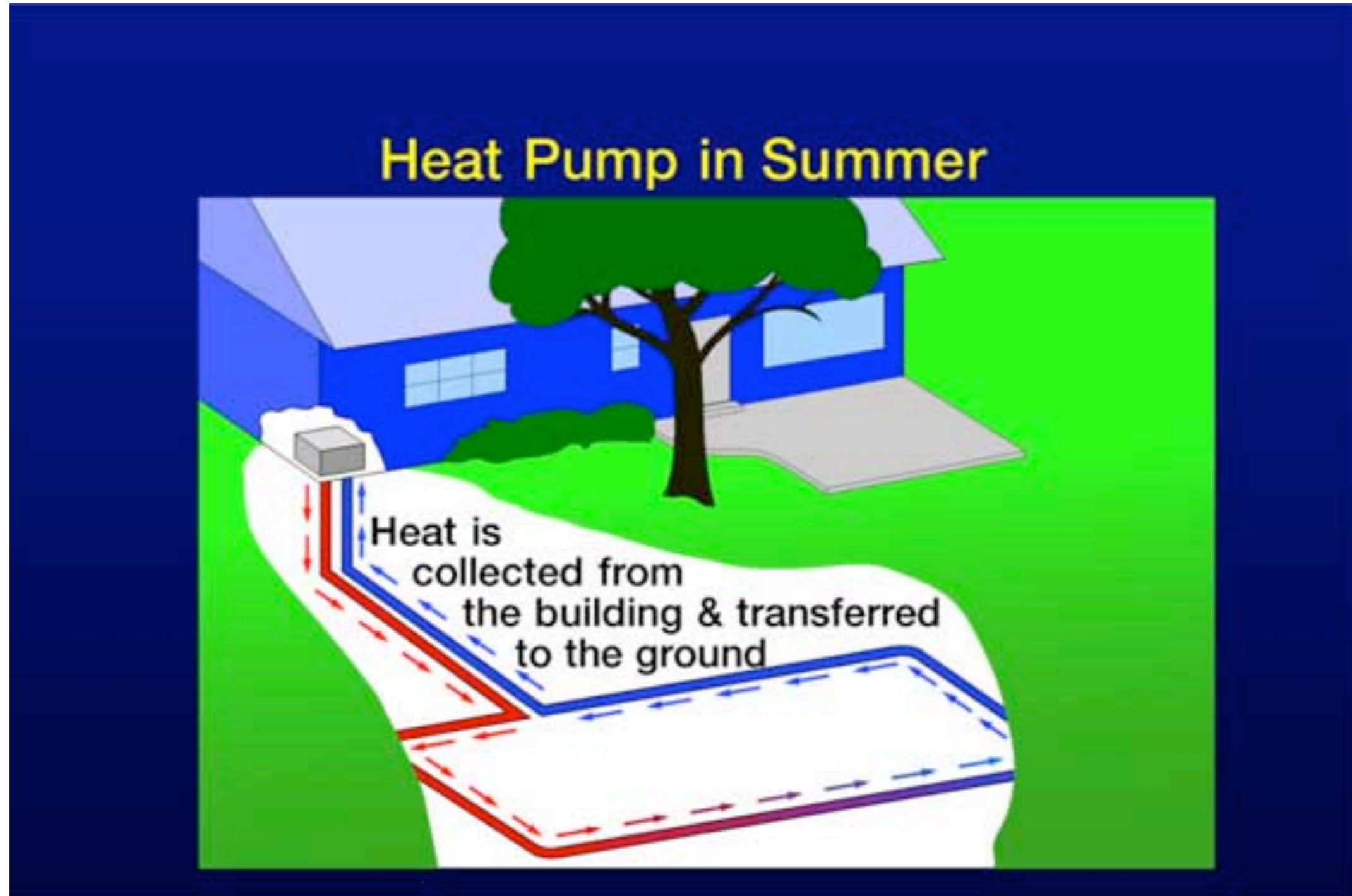
GeoExchange - how it works

Heat Pump in Winter

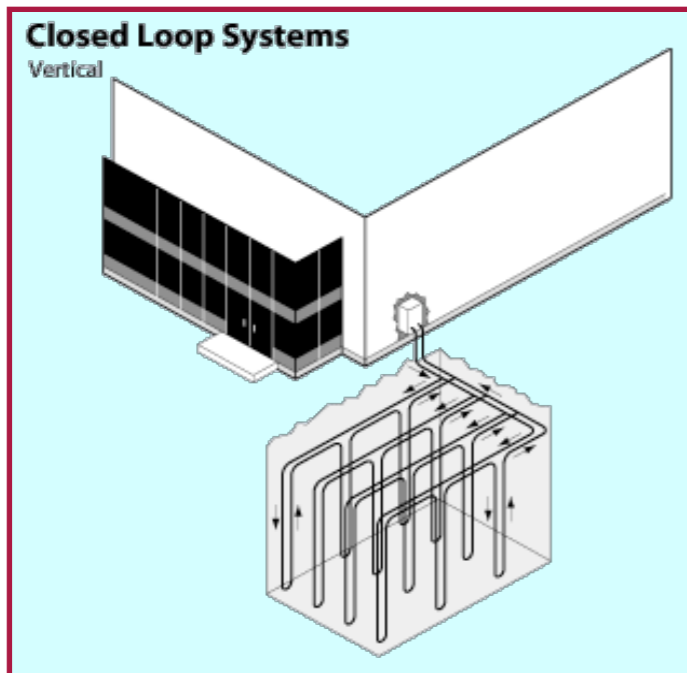


Exchanges heat with the earth rather than the outdoor air

GeoExchange - how it works



Utilizing GeoExchange

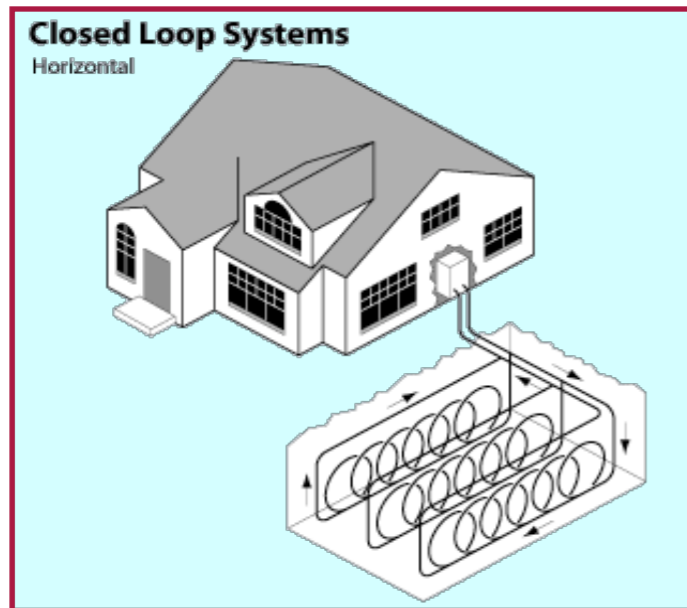
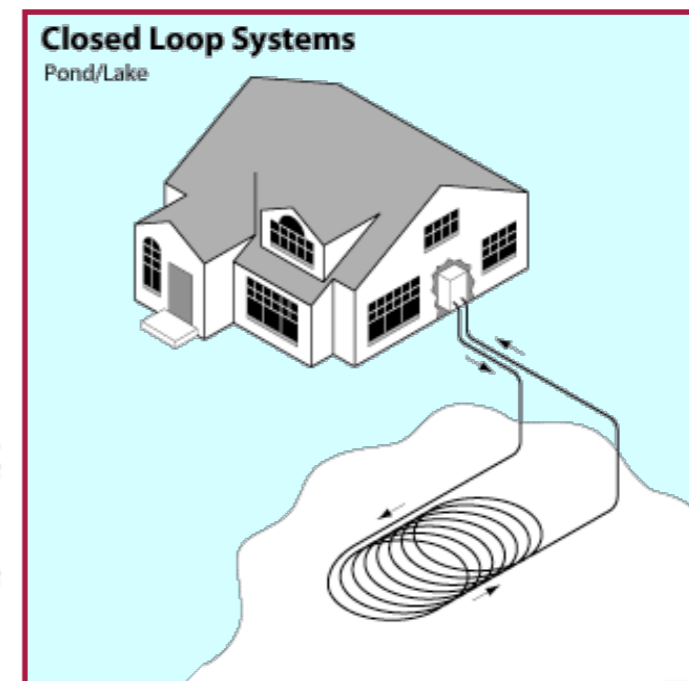


Vertical System

Depth of 100 to 300 feet / ton. Ideally suited when available land area is limited.

Pond or Open-Water Loop

Utilizes a nearby body of water such as a pond, lake, or river in place of subsurface environment.

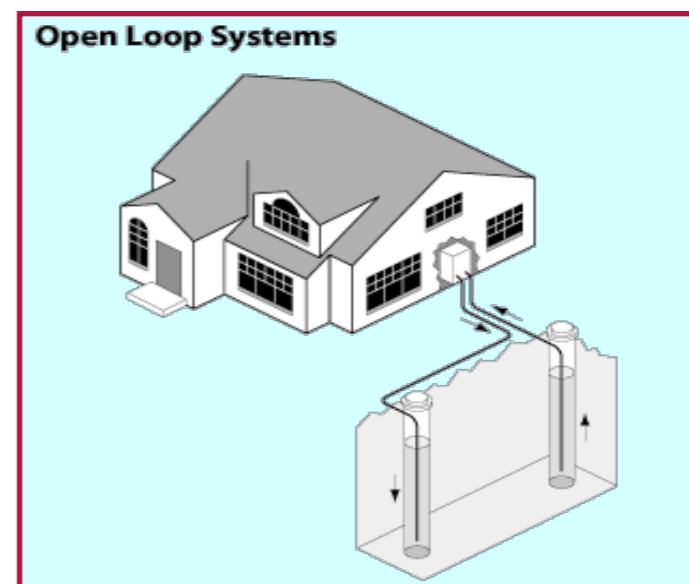


Horizontal System

Pipe is laid into horizontal trenches at typical depth of 6 to 8 feet and to a length of 75 to 400 feet / ton.

Open Loop

Utilizes groundwater or surface water as the heat transfer fluid.



- 30 to 70% savings in heating
 - 20 to 50% savings in cooling
- Notables that have GeoExchange systems:
President Bush & Queen Elizabeth

Benefits of GeoExchange

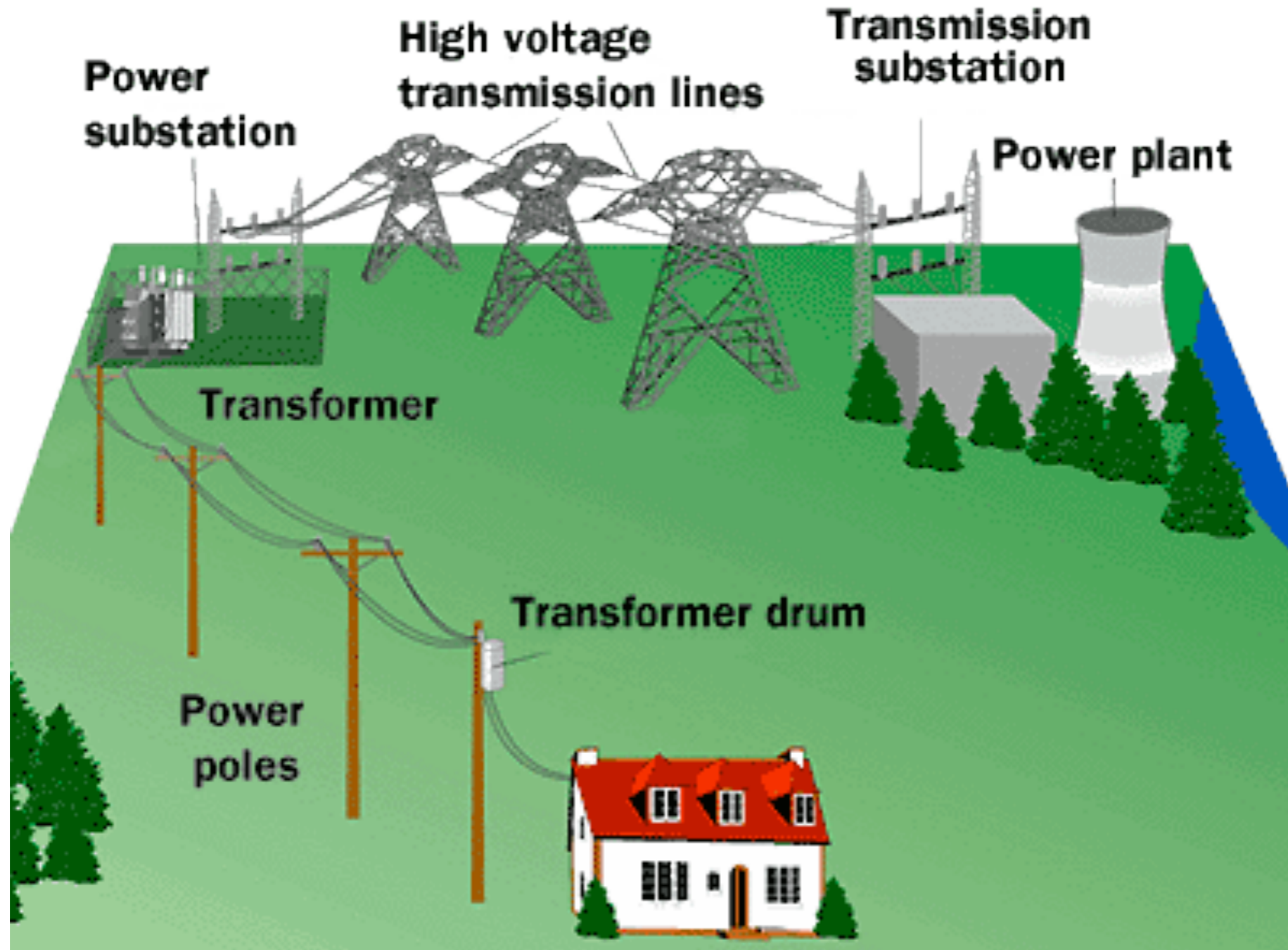
- Can be used almost everywhere worldwide
 - Is energy and cost-efficient
 - Conserve fossil fuel resources
- Provides clean heating & cooling - no emissions from burning fuels

In a poll, over 95% of people who had installed a GeoExchange, a GeoPump*, said they would recommend it and would do it again.

* GeoPump is a trademark

Transmission of Energy

Power Grid Image Gallery



Transmission and distribution losses in the USA were estimated at 7.2% in [1995](#). As of 1980, the longest cost-effective distance for electricity was 4,000 miles (7,000 km), although all present transmission lines are considerably shorter.

Electrical Power grid

Transmission of electricity - main lines



Transmission of energy (electricity) over power lines is a lot cheaper than building pipe lines for oil/gas, hauling coal₄₂ etc.

A challenge for transmission

SUPER-CONDUCTIVITY

The discovery of high-temperature super-conducting materials in 1986 sparked a dream of an amazing new electrical world , a world of loss-free power transmission from coast to coast enormously powerful computers, and of levitated trains passing in a blur of speed.

DIRECT CURRENT

Transmission lines -
more efficient than alternating current

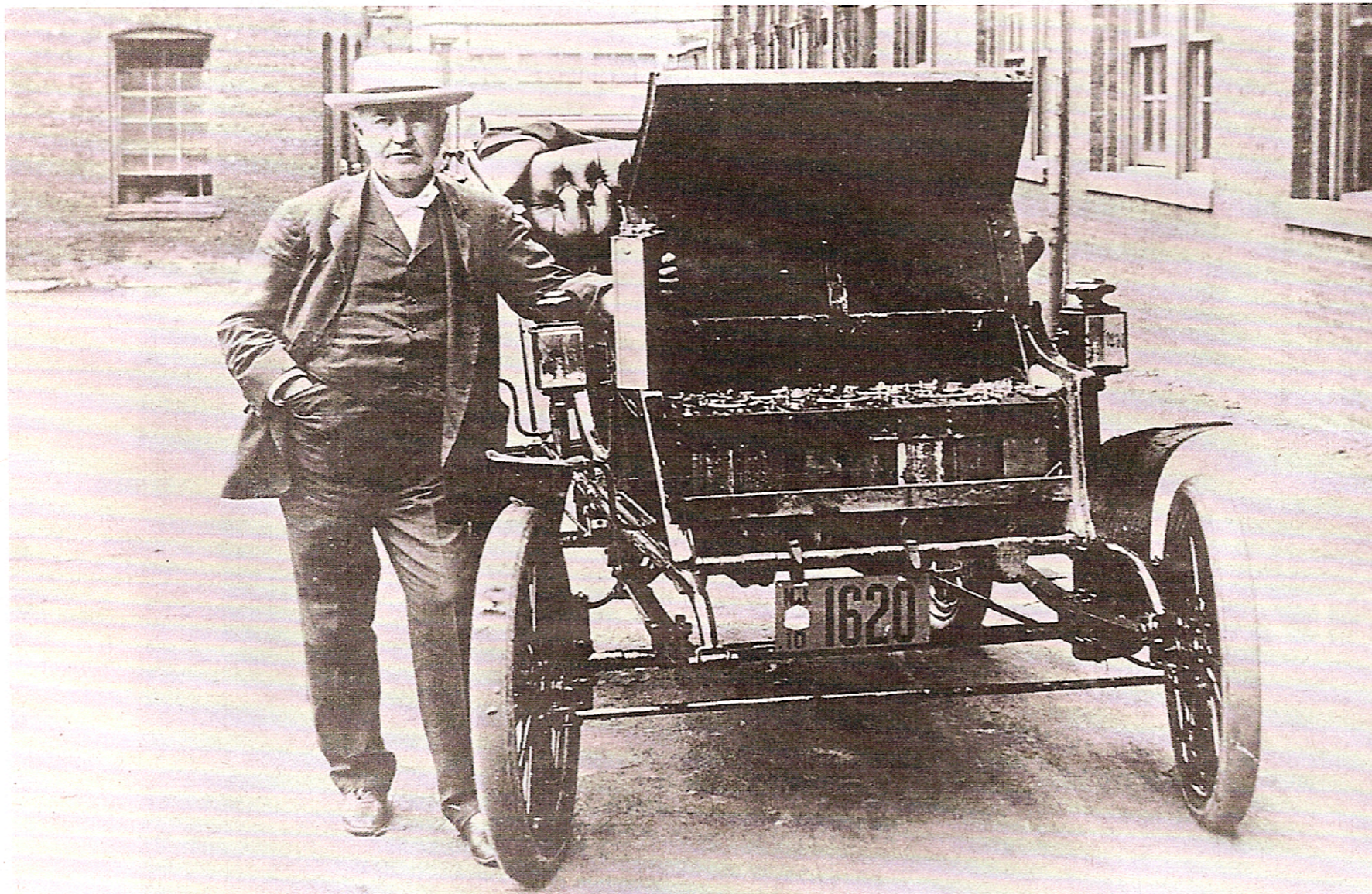
CARBON NANOFIBERS

Long fibers in aluminum wires would be 50 to 100 times stronger than steel, one-six the weight, and transmit electricity many times that of a copper wire

STORAGE of ENERGY

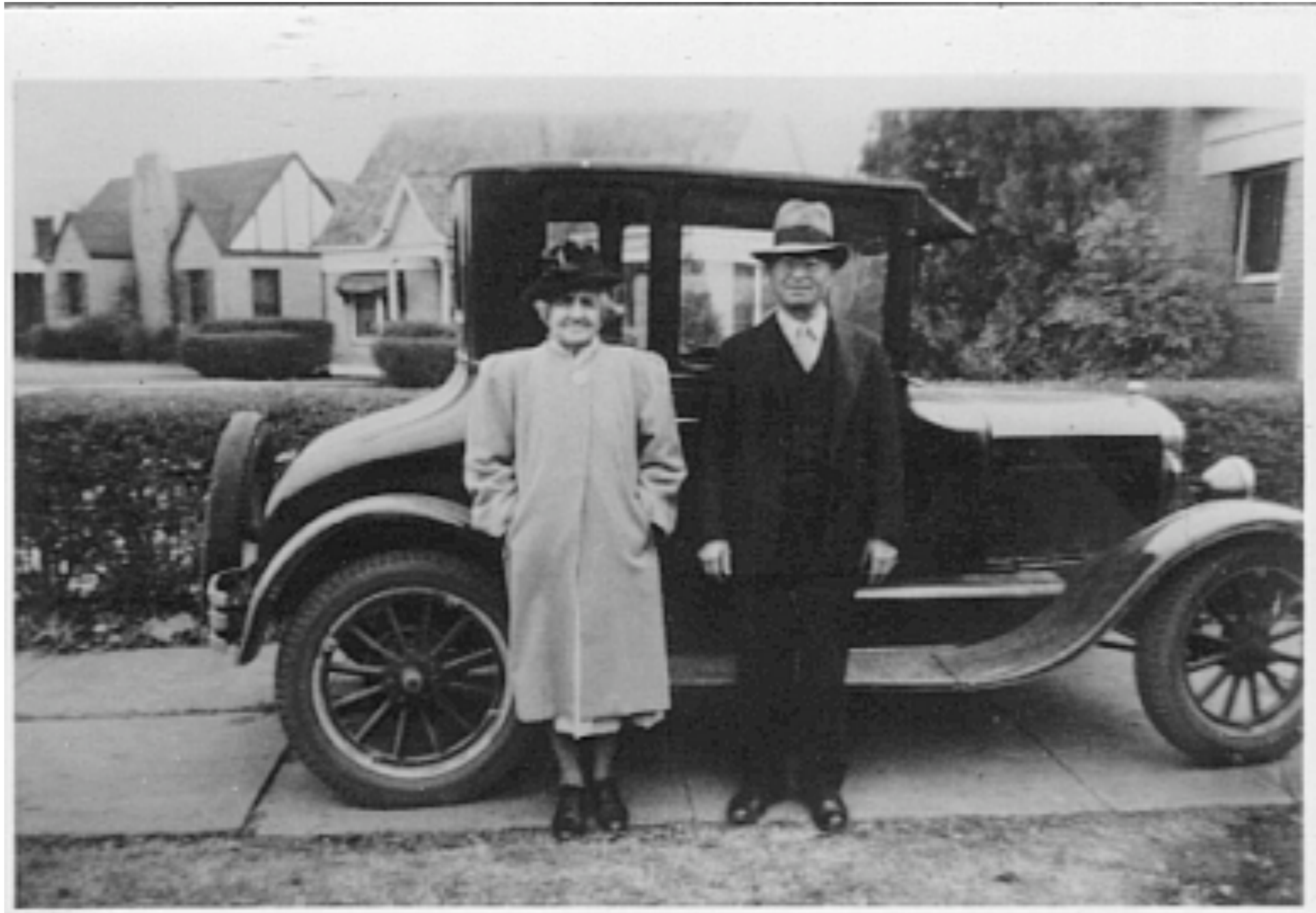
Edison's electric car in the early 1900s

- In the early 1900s Thomas Edison developed an alkaline battery to double or triple the range of the electric car. It didn't quite do that, but alkaline batteries were neat in that they could be rinsed out and used over and over again. Henry Ford did not accept it, instead went for the internal combustion engine



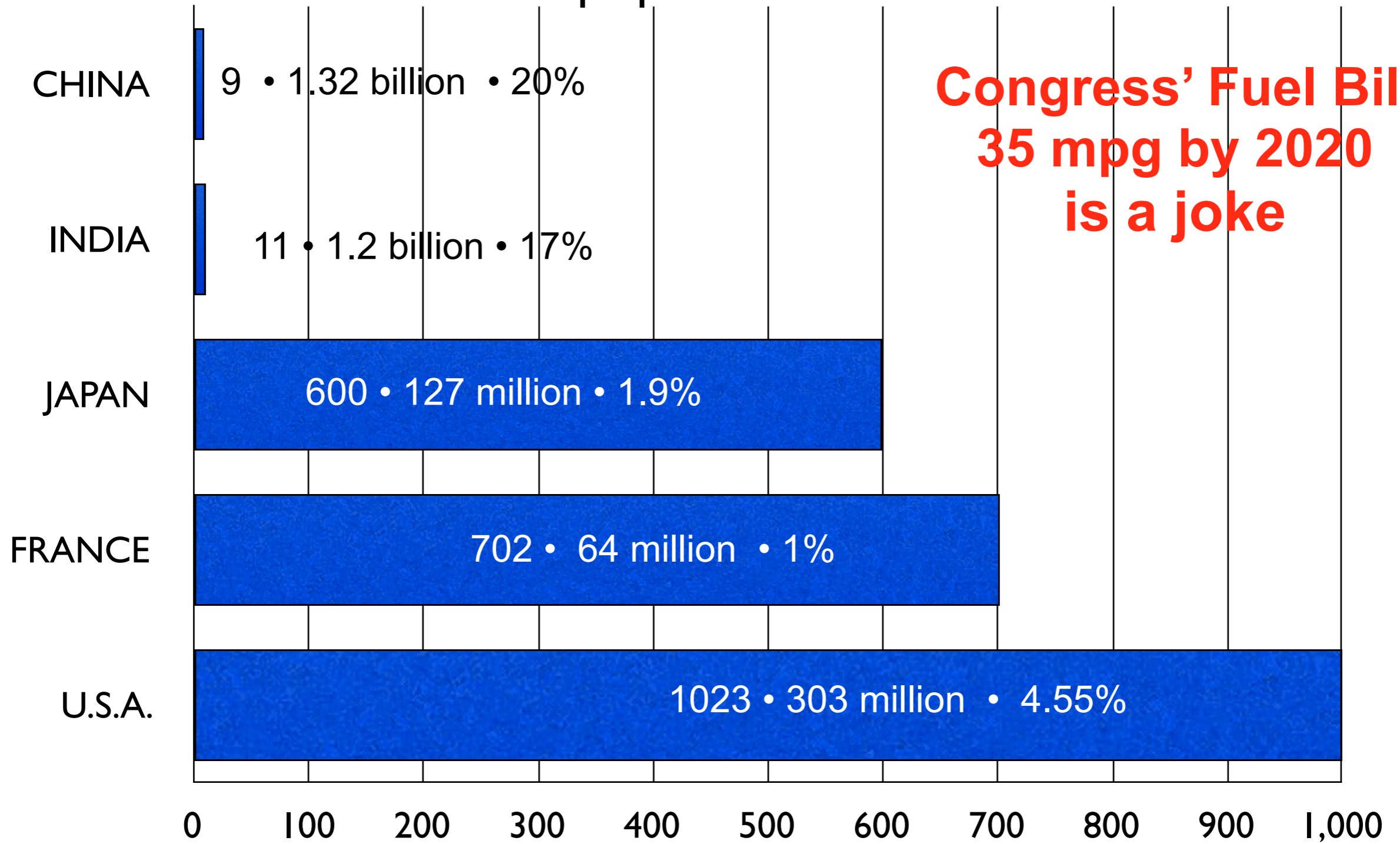
Thomas Edison holding one of the batteries used to power his early electric car, the Baker.

And, Ford built cars in any color as long as they were black



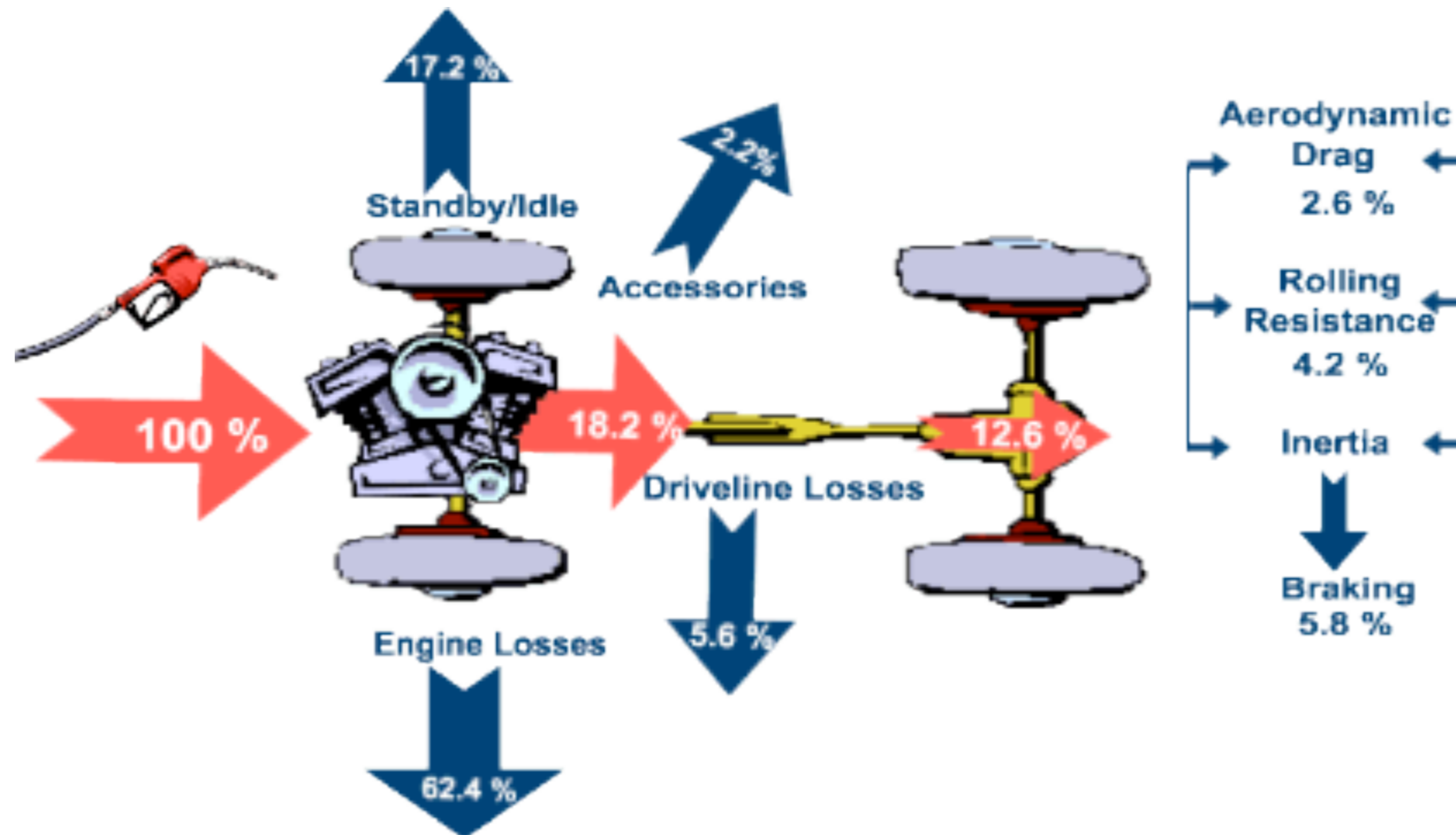
Mario's grandparents & their 1926 Model T Ford
(the car called "Mr. Leo" is still in our family)

- Cars per 1000 people over the age of 16
- Population
- % of the total world population



**Congress' Fuel Bill
35 mpg by 2020
is a joke**

Where does the energy go?



Only about 15% of the energy from the fuel you put in your tank gets used to move your car down the road or run useful accessories, such as air conditioning - about 1% to moving the person. The rest of the energy is lost to engine and drivetrain inefficiencies and idling. Therefore, the potential to improve fuel efficiency with advanced technologies is enormous.

Jay Leno's **Tesla Roadster**

The most fun you can have without fuel

They are claiming well over 200 miles per charge

Engine Electric motor powered by lithium-ion battery

Power 248bhp @ 8000rpm **Torque** 200 lb ft @ 0-6000rpm

Transmission Two-speed manual **CO2** n/a **Acceleration** 0-60mph: 4sec

Top speed 130mph **Price** \$98,000

- 6831 small lithium ion batteries • 90% of American drivers drive less that 100 miles per day

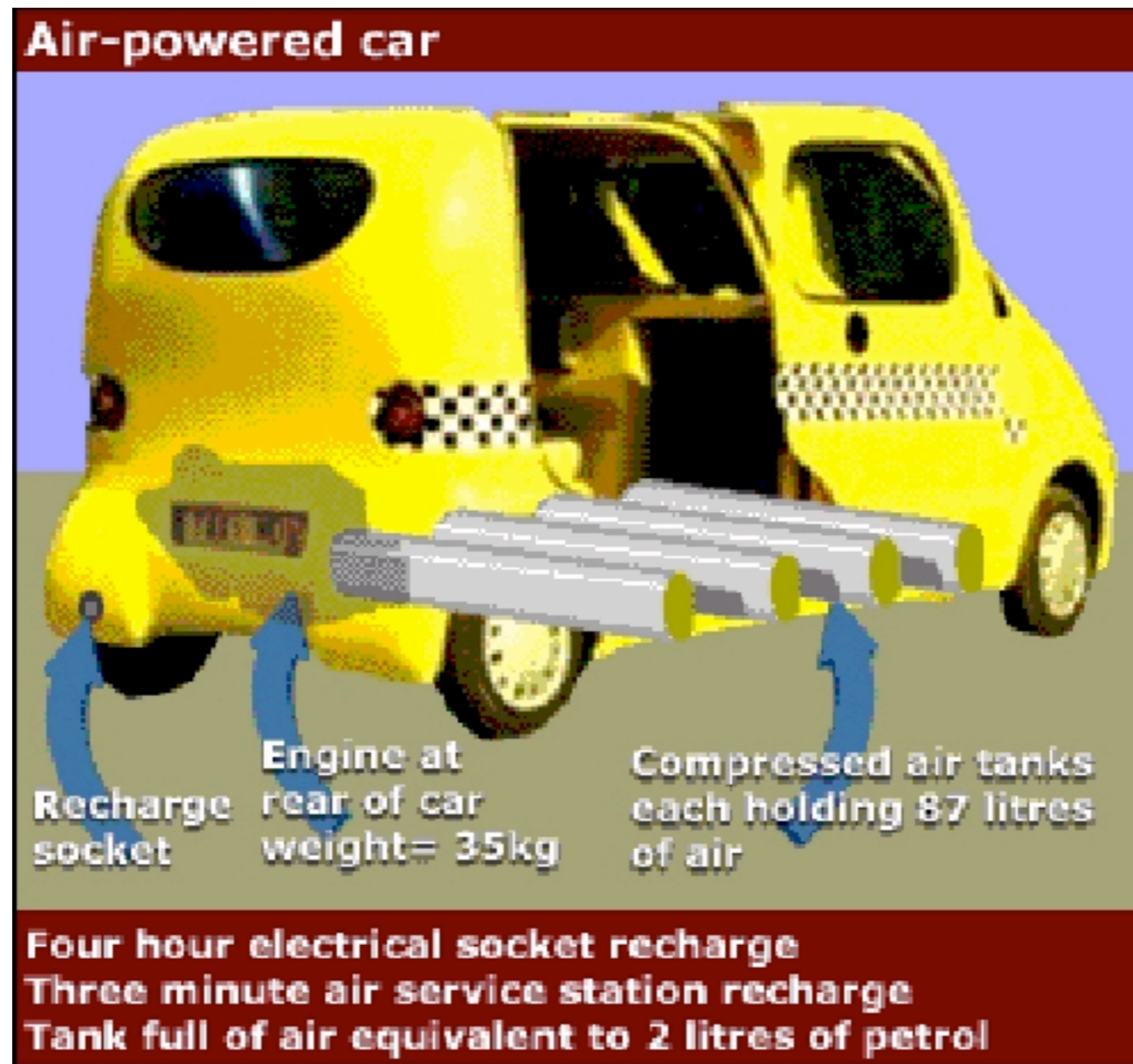


Toys of today = Commercial products of tomorrow

Today's Hybrid cars are too complex - we need to make them simple.



Energy Storage - Compressed Air



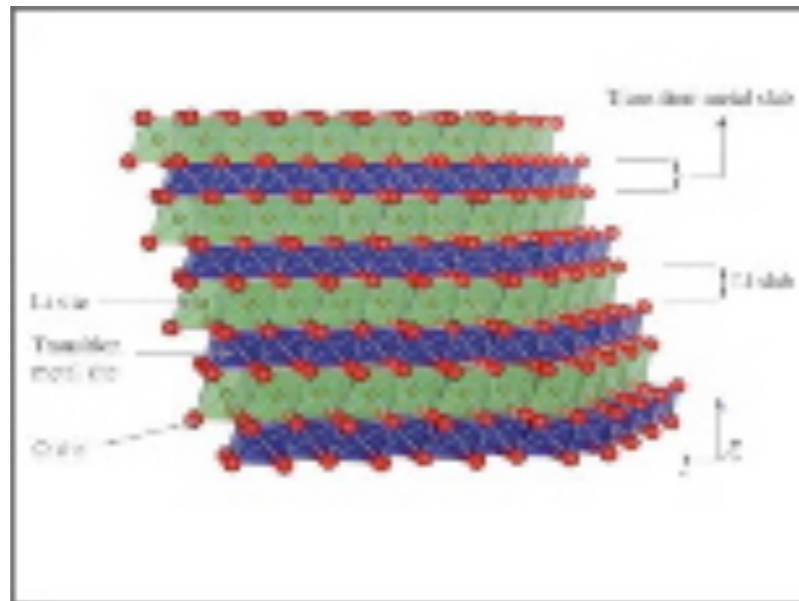
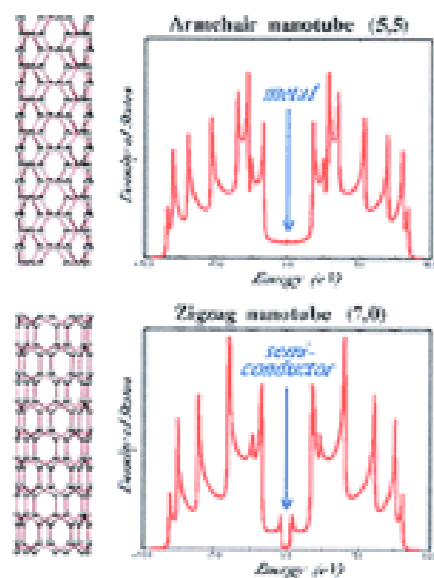
Storage of Energy - Another challenge

BATTERIES

It looks good on paper

Cellulose and nanotubes combine to bring flexible batteries to the world

Nanotubes are being considered as energy storage/delivery systems because of possibilities of hydrogen storage and their excellent electron transfer characteristics



Be on the lookout for ULTRA-CAPACITORS

Latest 1/14/08: Toyota plug in by 2010 using lithium-ion batteries.

Lithium nickel manganese oxide could revolutionize the hybrid car industry -- a sector that has "enormous growth potential," says Gerbrand Ceder, MIT professor of materials science and engineering, who led the project.

Compressed air batteries

ULTRA-CAPACITORS

A new version of an old idea is threatening the battery industry



If a driver could pull into an electrical filling station and top up his capacitors as rapidly as he can now replenish his petrol tank it would both increase the effective range of all-electric vehicles and decrease resistance to buying them in the first place.

SUMMARY

- Of all the energy sources, nuclear fusion, wind, solar, geothermal and geoexchange offer the greatest hope for a pollution-free planet. Innovations needed.
- Homes and buildings utilizing GeoExchange systems offer great economic and ecological advantages
- a new generation of electrical wires are needed for greater efficiency in electrical transmission & motors
- Light-weight, low-cost, eco-friendly, & high-storage capacity batteries are needed.
 - Internal Combustion engines totally banned. All overland transportation to be totally electric
- Light-weight, ultra-strong “composite” vehicles, adaptable to carry goods and/or people
 - GAS STATIONS converted to BAT-STATIONS™

ULTIMATE CHALLENGE

to achieve the **ENERGY-2050** VISION

- Thinking out of the “comfort zone,” + more “quantum jumps” in the technology of nuclear fusion, wind turbines, & solar cells
- Utilizing the earth’s temperature via Geothermal & GeoExchange
 - Getting the facts out & being wise enough to consider changes
 - People speaking louder and unified in their message, each becoming **a search engine for technology**
 - Support of worldwide governments & industry via incentives
 - Promote the establishment of a GLOBAL ENERGY POLICY as a priority

MAKE IT HAPPEN - Get the message out
Pass on this Vision & Challenge



Please contact me: Mario.Messina@MessinaChemicals.com⁵⁴