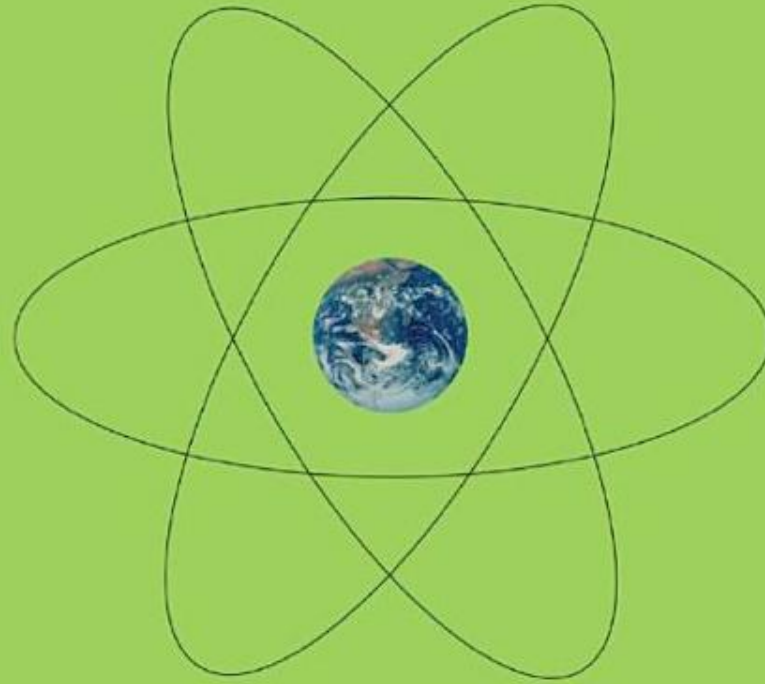


# POWER TO SAVE THE WORLD

THE TRUTH ABOUT NUCLEAR ENERGY

GWYNETH CRAVENS



# Getting Past Us vs. Them

## “Always Look at the Whole”

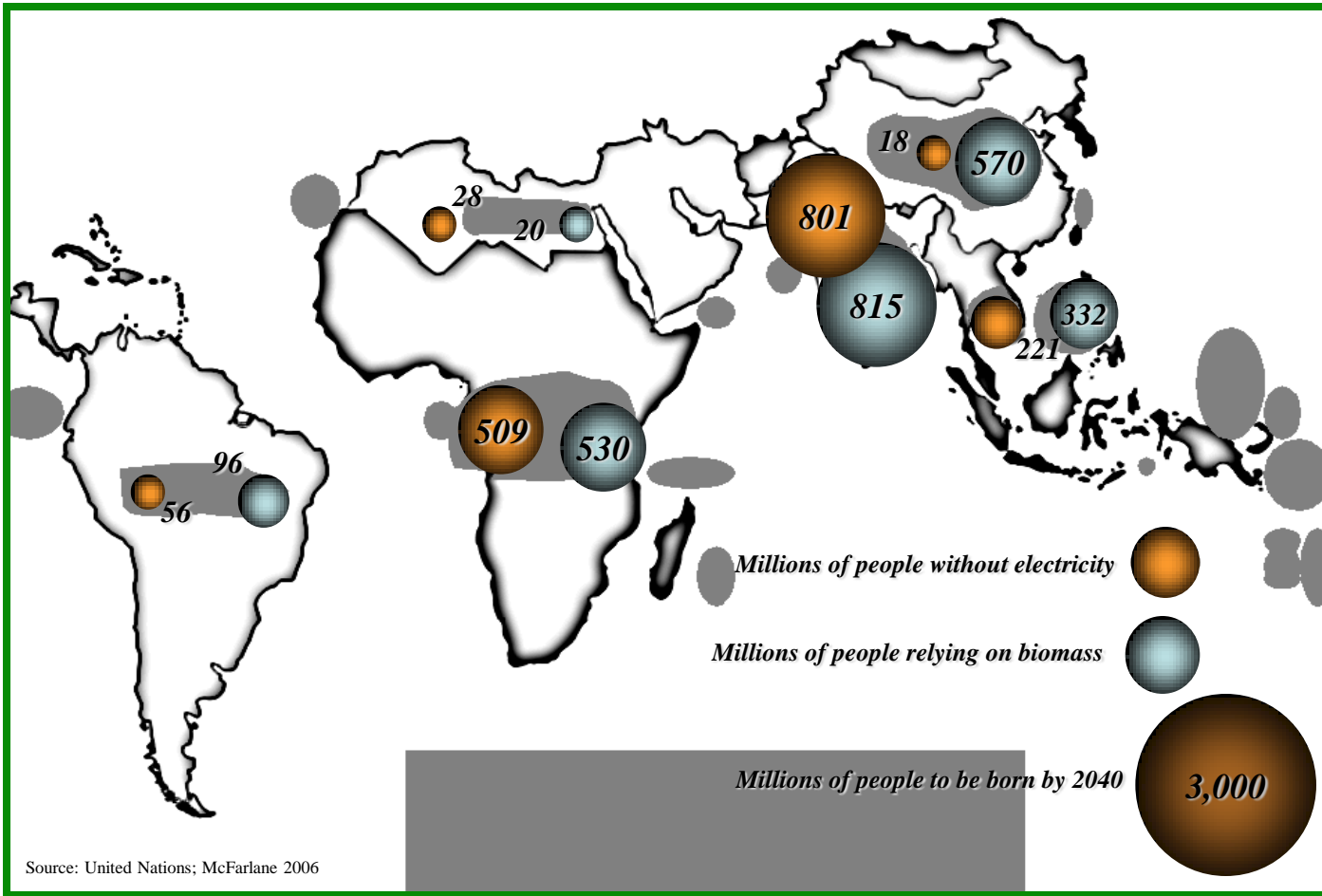
1. The Big Picture: What's At Stake
2. The Journey From Myth to Fact
3. Facing the Greatest Challenge... Together



# THE BIG PICTURE: Global Energy Distribution



as indicated by nighttime electricity use



# Map of Global Energy Poverty

**1.6 billion people have no access to electricity, 80% of them in South Asia and sub-Saharan Africa.**

**2.4 billion people burn wood and manure as their main energy source.**

**3 billion more people will be born by 2040**



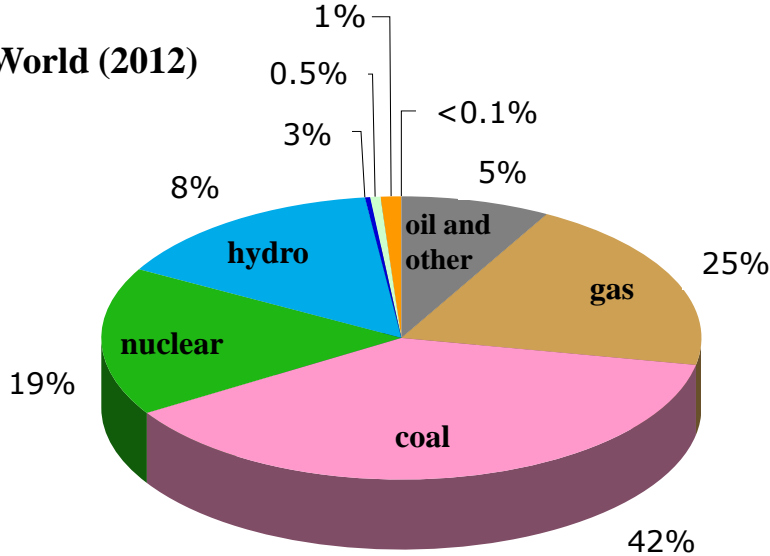
Source: ©2005 Kay Chernush for the U.S. Department of State

# 1.6 Billion People: No Access to Electricity

- **Regions without electricity: 43-year lifespan.**
- **Regions with some power = 50-year lifespan.**
- **Fully electrified regions = 70-85 year lifespan.**
- **Electricity from nuclear power means:**
  - Clean air, clean water
  - Better healthcare thanks to refrigeration of medicines, vaccines
  - Better lives for women
  - Stronger economies

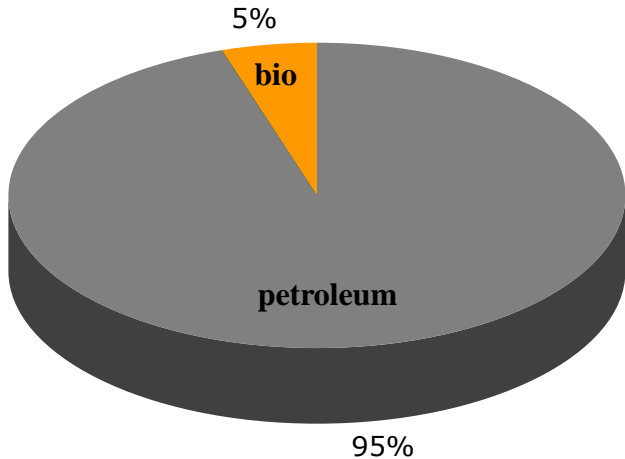
**Present Energy Distribution (Power)**

**World (2012)**



- Oil
- Gas
- Coal (all types)
- Nuclear
- Hydroelectric
- Wind
- Geothermal
- Biofuels
- Solar

**Present Energy Distribution (Transportation)**



**United States**

**32% coal**  
**34% gas**  
**20% nuclear**  
**7% hydroelectric**  
**4% biomass 3% other**

**Washington**

**11% coal**  
**8% gas**  
**10% nuclear**  
**64% hydro**  
**7% other**

**Indiana**

**94% coal**  
**3% gas**  
**0% nuclear**  
**3% other**

**Illinois**

**48% coal**  
**2% gas**  
**48% nuclear**  
**2% other**

**European Union**

**32% coal**  
**18% gas**  
**30% nuclear**  
**11% hydroelectric**  
**6% oil 3% other**

**Korea**

**43% coal**  
**17% gas**  
**5% oil**  
**34% nuclear**

**China**

**30% coal**  
**20% gas**  
**30% nuclear (GenIII/IV)**  
**10% hydro**  
**10% renewables**  
**by 2040**

**Meet Dr. Rip Anderson (SNL): Oceanographer, organic chemist.**

**•Headed 4 large nuclear and environmental health projects.**

**•Pioneer in probabilistic risk assessment.**

**•Environmental & community activist.**

**•Big picture, long term:**

***Plant saplings now.***

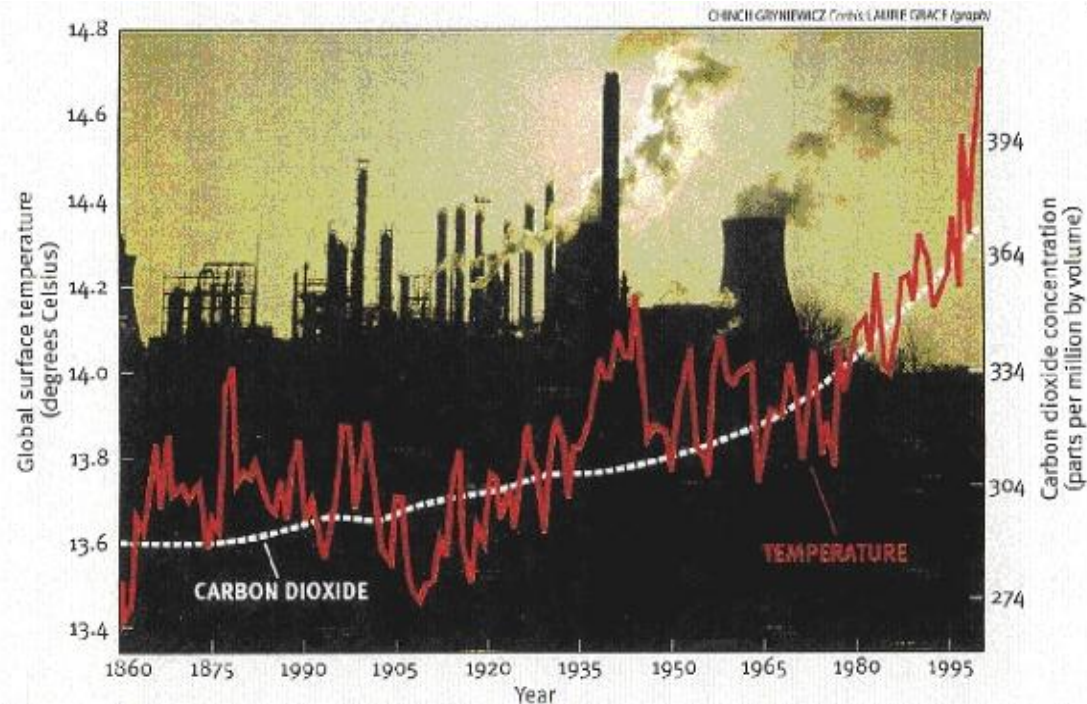
***Forests will appear.***



# World Record for Carbon Dioxide Emissions: 31.6 Gigatons in 2011

A 4° Temperature rise = 40% Extinction of Species  
--Latest data predicts up to 7° rise

- Melting of ice caps, glaciers, permafrost
- Coastal flooding
- Ocean acidification
- Ecosystems dying





# From Myth to Fact: The Nuclear America Tour

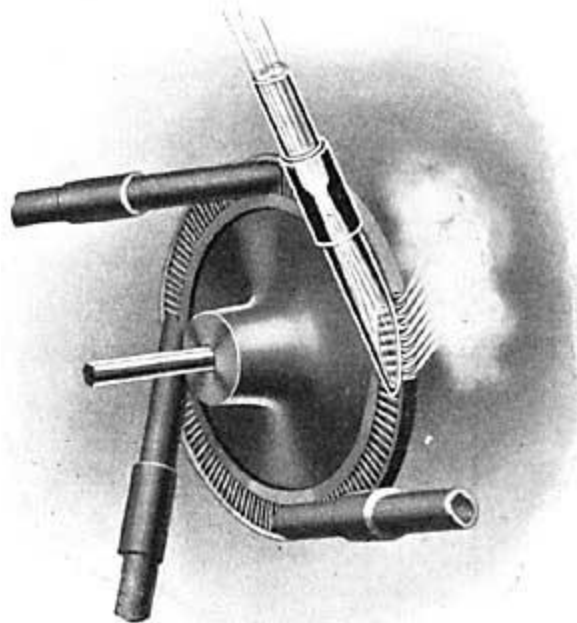


## **Niels Bohr said . . .**

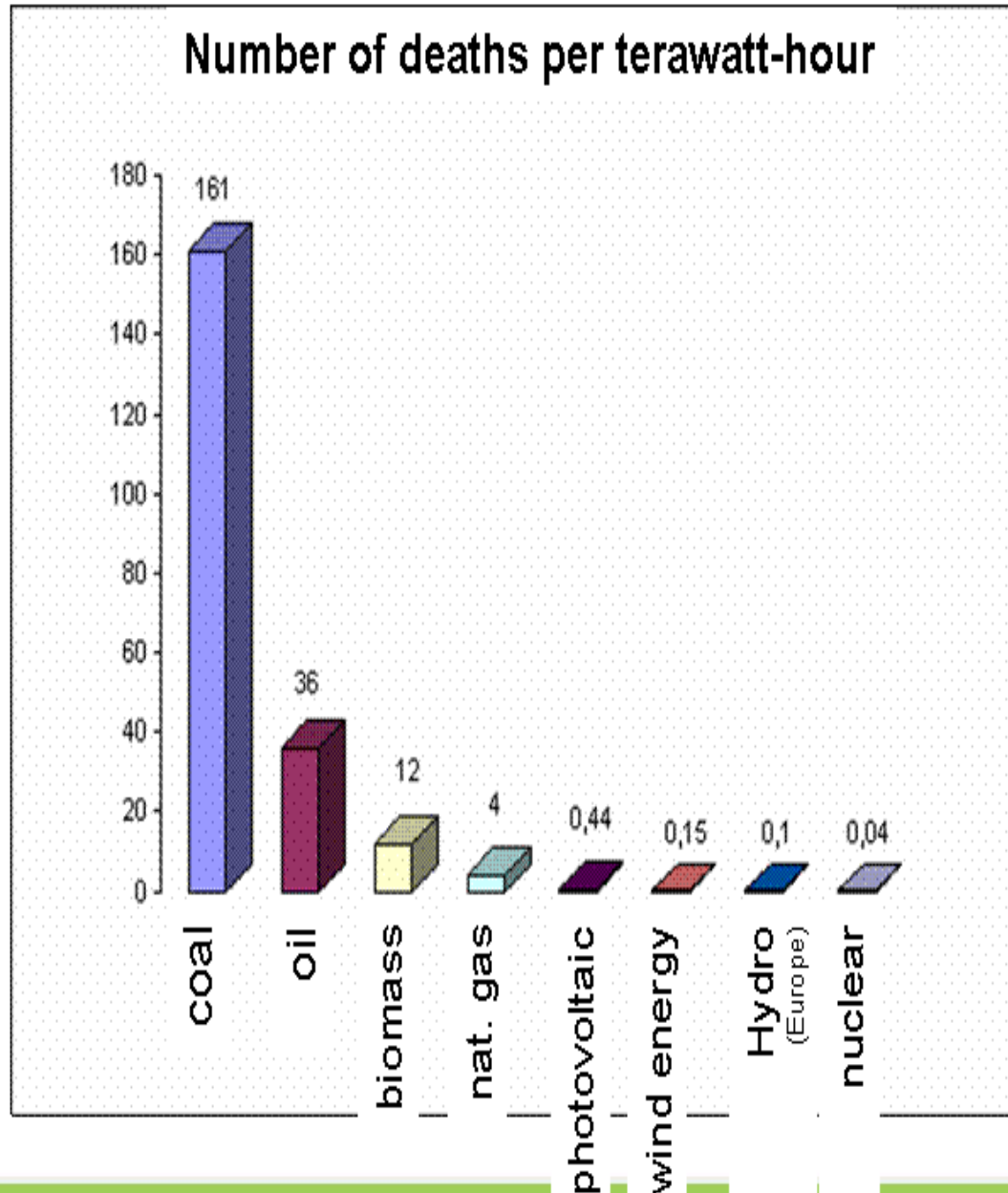
**“The relentless goal of science is the gradual removal of prejudice.”**

**Richard Rhodes: “By ‘prejudice,’ Bohr meant belief unsupported by evidence.”**

**In thermal power plants, boiling water produces steam.  
Steam turns turbine blades, spinning coils past magnets.  
A stream of electrons flows along a wire.  
That's electricity. Demand is increasing.**

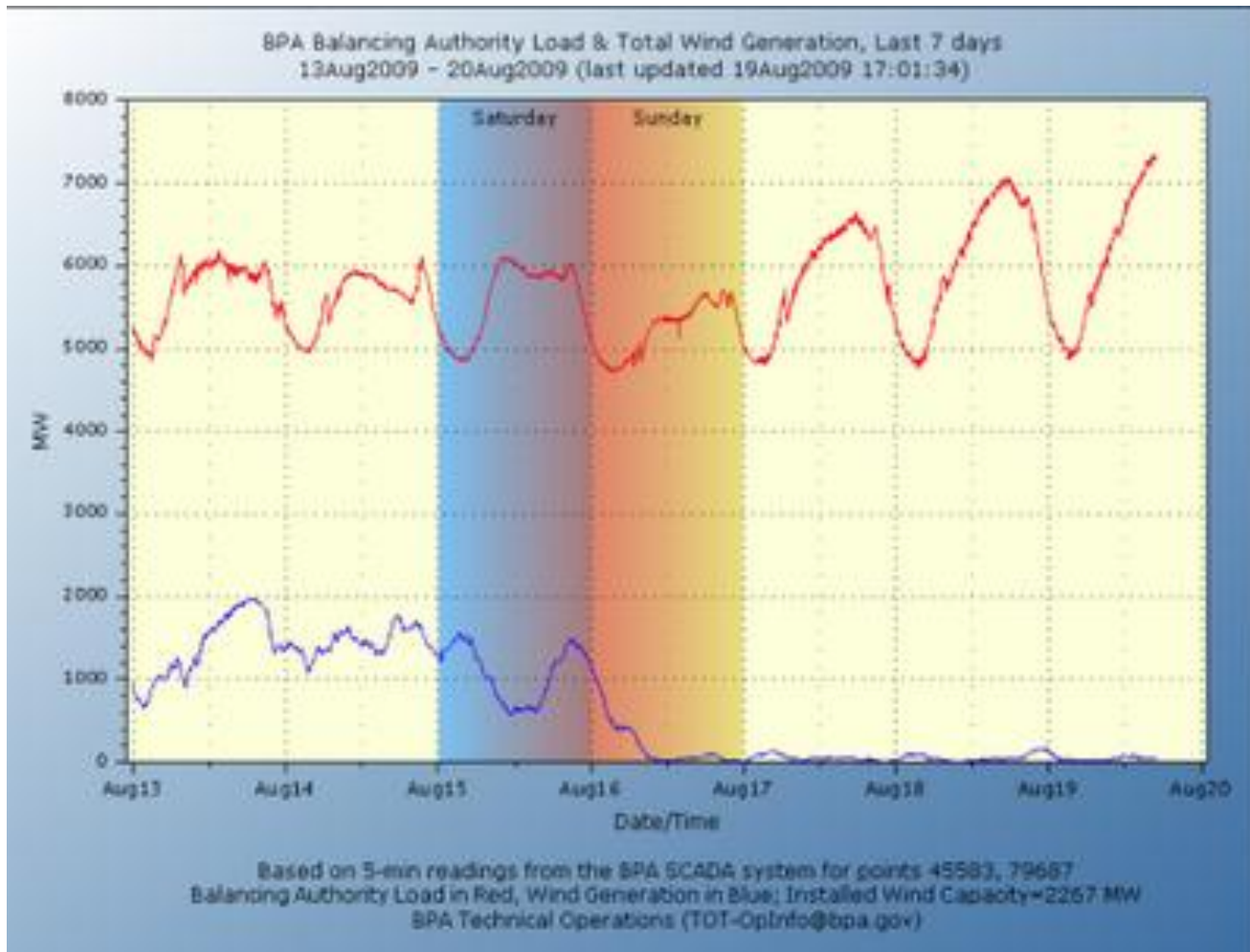


# Fossil Fuel vs. Nuclear Electricity

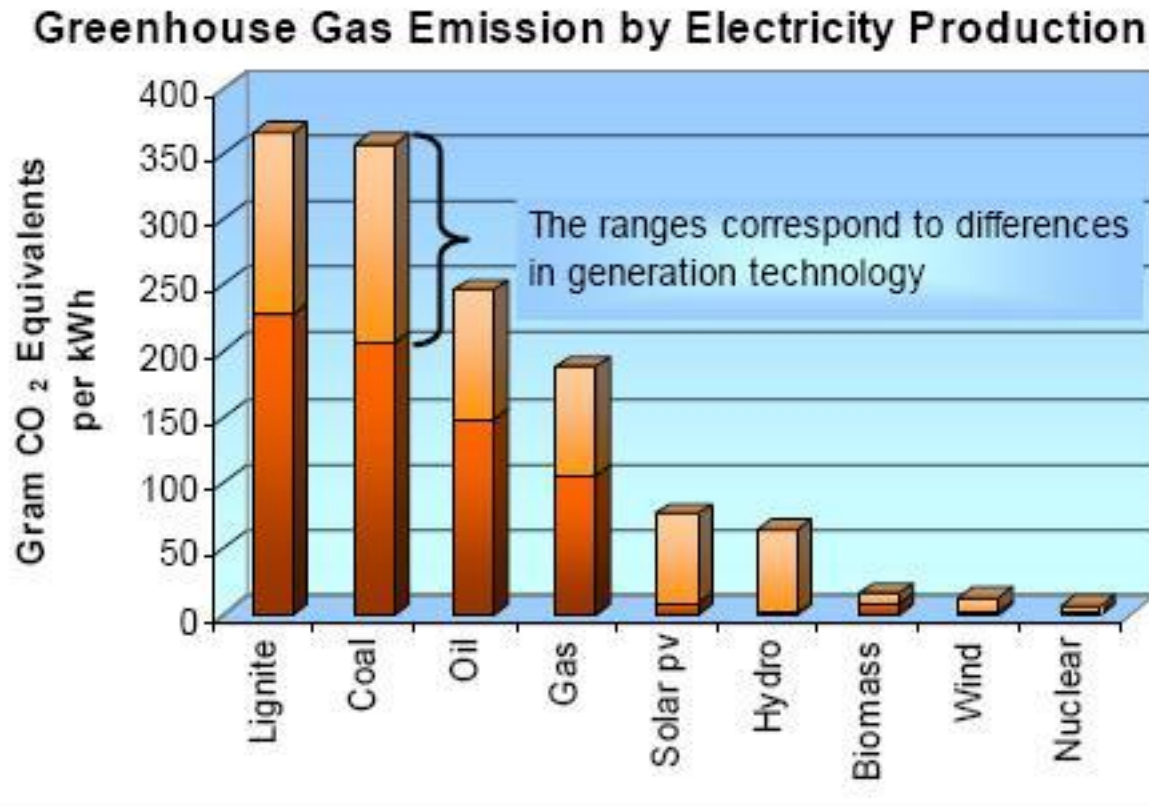


# Bonneville Power Administration

## Why Wind Can't Replace Base-load Power

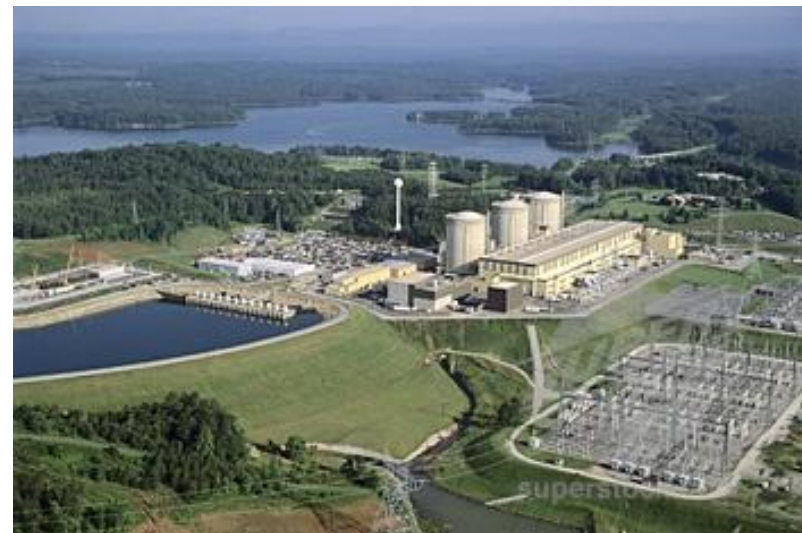


# Nuclear has smallest carbon footprint, smallest environmental footprint

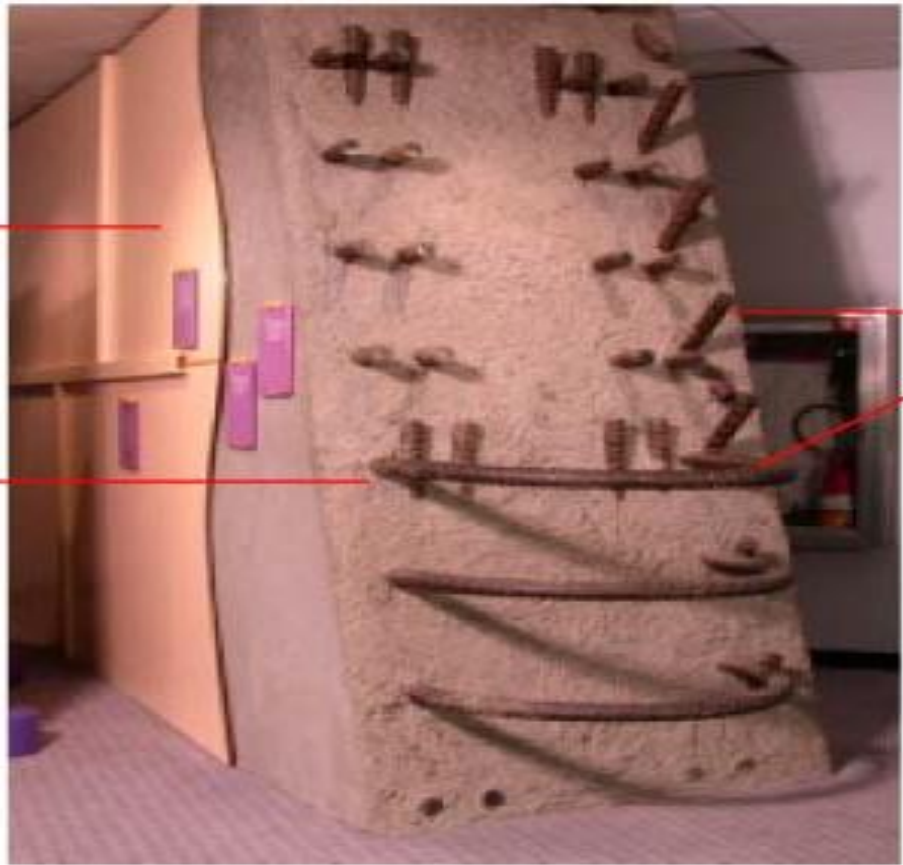


*Greenhouse Gas Emission by Electricity Production Method.*  
(Source: OECD/NEA)

- **No nuclear power plant can explode atomically**
- **U.S. reactors are**
  - **Mostly located 30 meters underground**
  - **Mostly anchored in bedrock**
  - **Always enclosed by multiple layers of containment**



# Physical Barriers: 4-ft. thick concrete stops radiation.



Steel Reinforcing bars

Construction of Containment Wall

## Mental Barriers:

Powerful myths block facts





# 1 fuel pellet weighs same as 3 pennies



A typical pellet of uranium weighs about 7 grams (0.24 ounces). It can generate as much energy as...



3.5 barrels of oil, or...



17,000 cubic feet  
of natural gas, or...



1,780 pounds of coal.

# 1 Person's Lifetime Volume of Waste: Coal vs. Nuclear

1 person using only 1  
power source for 77  
years:

Coal:

*69 tons +  
77 tons CO<sub>2</sub>*

Nuclear:

*Used fuel pellets fill  
1 Coke can; almost  
no gaseous waste.*



**6 railroad cars holding 12 tons each of coal waste contain 1 person's share.**



←  
**Sandia Mountains: 1.25 miles higher than the city of Albuquerque. They're also the same size as the amount of CO<sub>2</sub> emitted from all the world's power plants for 1 year if it were to be solidified.**

→  
**1 big townhouse is the same size as the annual output of *all* the world's spent nuclear fuel for 1 year.**



# Facts About Waste

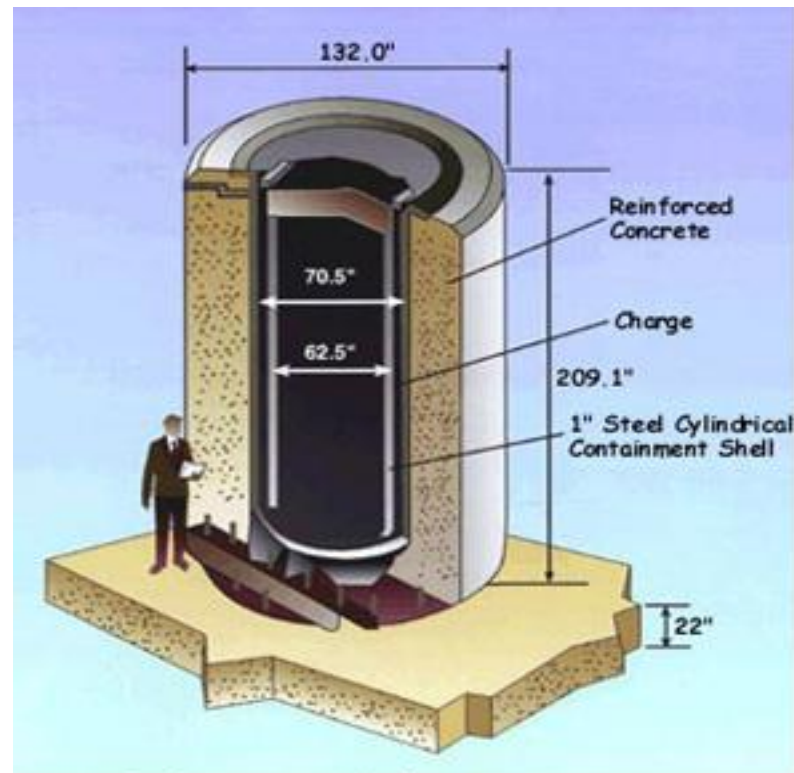
- **In 50 years US nuclear power has produced less than *70,000* tons of spent fuel.**
- **Of that, less than 1% is long-lived.**
  - **Could fit inside a small studio apartment.**
- ***All* spent fuel in U.S. could fit inside 1 Home Depot.**
  - **Retains 98% of its energy. Could all be recycled into fuel, medical isotopes.**
- **In ONE year Americans discard *179,000* tons of toxic batteries — mostly in landfills.**

# France--80% Nuclear--Recycles

## Final Residue is Tiny

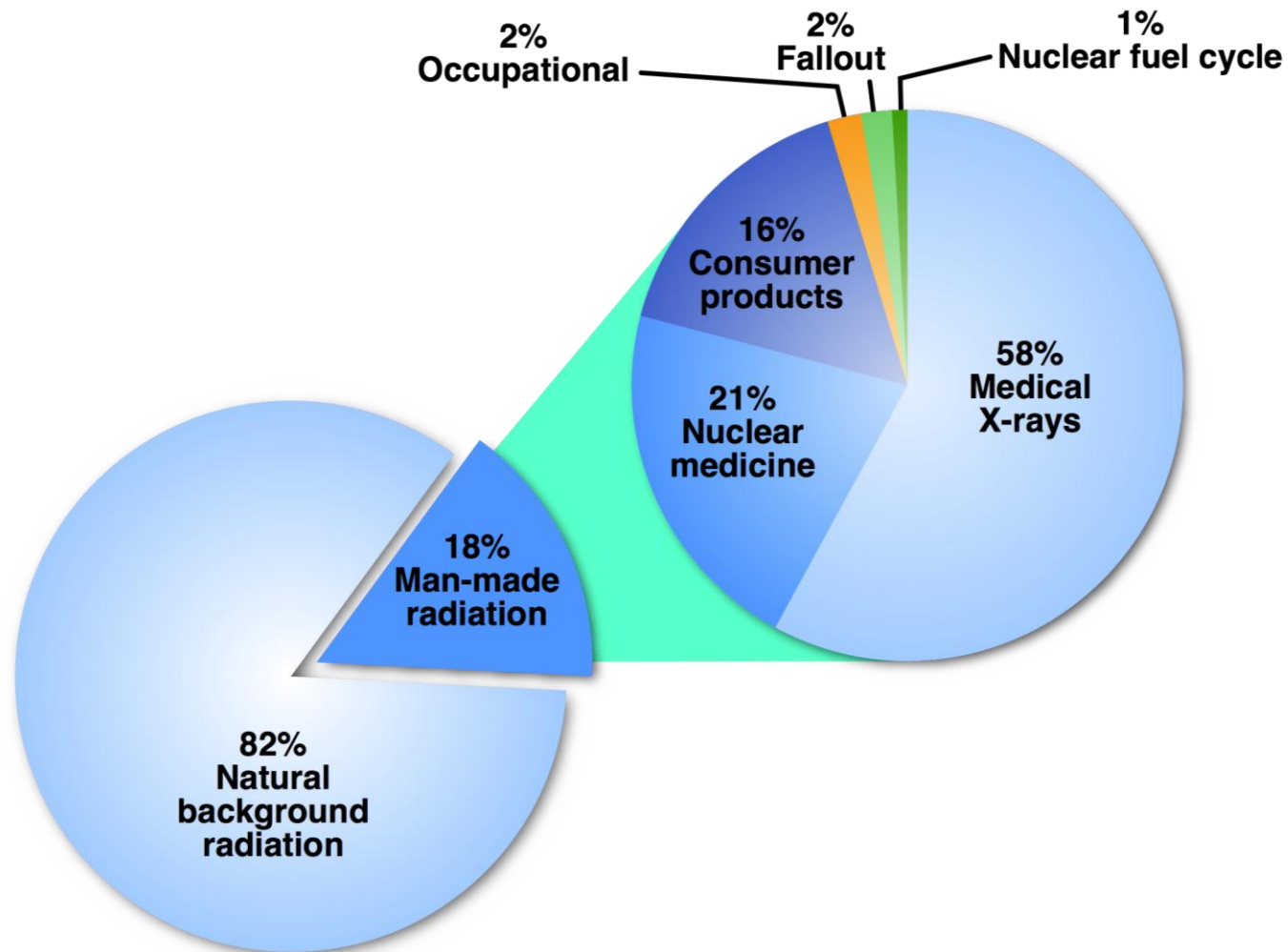


# Spent Fuel Storage Cask Isolates Radioactive Fuel Pellets for 100 Years

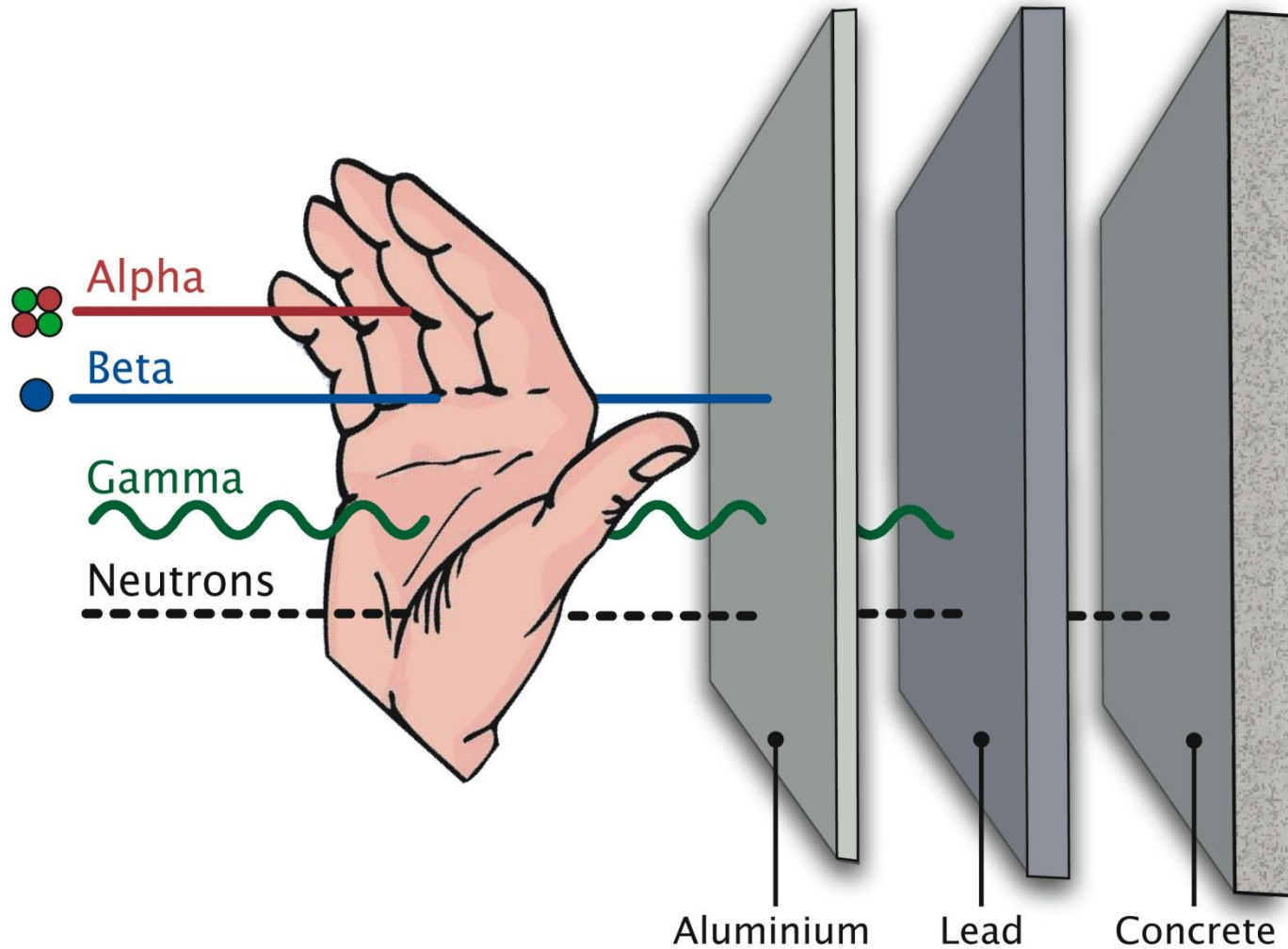


Spent Fuel Storage Cask

# Radiation Sources

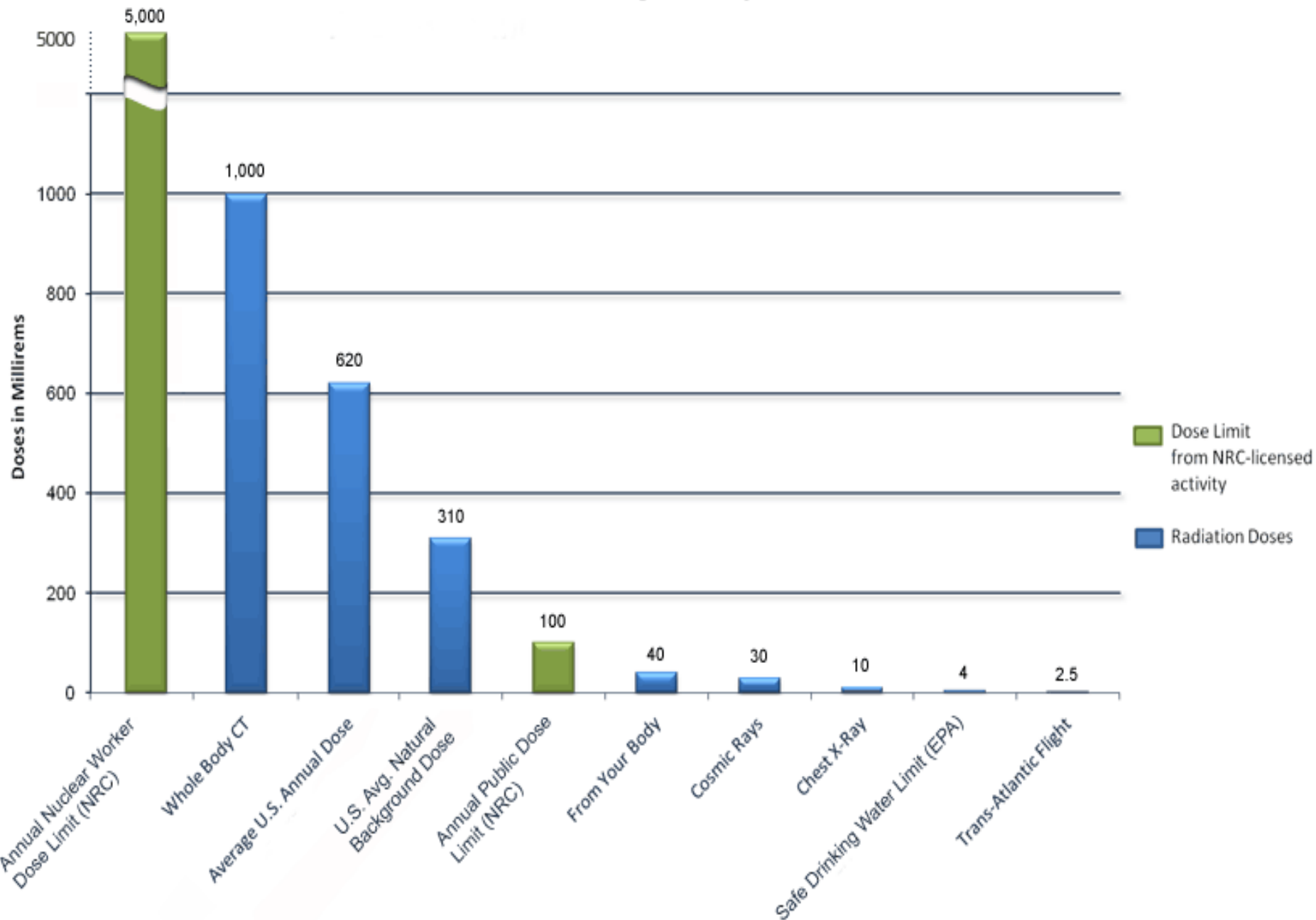


# Shielding stops all rays and particles





# Radiation Doses and Regulatory Limits (in Millirems)



# One Banana = More Annual Radiation Exposure Than A Nuclear Power Plant



**0.01 millirem/yr**



McGuire Nuclear Station, Huntersville, NC

**0.009 millirem/yr**

# Getting Past “Us Versus Them”:



# It's Time to Cooperate

**“We are caught in an inescapable network of mutuality, tied in a single garment of destiny. Whatever affects one directly, affects all indirectly. This is the interrelated structure of all reality.”**

**--Martin Luther King**

**10<sup>-6</sup>**

**A Thought Experiment: Faced with fear of the unknown, we all react the same way.**



# Unfamiliar Risks Scare Everyone

Leo Gómez, radiation biologist (ORNL, LANL, SNL):

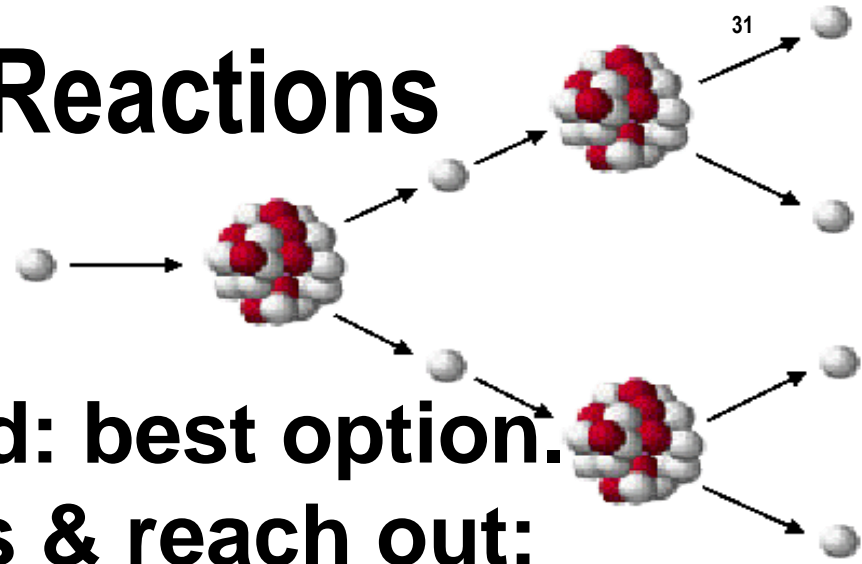
- **“We grumble a lot about *Them*. . .**

**But when faced with fear of the unknown, we react the same way they do.**

**Our arrogance protects us from that fact, and then, rather than listening to concerns. . .**

**We do all the talking & meet objections by shouting louder.”**

# Social Chain Reactions



**1. Act now:**

**Nuclear, wisely used: best option.**

**2. Drop your prejudices & reach out:**

**Help move your neighbor from myth to fact.**

**-- Listen to concerns. Find common ground.**

**--*Then* share your knowledge.**

**--Teach children. Word will spread.**

**3. Move from “Us versus Them” to “We”**

# **Rip Anderson: “The nuclear industry needs a paradigm change.”**

- Always include social & political factors in risk analysis.**
- Stop publishing worst-case analyses as truth.**
- Create a small group to invalidate the idea itself.**
  - If group fails: project has passed the toughest test.**
  - If group succeeds, you’ve been spared a lot of future pain.**



# “Always Look at the Whole”

1. The Big Picture: *We must act now.*

2. The Journey From Myth to Fact: *Let's remove prejudice by using science-based information.*

3. Facing the Greatest Challenge...

Together: *Let's cooperate and be good stewards of the planet and of our energy future.*



*Eileen Collins: “As I looked out the window, and I saw the sun coming up and the curvature of the Earth, I thought, ‘Wow. The Earth is round.’*

*But when I saw it with my own eyes, it meant something different to me. And looking at the Earth’s atmosphere and seeing how thin it is, you realize the Earth is a very fragile planet.”*

