

GTSP



Global Energy Technology
Strategy Program

New Generation Nuclear Fission: Response

Long-Term Nuclear Technology Pathways

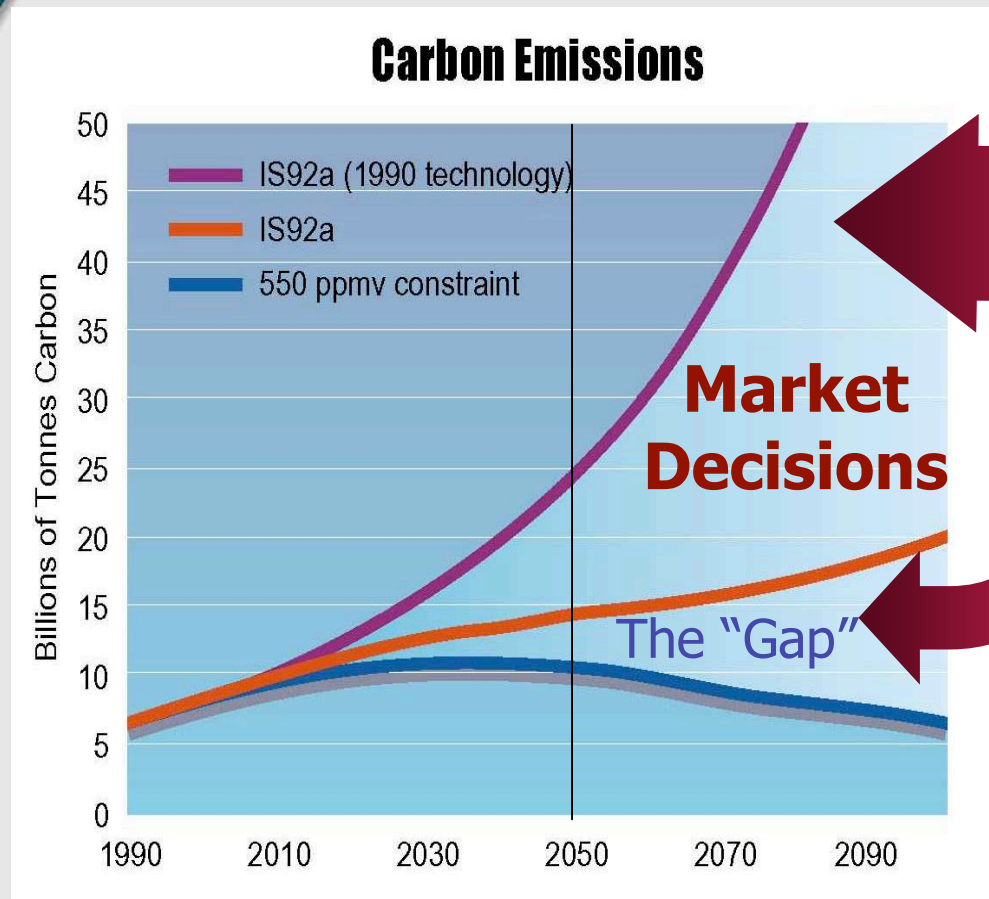
John Clarke
7 July 2003
Aspen, CO

Battelle



**Pacific Northwest
National Laboratory**
Operated by Battelle for the
U.S. Department of Energy

Stabilizing CO₂ Requires Base Case and "Gap" Technologies



Assumed Advances In

- Fossil Fuels
- Energy intensity
- **Nuclear**
- Renewables

Gap technologies

- Carbon capture & disposal
Adv. fossil
- H₂ and Adv. Transportation
- Biotechnologies
Soils, Bioenergy, adv. Biological energy

Future Cost of Uranium?

- ▶ Commodity mineral costs do tend to decline because the technology of finding and extraction improves.
 - Example: Normalized copper prices decreased from 1800 to about . . . um . . . 1920?
 - Not to be picky, but notice:
 - Copper prices/wages seem to have been relatively constant since 1920 and
 - Copper prices/CPI seem to have risen for the last ~60 years
- ▶ The Question Remains: Will the cost of Uranium go up or down?

Gen-III Fuel Cost Depends On Technology & Consumption

**Gen-III Uranium
Consumption
With
Stabilization @
550ppm**

**Gen-I/II&III
Uranium
Commitment**

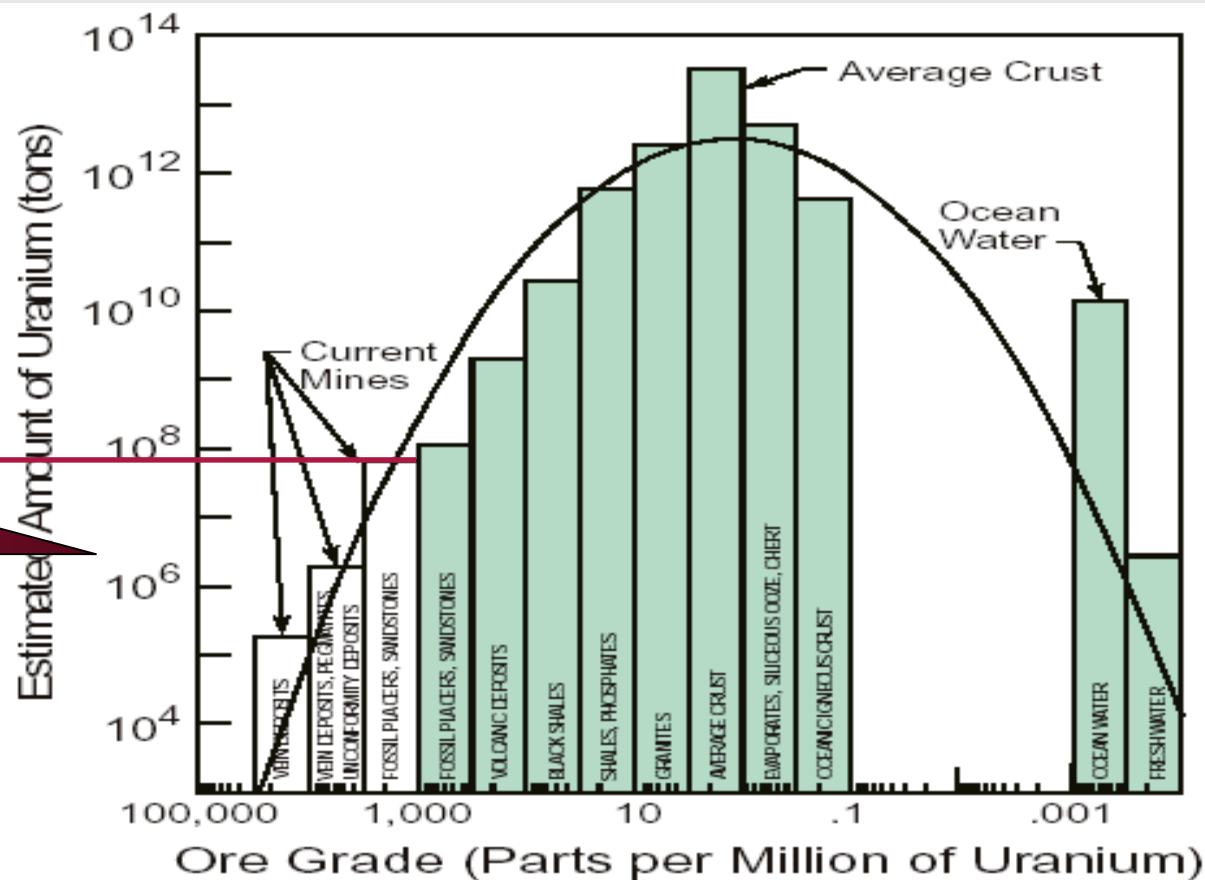
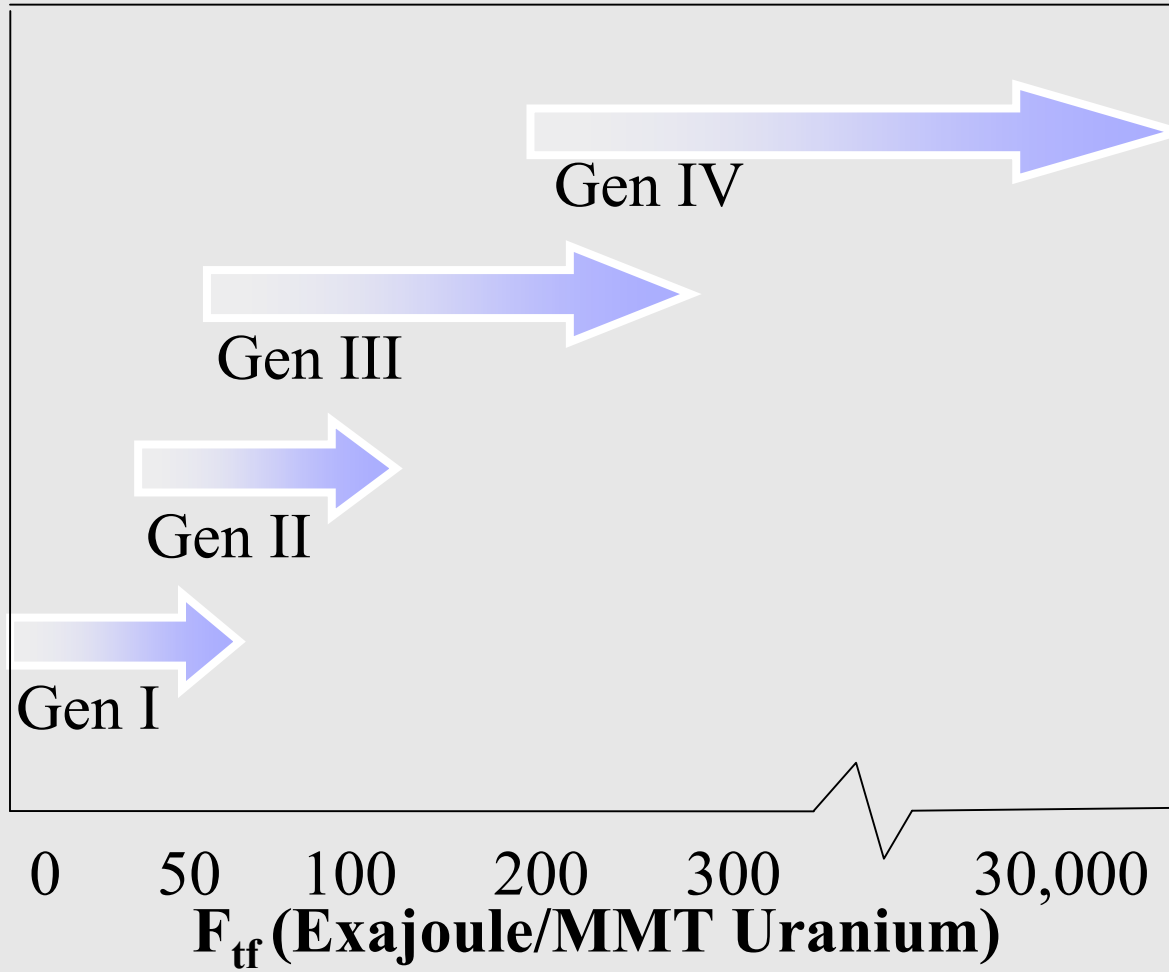


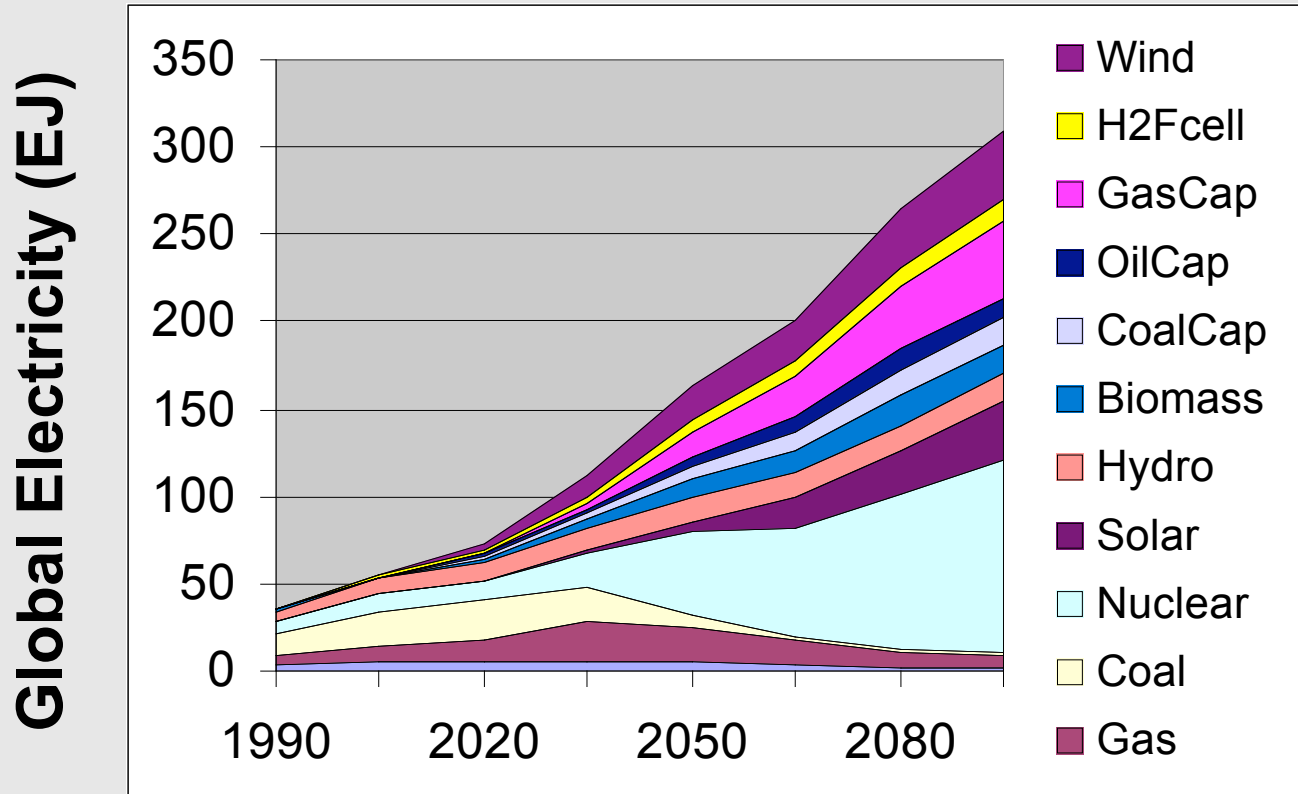
Figure 1.6 Distribution of Uranium in Earth's Crust (from Deffeyes 1980)



Nuclear Fuel Efficiency



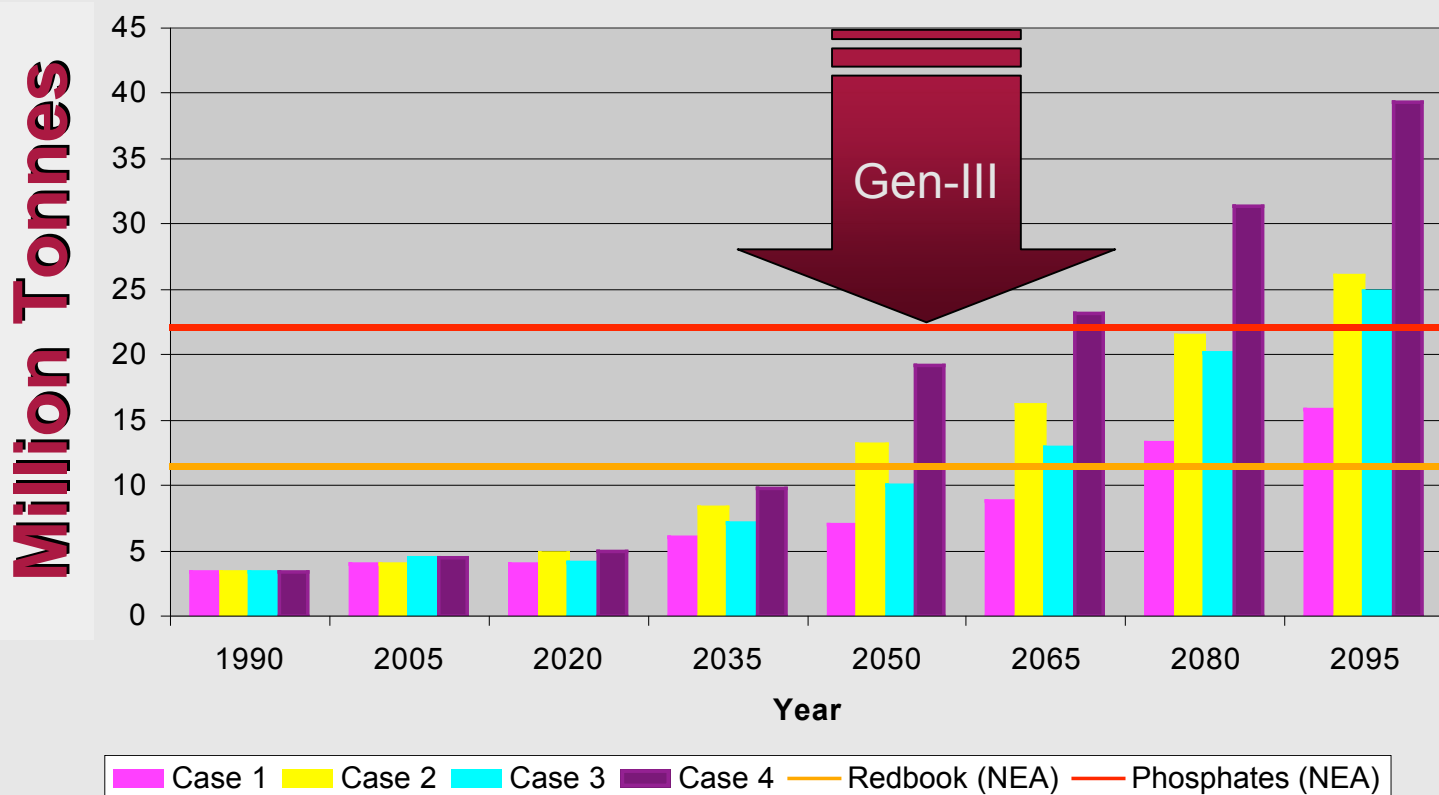
Global Climate Policy (550ppm) & Market Driven Gen-III Technology* Evolution



*** Assuming Success**

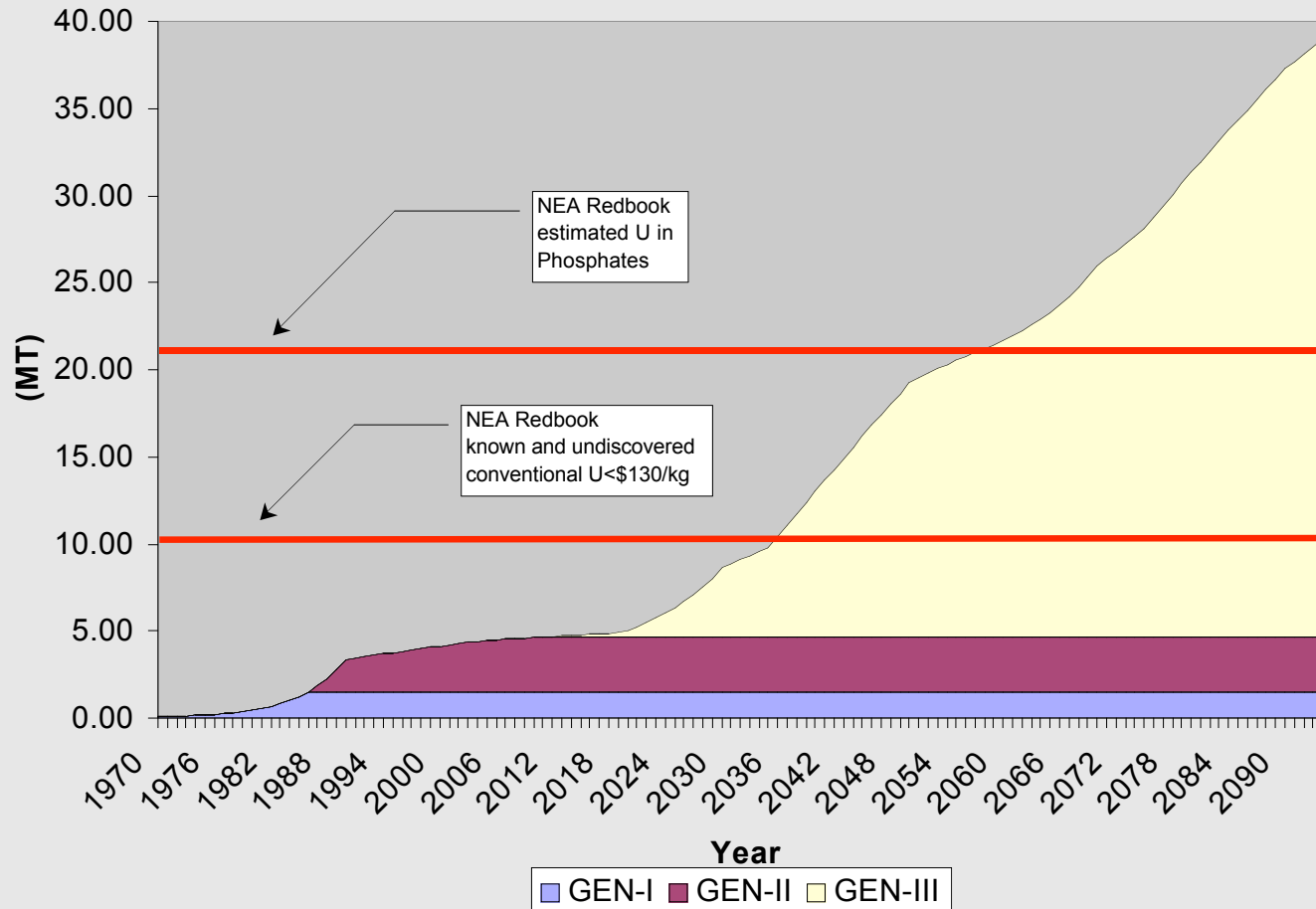
Market Adopts Reprocessing ~2050: Due to Cost Competition & Fuel Technology Advances

**Uranium Commitment
Market Driven Nuclear Pathways**



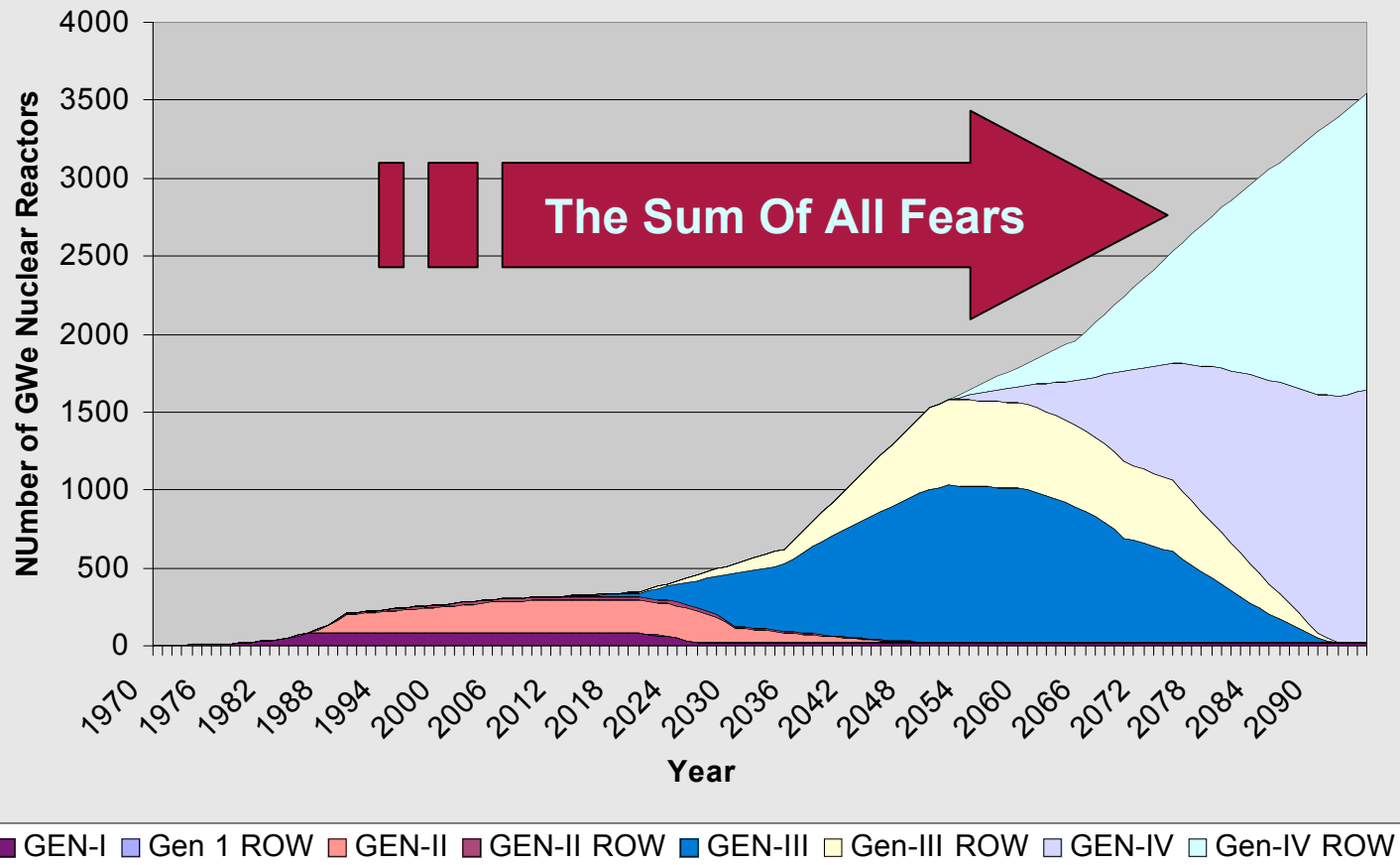
Is the Resulting Natural Uranium Commitment to GEN-III Sustainable?

Cumulative Uranium Commitment



An International Nuclear Regime May Be Essential For Sustainable Gen-IV Nuclear Power!

Regional Evolution of Reactor Technology



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Backup

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Estimates of Uranium Cost

