

Nuclear Power: Are the \$tar\$ Aligned?

Peter A. Bradford

Harvard Electricity Policy Group

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Don't Call It a Renaissance Until They've Shown You a Masterpiece



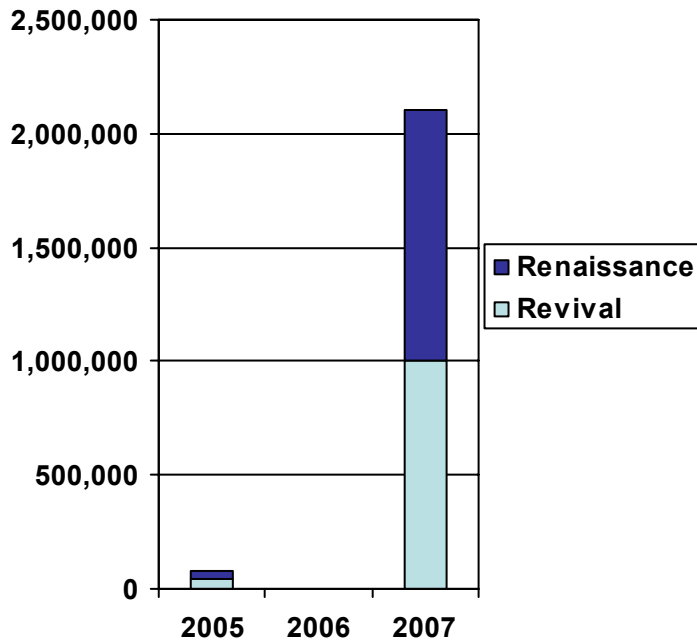
Current status of nuclear power

Country	Nuclear capacity GW (plants)	Percent of electric generation	Plants under construction
United States	100.3 (104)	19	1
France	63.3 (59)	79	1
Great Britain	11.0 (19)	18	0
Japan	47.6 (55)	34	1
Russia	22 (31)	14	7
Canada	12.6 (18)	13	0
Germany	20.3 (17)	29	0
South Korea	17.5 (20)	40	3
India	3.8(17)	03	6
Ukraine	13.1 (15)	48	2
China	8.6 (11)	02	5
World total	372 (439)	16	34

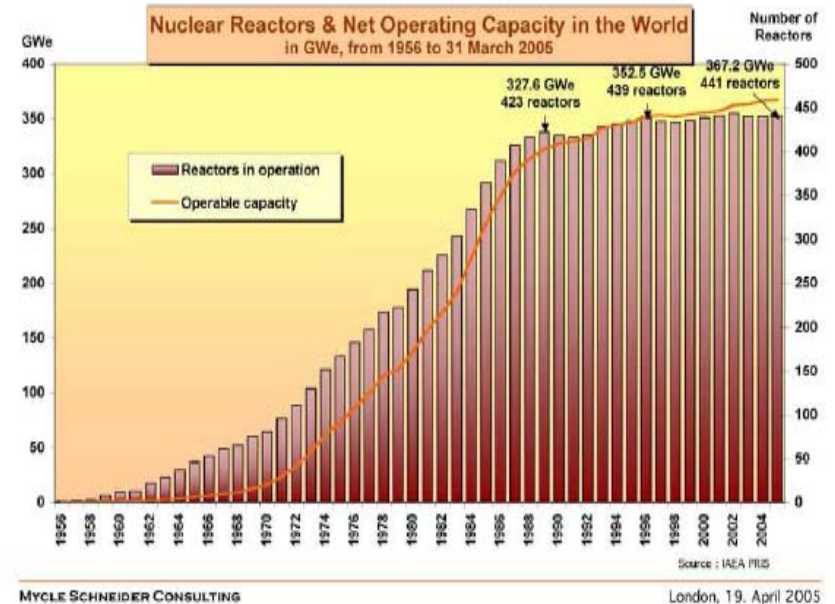
Data from the International Atomic Energy Agency, <http://www.iaea.org/programmes/a2/index.html>.

The Nuclear Renaissance: Rhetoric v. Reality

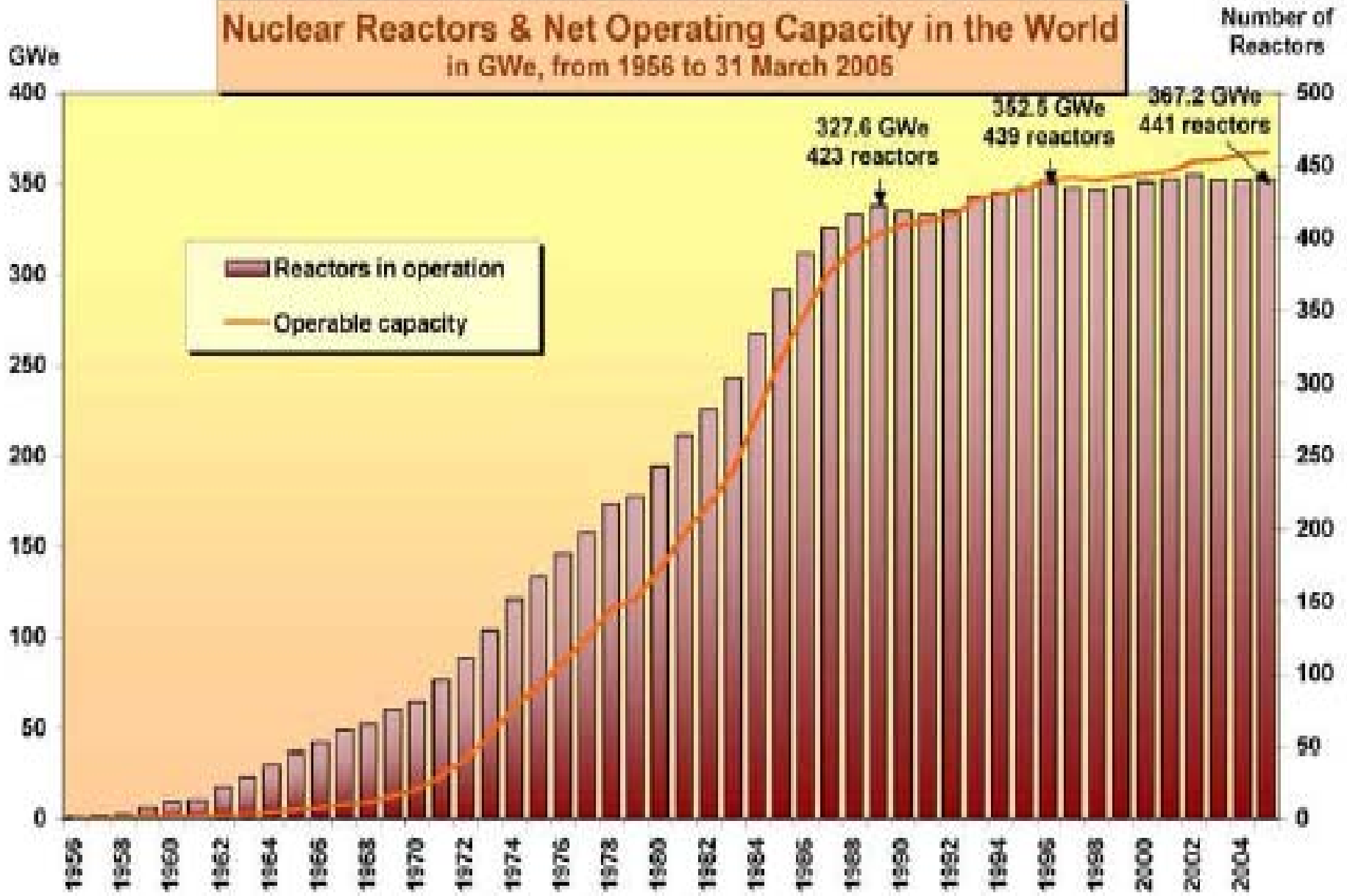
Mentions Per Google



Megawatts Per Reality

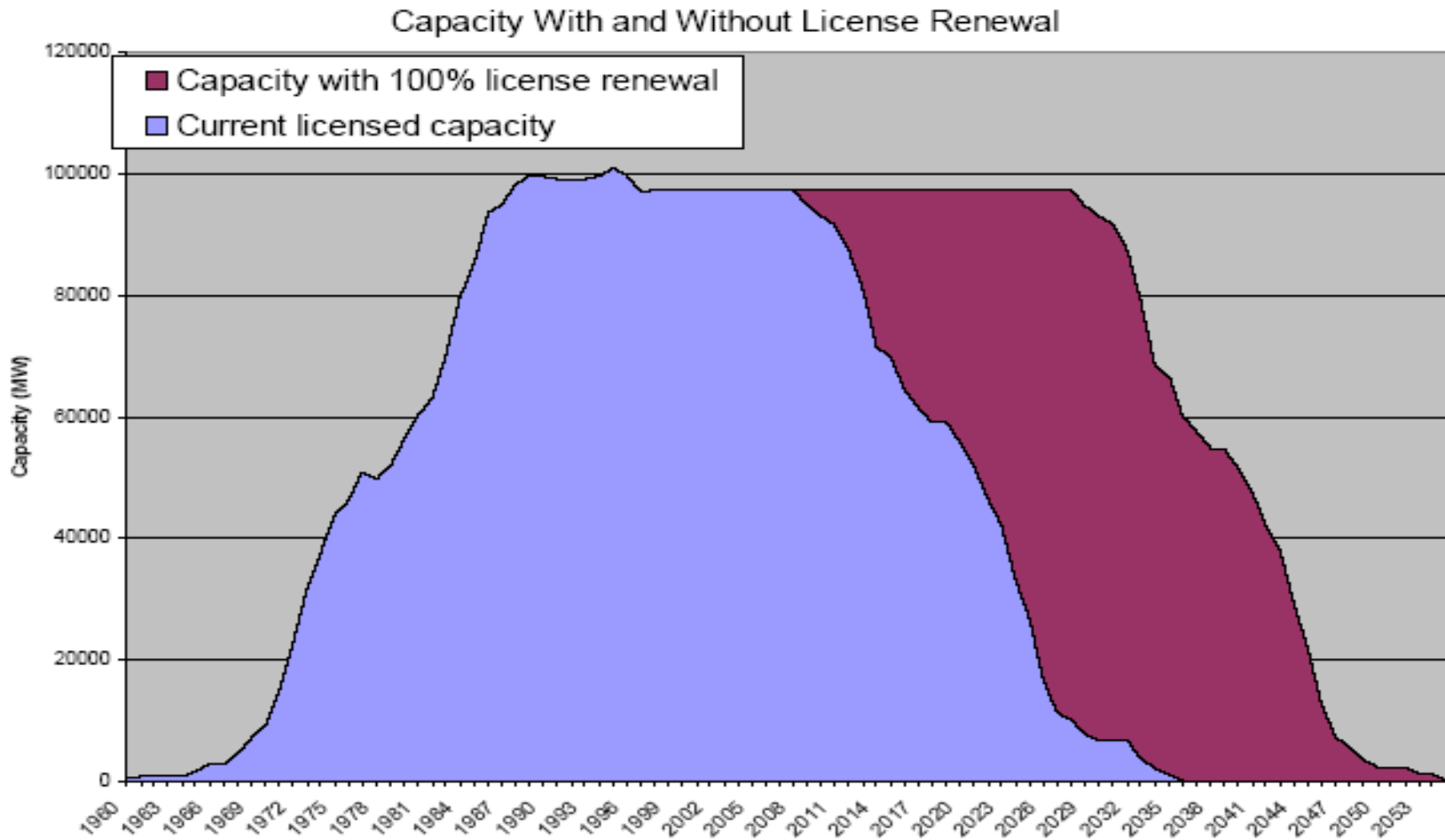


Nuclear Reactors & Net Operating Capacity in the World in GWe, from 1956 to 31 March 2005

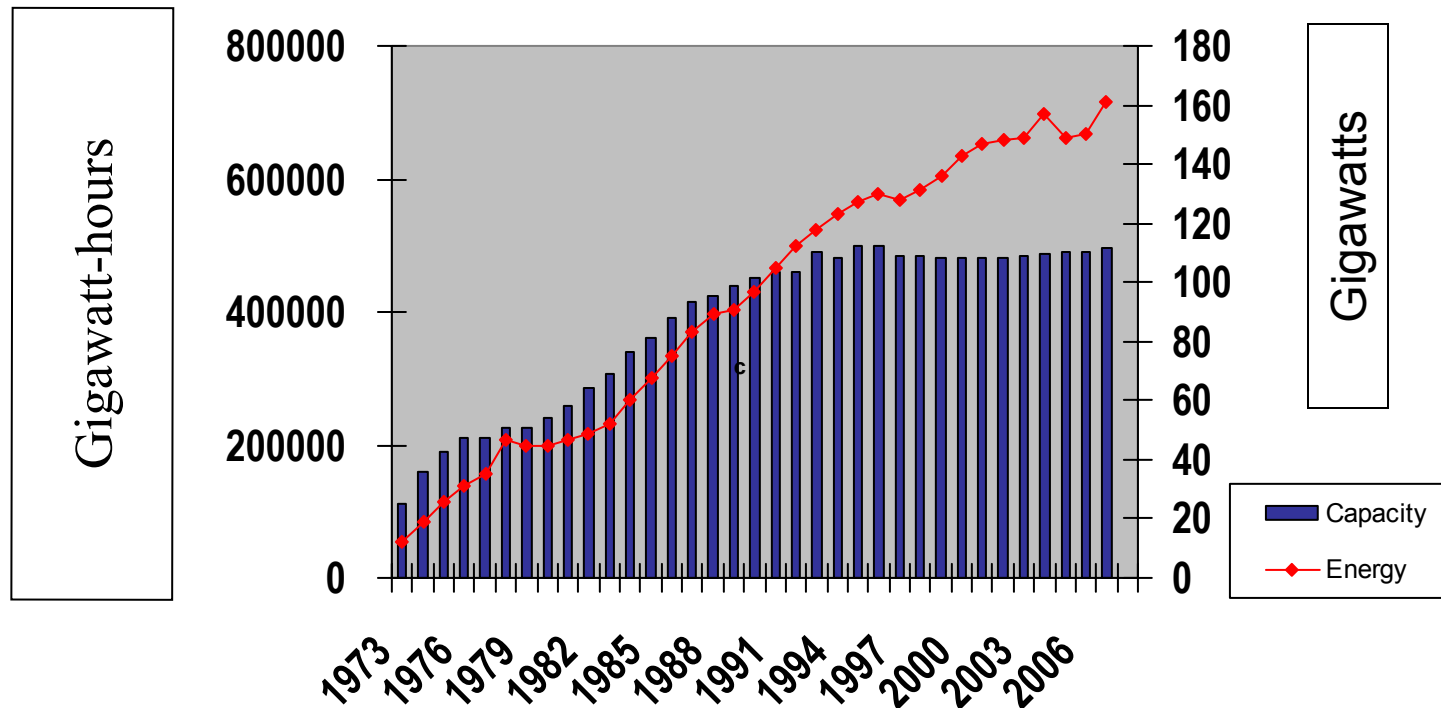


Source : IAEA PRIS

With Few New Units (Paul Joskow, MIT)



U.S. Nuclear Output and Nuclear Capacity, 1973-2006: Productivity Improvement in the Face of Competition



Possible Patterns of Future Nuclear Power Development in the U.S.

- As an antidote to climate change
- Holding its present 20% share
- Whatever “the market” decides

Antidote to Climate Change I

- U.S. share of a Pacala/Socolow wedge would be about 300GW by 2054.
 - All existing plants replaced
 - 300GW at 1.2GW per plant = 250 plants
 - 250 plants at \$5 billion apiece (2008 dollars) = \$1.25 trillion (U.S. trillion)
 - Plus enrichment and waste repositories.

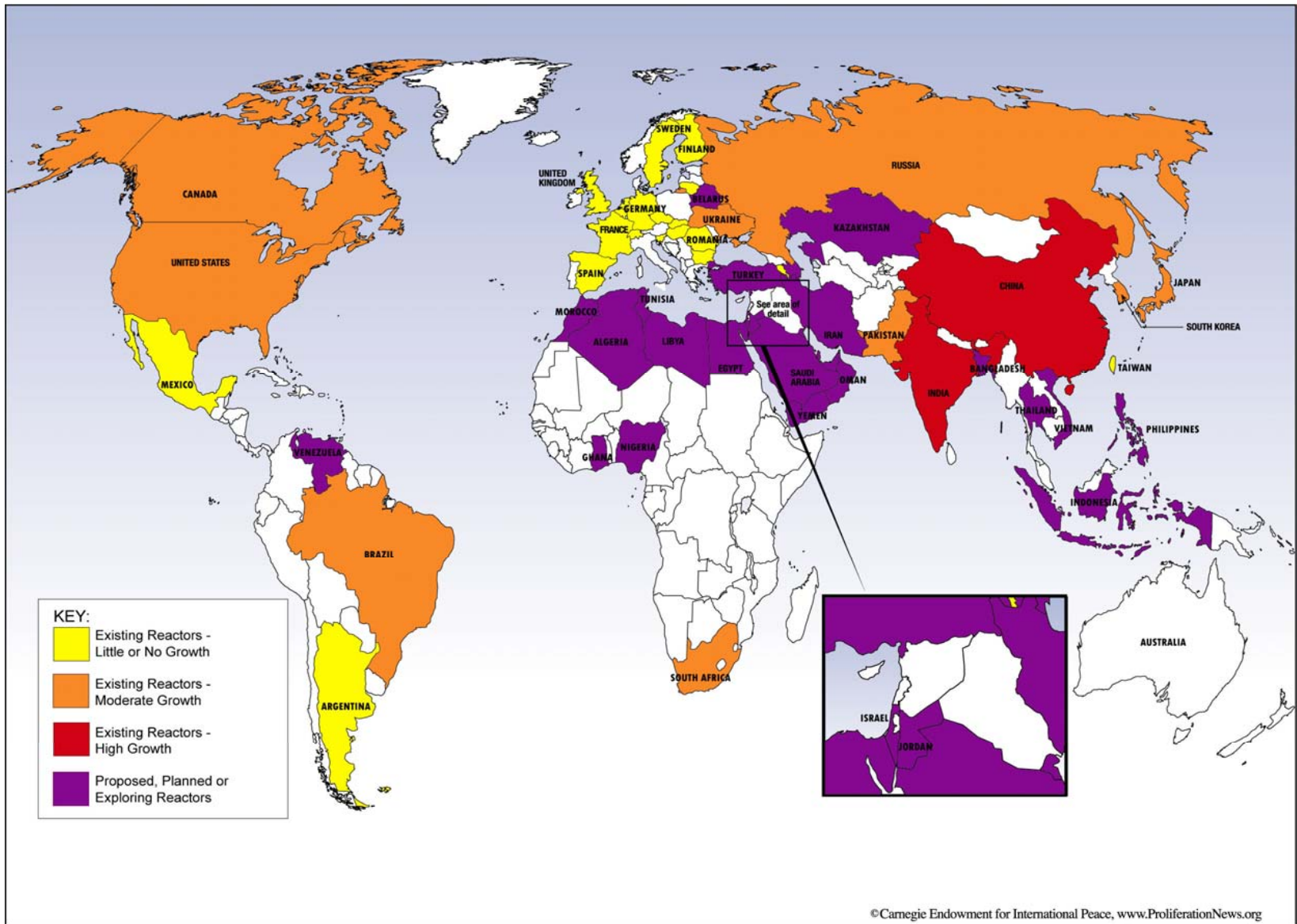
Antidote to Climate Change II

- What would it take to make this happen?
 - A sense that there was no realistic alternative, preferably endorsed (or at least acquiesced in) by some prominent environmentalists;
 - Putting costs in the federal budget so that customers don't pay them directly;
 - Charging costs to customers before plants are built in order to reduce the cost of capital by shifting risks off of investors.

Antidote to Climate Change III

- Might the U.S. spend that much on nuclear power (or set out to) even if better alternatives were available?
- Conclusion of a review of U.S. experience with irrigation and dam projects:
 - Not only is the U.S. capable of irrational public infrastructure projects on a large scale, but these expenditure have lasting consequences.

Where Will Nuclear Energy Grow?



Preconditions for Irrational Federal Infrastructure Exuberance

- Powerful federal agency on a mission
 - Bureau of Reclamation/Department of Energy
- Strong congressional sponsorship;
- Sense of urgent national need;
- Sense of strong job creation;
- Local support;
- Willingness to override clear evidence of more efficient and less damaging alternatives

Reasons to underwrite nuclear, as told

- To Wall Street and NRC
 - Mature technology;
 - Mature licensing process;
 - Enhanced public acceptance;
 - Costs under control;
 - Alternatives inadequate
- To Congress
 - Unproven technology;
 - Untested licensing process;
 - Vampire intervenors;
 - Costs unforeseeable;
 - Alternatives, although inadequate, might get ruinously cheaper.

Antidote to Climate Change IV – “Policy Enhanced Investing”

- Engage the taxpayer and customer as an ally and investor in the future of nuclear industry.
- Redirect discussions of nuclear subsidies or uncompetitive new generation to more favorable topics such as the “low marginal costs” of existing power plants.
- Shift as many technical, financial, procedural, and environmental risks as possible onto external parties.
- Distribute as little of the return to risk-sharing partners as possible.

(Doug Koplow – Earthtrack)

Holding the 20% share II

- What would it take?
 - At 1.5% growth, about 200GW by 2054
 - 200GW at 1.2GW per plant = 166 plants
 - 166 plants at \$7 billion apiece = \$1.1 trillion
 - Plus enrichment and waste repository(ies)

Recent Federal Nuclear Support

- 1.8 cent/kwh production tax credit
- Accident liability limit renewal
- Delay insurance (.7-.8¢/kWh for 1st tier)
- All this plus licensing cost sharing and the evisceration of public involvement;
- Funding for GNEP;
 - \$750 million over last 6 years, \$300 million more requested in next fiscal year
- \$18.5 billion for loan guarantees.

Loan guarantees distort credit markets

(Weidenbaum et al)

- Federal credit programs merely shift funds from one borrower to another. They do not increase the funds available to the economy.
- Who gets squeezed out? New and small businesses, school districts and smaller local governments and individuals, private mortgage borrowers not under the federal umbrella. The unsubsidized borrowers wind up paying higher interest rates.
- Federal credit programs put the government in the position of holding assets of questionable quality or limited use, making it difficult to recover the original value of the loans in the case of default, and complicating the process of liquidating the agency.
- Loan guarantees undermine a basic function of credit markets, i.e. distinguishing credit risks and assigning appropriate risk premiums;
- In stressed credit environment guarantees could exacerbate weakening of dollar and inflationary concerns

Loan guarantees distort power markets

- To investors nuclear power will be less risky and will promise higher returns (because the equity owners will need to put up less capital).
- To regulators and to market operators, nuclear power will seem less expensive because risks have been shifted to taxpayers
- Loan guarantees hide the true cost from consumers and thereby encourage wasteful consumption practices
- Thus both public and private investment will be disproportionately shifted toward nuclear power

The Loan Guarantee Cost Overrun

- In 2005, Congress believed that the EPA Act support package (including \$4 billion for loan guarantees) would be enough to allow a few “first mover” nuclear units to demonstrate the new designs and the new licensing process
- Now, Congress is told that unless the industry gets far more, the “nuclear renaissance” will be stillborn because “there is not going to be any financing.” [The Hill](#), May 24, 2007
 - This jump in two years from \$4 billion to \$50 billion or more is the greatest nuclear cost escalation in history, and no one has even broken ground yet.

Are the Default Risks Real?

- In the 1990s, nuclear power was the largest beneficiary of a rescue that Moody's estimated at "between \$50 billion and \$300 billion" and necessary to avoid bankruptcy for several major utilities.
 - These were the "stranded cost" surcharges that accompanied electric restructuring and charged the unrecoverable costs of nuclear power to the customers
 - Loan guarantees would charge the next rescue to the taxpayers instead of the customers, and would do so before the fact.
 - At \$50 billion, the stranded cost rescue would have amounted to \$500 million per plant, so a one time loan guarantee fee would have had to exceed 15% (assuming debt of \$3 billion/plant) to be revenue neutral.
 - Exelon recently proposed "7 to 8 percent".

Are the Default Risks Real?

- Fifty-one nuclear plants have shut down for a year or longer;
- As many U.S. plants were canceled as completed, some after billions spent;
 - Much maligned “old” NRC licensing process licensed more plants (200+) than next four countries combined. No rejections.
- Some cost overruns bankrupted N-plant builders in the 1970’s/1980’s; several others nearly did so.

Are the Default Risks Real?

- West Valley reprocessing plant opened in 1966, hailed by NY Governor Rockefeller as “in the best tradition of the American free enterprise system...this state sponsored project, operating through private enterprise with federal cooperation, places NY in the forefront of the atomic industrial age now dawning”
 - Closed in 1972 with an 18% lifetime capacity factor
- Leaving NY as guarantor with a \$250 million cleanup bill and the US with a \$5 billion bill in 2008 dollars
- Job still not complete

Are the Safety Risks Real

- Nuclear safety risks increase when we behave as though the plants will be safe because they are needed.
- All of the reviews of the Three Mile Island accident cautioned that the NRC was putting too much emphasis on licensing rather than overseeing the existing plants
 - Nuclear power develops best when it grows apart from politically driven mandates and expectations

The 1980 Renaissance

- “Halfway between ecstasy and euphoria”
- Intense federal support for expedited licensing, reprocessing, advanced reactors, cheerleading.
- Achievements
 - No new license applications
 - No reprocessing
 - No breeders
 - Waste repository date slipped two years/year

Are Nuclear Investments Really “Too Large for the Private Sector”

- TransAlaska Pipeline cost some \$7 billion in 1970s and was privately financed.
- Problem with nuclear is not investment size but risk.

Are Nuclear Investments Really “Too Large for the Private Sector”

- [NuStart](#), [TVA-led](#), and [Dominion-led](#) initiatives.
- Financially strong:
 - \$430 **billion** in revenues during 2003 -- rivaling the entire Russian Federation and beating the *combined* GDP of 104 different countries!
 - 8 members among the world’s 500 largest global corporations (GE is number 9).
 - 3 additional members among 500 largest in the US; one among the biggest US private firms.
 - 3 members are governments.
- Politically-savvy:
 - Of 11 US-based private sector members, six were among the [highest donors](#) to the 2004 election cycle for energy/natural resources sector.
 - Two (GE and Southern) are amongst the [top 100 donors](#) since 1989 to politicians.

(Koplow, Earthtrack, 2005)

Are Loan Guarantees for Nuclear Power Crucial to Fighting Climate Change?

- They could divert public and private money and attention from the several measures that will provide greater returns more quickly.

Ingredients of a Sustainable Nuclear Renaissance

- Significant number of new plants per year financed by private capital;
- Successful participation in competitive power supply markets;
- A waste disposal program decisively underway;
- A nonproliferation regime adequate to the nuclear fuel cycles in prospect;

Sensible Energy Policy that Might (or Might Not) Improve Nuclear Power Prospects

- Implement climate change policy that recognizes value of all carbon reducing technologies, including carbon sequestration, energy efficiency and renewable energy
 - Carbon caps and markets, or
 - Carbon taxes
 - Production tax credits
 - Remove liability limitations for future projects
- Use neutral market mechanisms – i.e. auctions, integrated resource planning - to choose least costly approaches among these;
- Avoid “pin-the-tail-on-the-donkey” energy policy making;
- Take the time to deal sensibly with waste, proliferation and safeguards;
- Rigorous prioritization of options for research purposes – effective, efficient, expeditious;
- Revive Office of Technology Assessment

The 15 Wedges (Scientific American, 9/06)



A Wedge

- Prevent 1 billion tons carbon per year by 2054;
- Scaling up only of technologies already deployed on an industrial scale;
- Seven needed to stabilize CO₂ at 500ppm;
 - More may be needed

Wedges 1-5

- 1) Doubling fuel efficiency of 2 billion cars from 30 to 60 mpg
- 2) Decreasing the number of car miles traveled by half
- 3) Using best efficiency practices in all residential and commercial buildings
- 4) Produce twice today's coal power output at 60% instead of 40% efficiency (compared with 32% today)
- 5) Replacing 1400 coal electric plants with natural gas-powered facilities

Wedges 6-10

- 6) Capturing and storing emissions from 800 coal electric plants;
- 7) Producing hydrogen from coal at six times today's rate and storing the captured CO₂;
- 8) Capturing carbon from 180 coal-to-synfuels plants and storing the CO₂;
- 9) Adding double (i.e. tripling) the current global nuclear capacity to replace coal-based electricity;**
- 10) Increasing wind electricity capacity by 50 times relative to today, for a total of 2 million large windmills;

Wedges 11-15

- 11) Installing 700 times the current capacity of solar electricity
- 12) Using 40,000 square kilometers of solar panels (or 4 million windmills) to produce hydrogen for fuel cell cars
- 13) Increasing ethanol production 50 times by creating biomass plantations with area equal to 1/6th of world cropland;
- 14) Eliminating tropical deforestation and creating new plantations on non-forested land to quintuple current plantation area:
- 15) Adopting conservation tillage in all agricultural soils worldwide

The Nuclear Wedge

- Doubling of nuclear power really requires tripling the existing capacity (372GW/438plants) because today's plants must be replaced.
 - Probably 700-900 new plants needed to get 1100GW
- Assumes nuclear replaces all coal. In fact, nuclear will replace some gas and large hydro, requiring more new capacity to make a wedge.
- Prodigiously difficult and expensive, but so are many of the wedges.