COUNCIL on FOREIGN RELATIONS

Nuclear Renaissance and the U.S.-Japan Alliance: Finding New Markets and Preventing Proliferation

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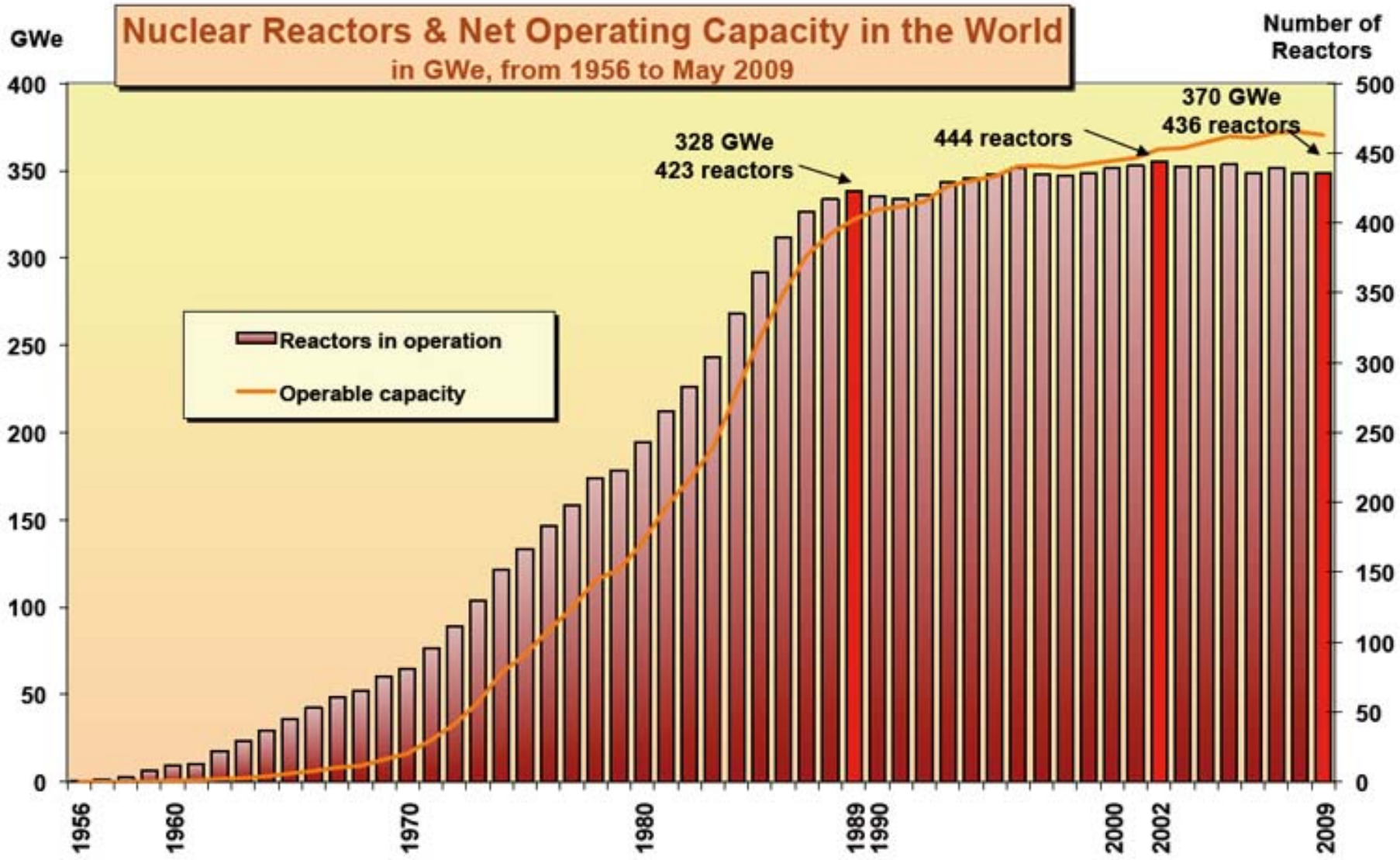
Agenda

- Overview of historic and current use of nuclear energy worldwide
- Projected future use – Will there be a “renaissance”?
- Globalization of nuclear industry and economic competitiveness
- Effectiveness of GE-Hitachi and Toshiba-Westinghouse in gaining market share and reactor orders
- Brief look at India’s opening market for foreign nuclear vendors
- Future opportunities and markets
- The Bigger Picture: Security and Energy Use



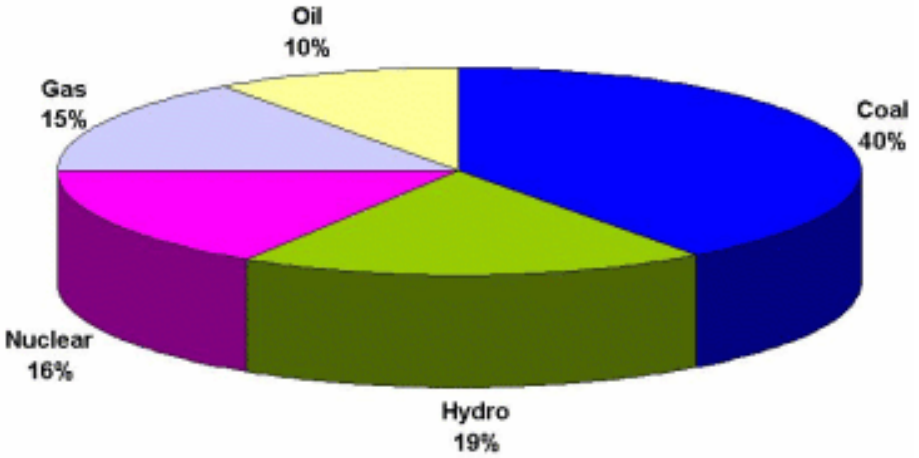
Sources: IAEA PRIS and Mycle Schneider Consulting

Nuclear Power Today

- **about 15% of global electricity demand and about 8% of total global energy**

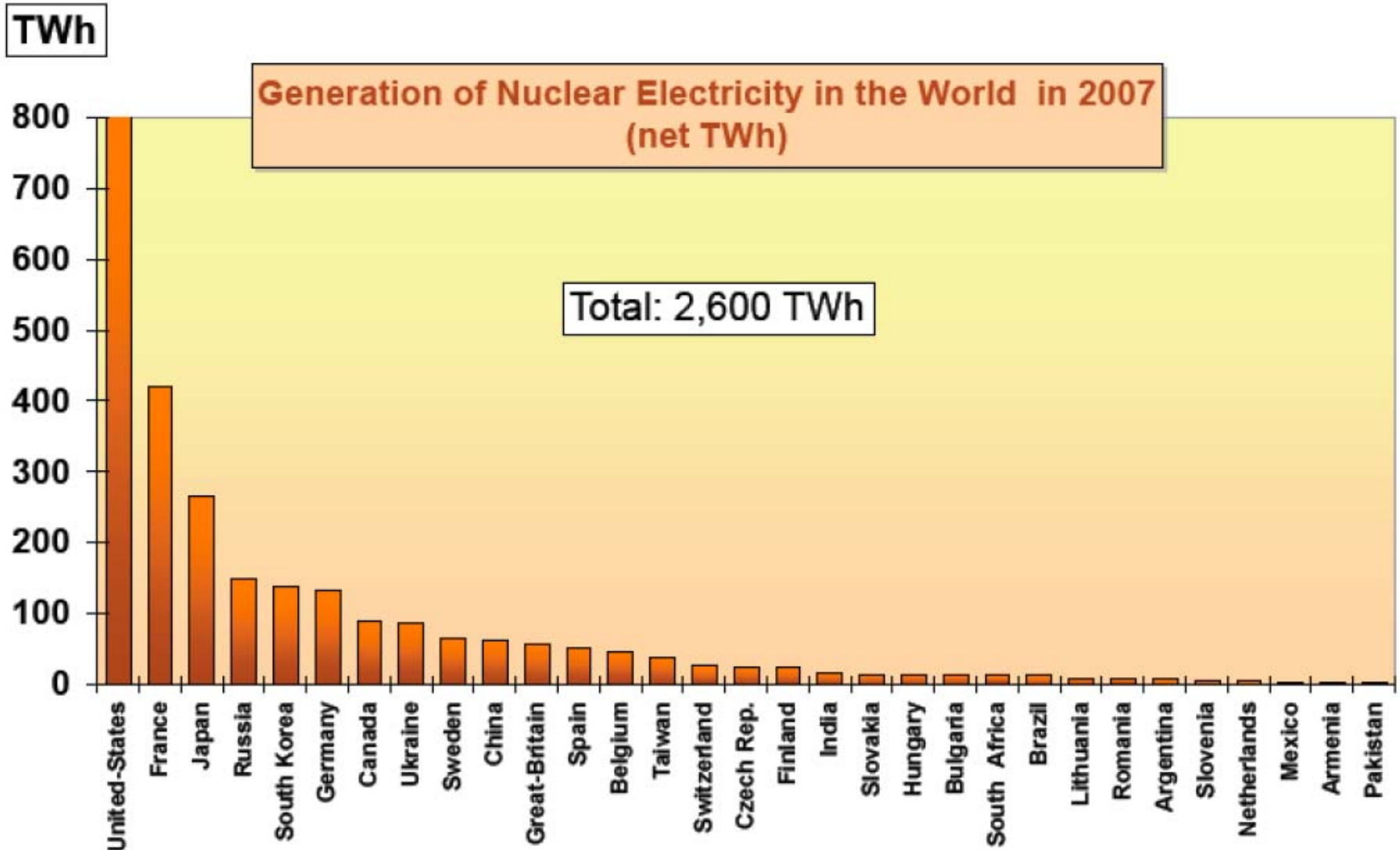
- **31 countries operating 436 reactors (370 GW)**
  - ➢1 GW or 1,000 Megawatts can power about 1 million homes in a developed country

- **11 countries enriching uranium (50 million SWU capacity)**



- **5 countries reprocessing spent fuel commercially**

- **0 countries with geologic repositories for nuclear waste**



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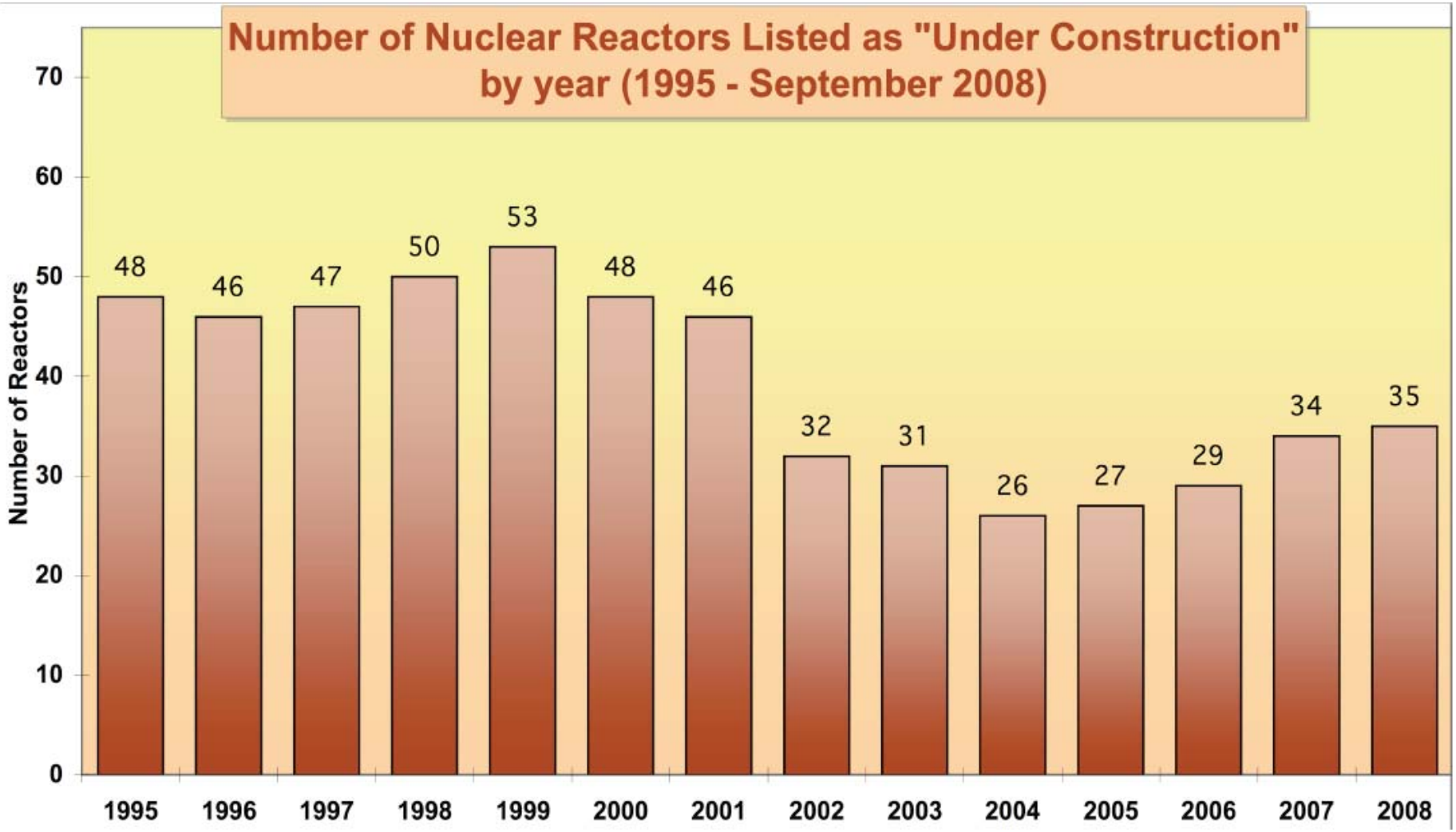


Sources: IAEA PRIS and Mycle Schneider Consulting

Recent Nuclear Power Developments

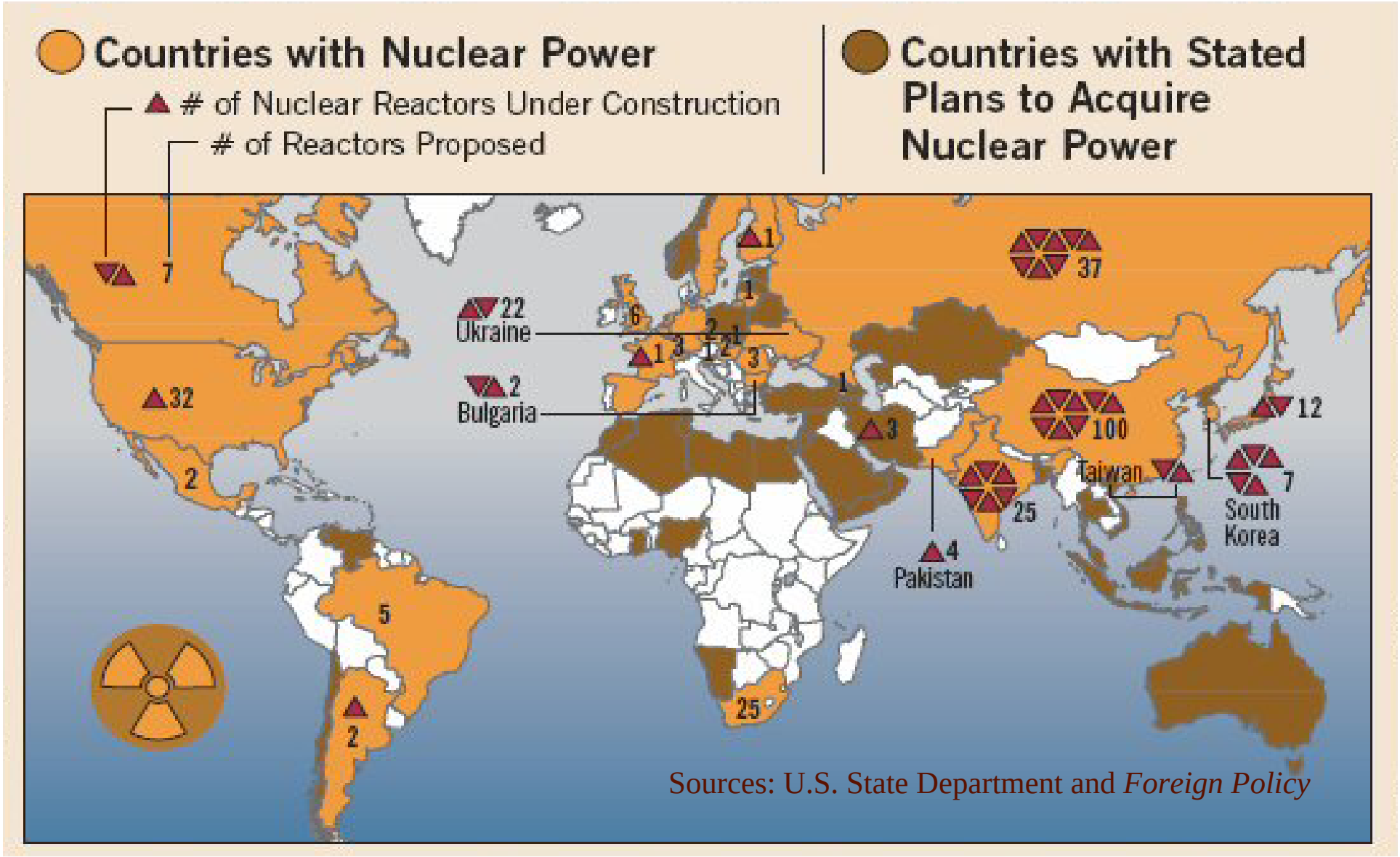
- As of June 2009 the International Atomic Energy Agency (IAEA) listed 436 operating nuclear reactors in the world, eight less than in 2002—the peak year.

- No new unit went online in 2008—first time in commercial nuclear power history that a year has gone by without a new unit.

- Three reactors were shut down in 2008.

- In 2008, the total installed capacity went down by about 1,600MW, equivalent to an EPR (European Pressurized Water Reactor) as under construction in Finland and France.

Proposed New Reactors



Barriers to New Build

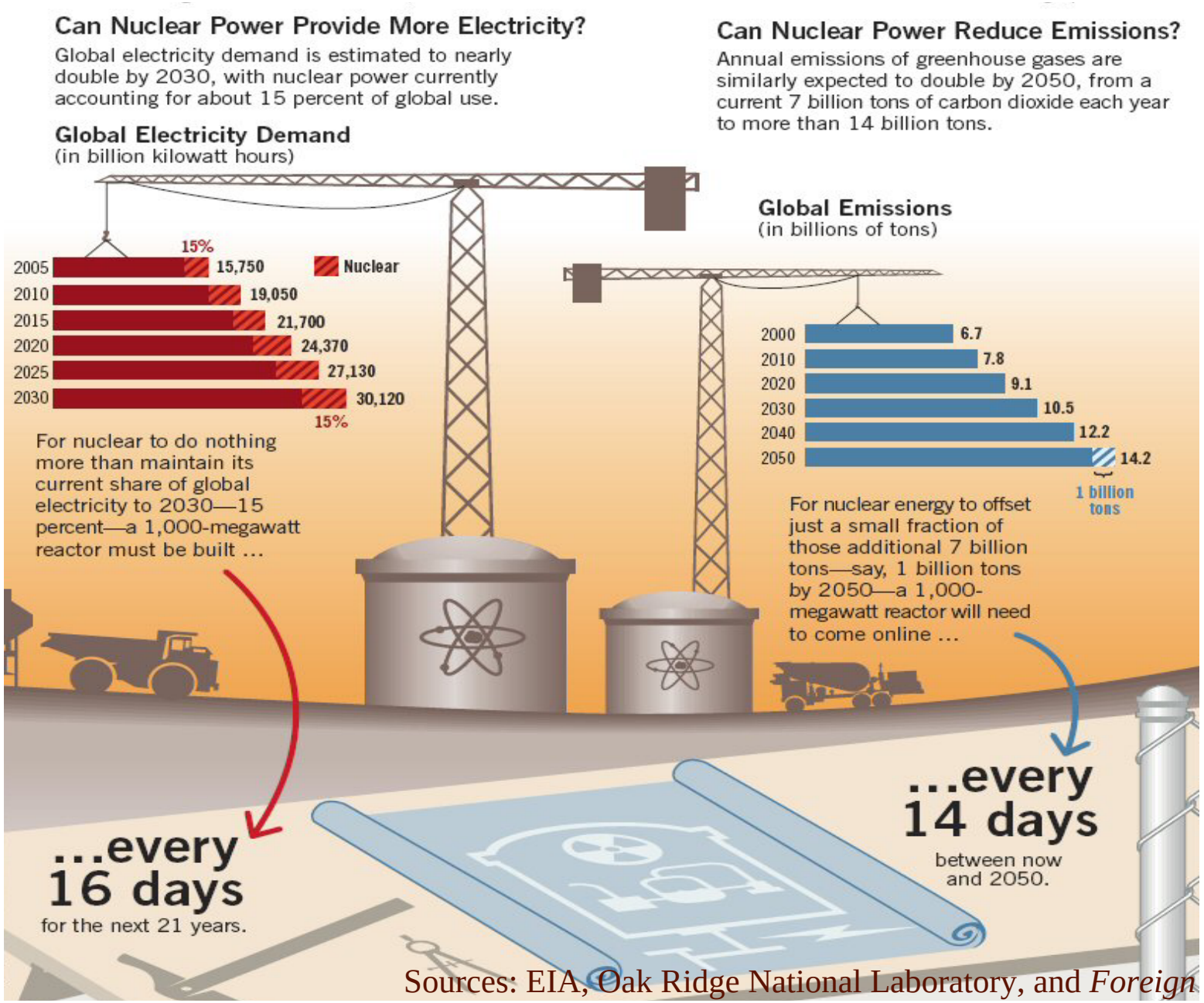
- Many factors complicate new nuclear build
  - Cost
  - Time
  - Personnel

Sources: IAEA PRIS and *Foreign Policy*

Nuclear Power's Usage and Share of Electricity

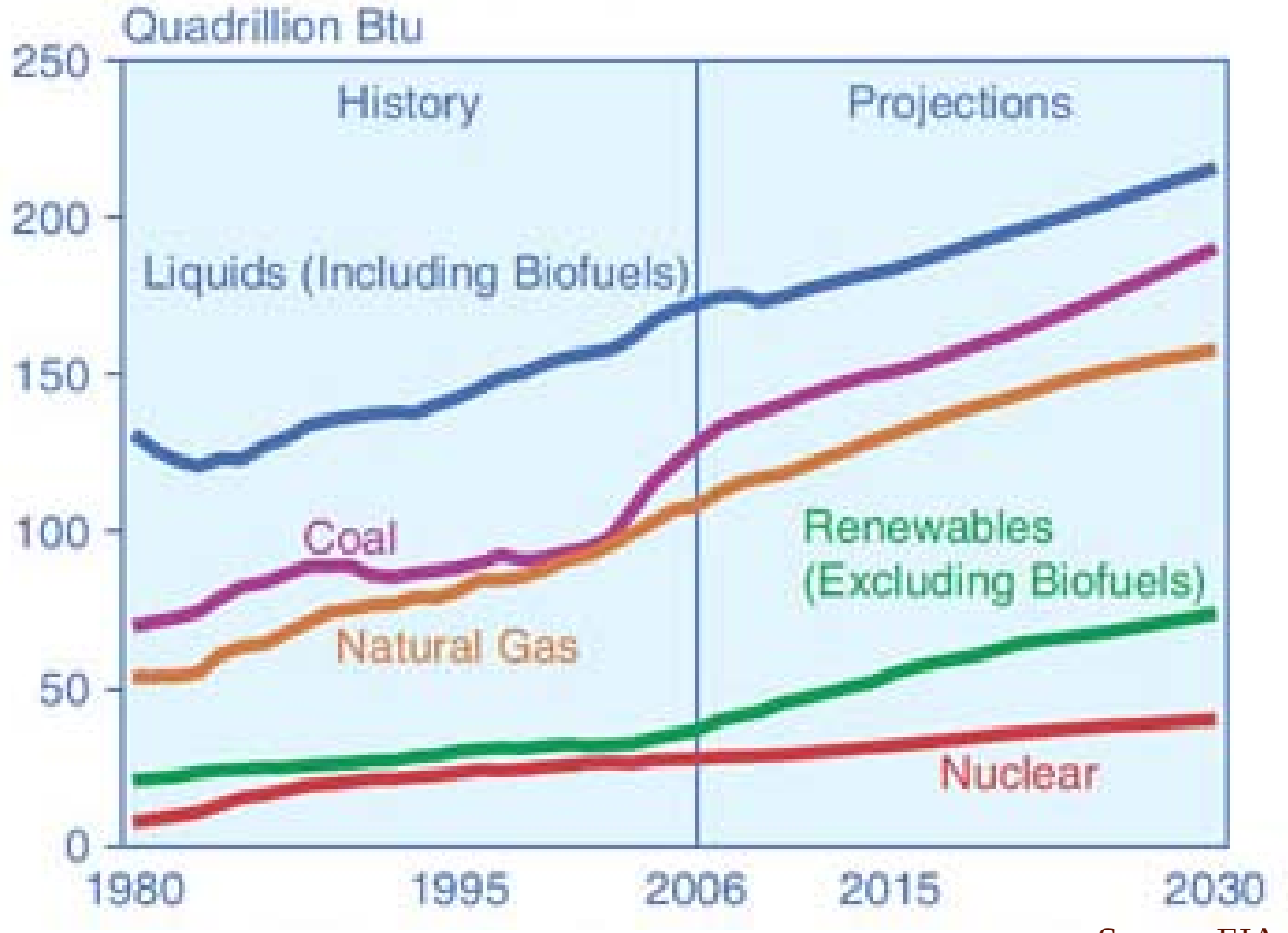
- A country's use of nuclear power has much to do with government intervention, for example:
  - Streamlined regulations
  - Loan guarantees, tax credits, and additional incentives
  - Other policies, possibly carbon pricing in the future
- Use also depends on fossil fuel availability and pricing
- Capital costs for coal and gas power plants significantly lower than nuclear plants – inverse relationship for fuel costs

- Although major developing countries have proposed many new reactors, China, Brazil and India, in particular, rely on nuclear for just small fractions of their electricity needs and will remain that way for at least the next couple of decades.



Sources: EIA, Oak Ridge National Laboratory, and *Foreign Policy*

Energy Capacity Projections to 2030

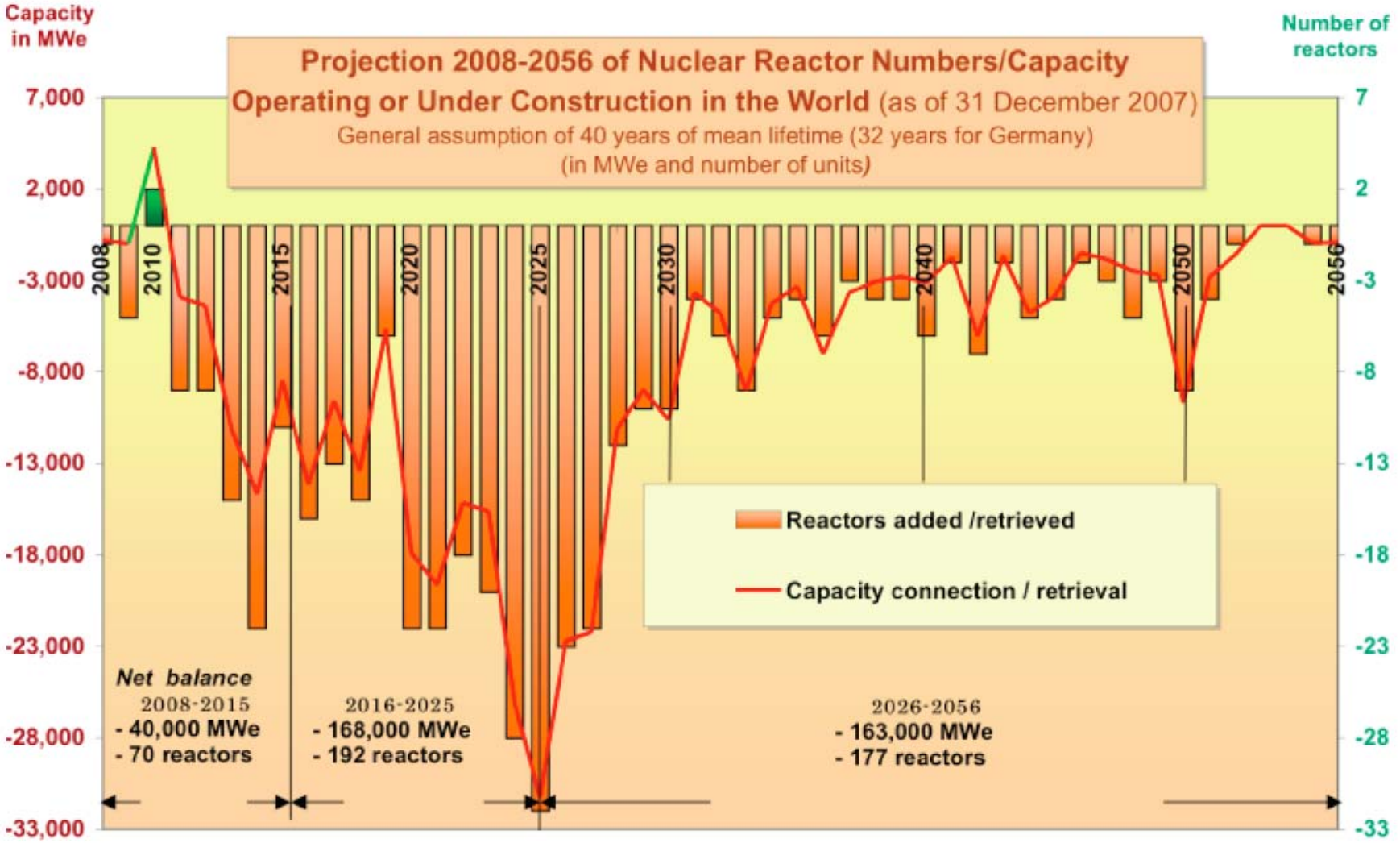


Source: EIA

Electricity Generation Projections to 2030

Source: EIA

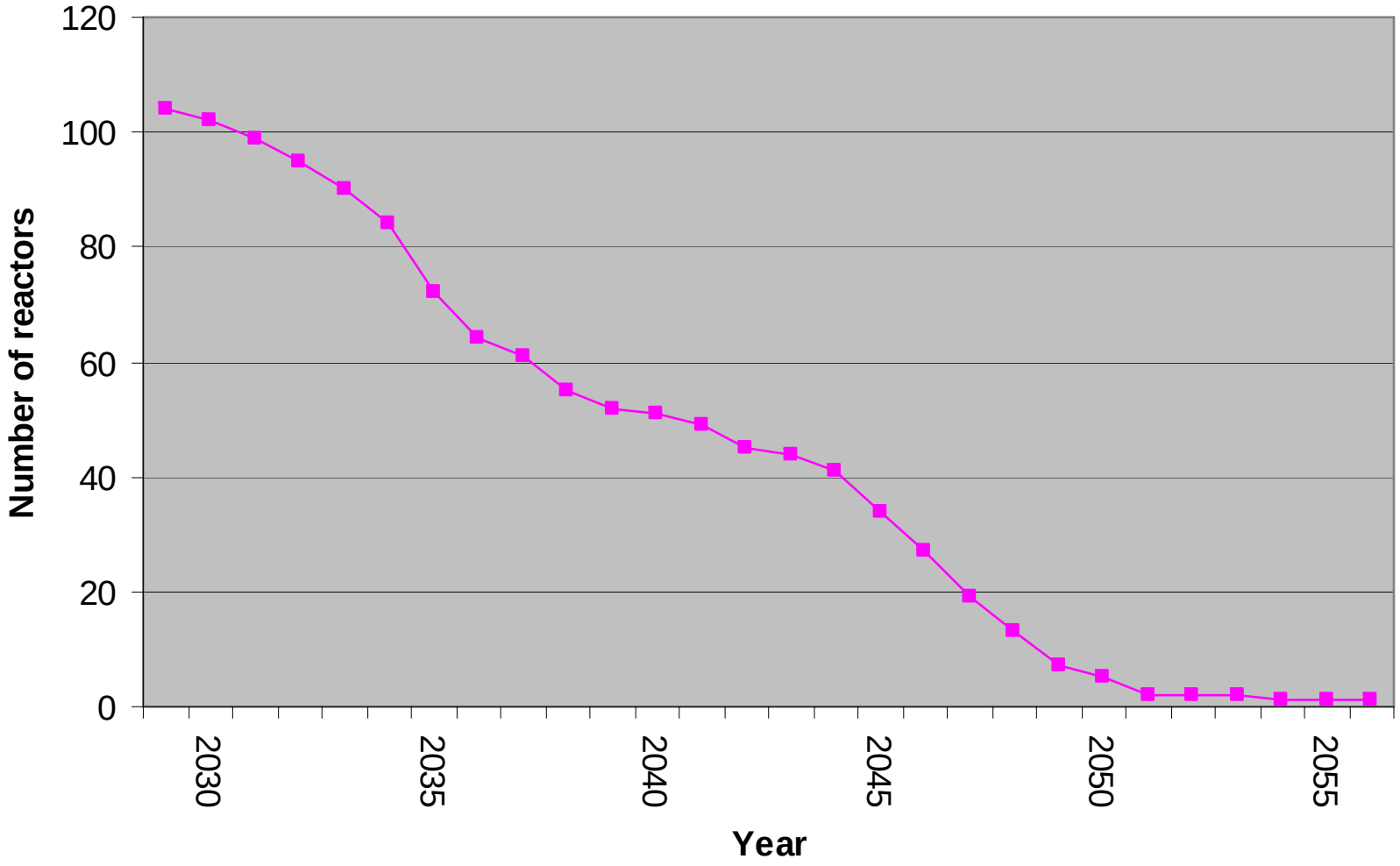
More Pessimistic or Realistic Projection?



Sources: IAEA PRIS and **Mycle Schneider Consulting**

Aging U.S. Nuclear Fleet

(graph assumes 20 year life extensions for all 104 currently operating reactors)



Economic Competitiveness: Increasing Globalization of Nuclear Industry

Offering BWR and PWR, the two mainstream systems in the world

TOSHIBA
BWR business

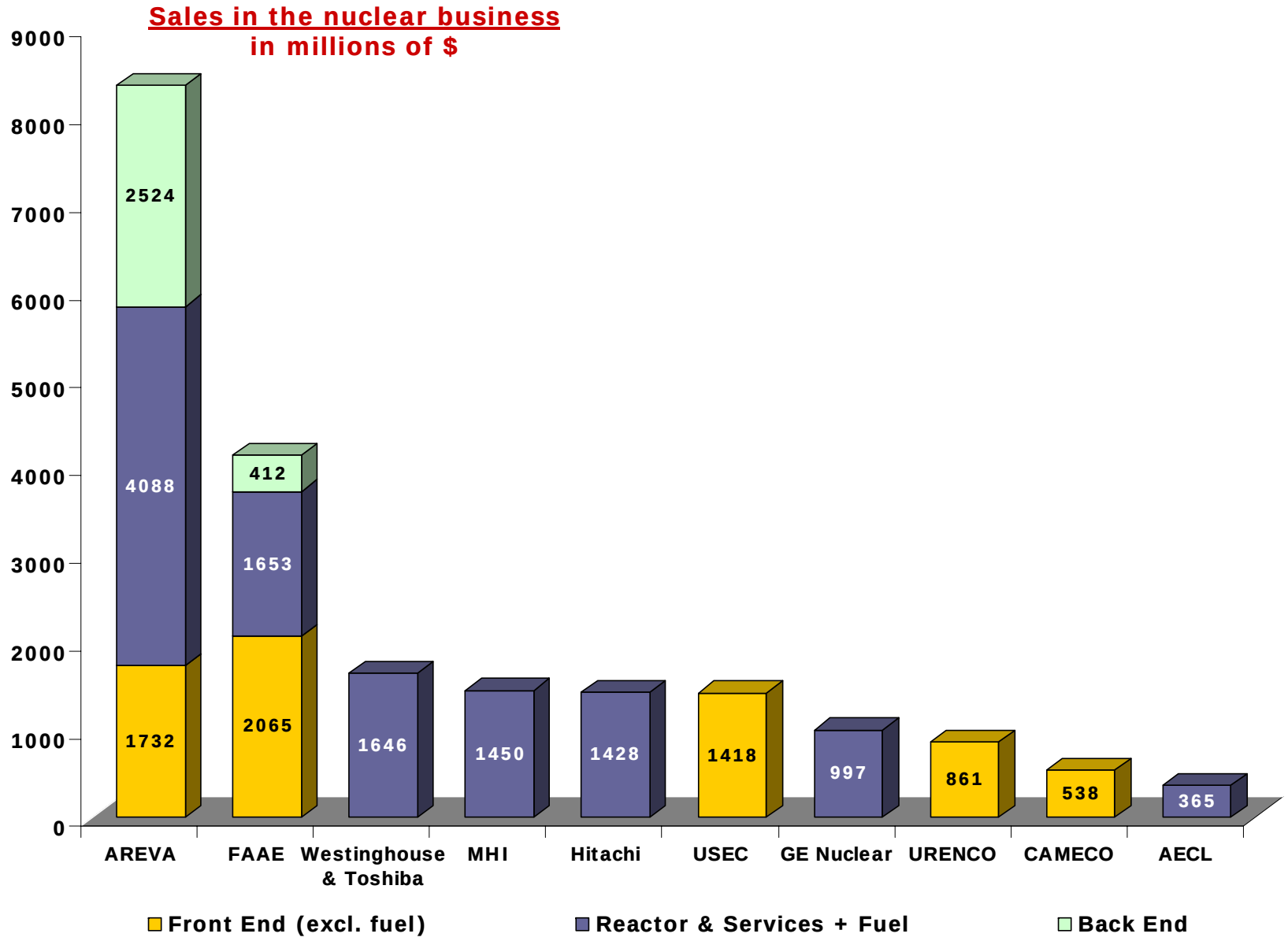
Westinghouse
Centering on PWR business

To become the world leader in the nuclear power plant business

EDF
Electricité de France

GE | HITACHI

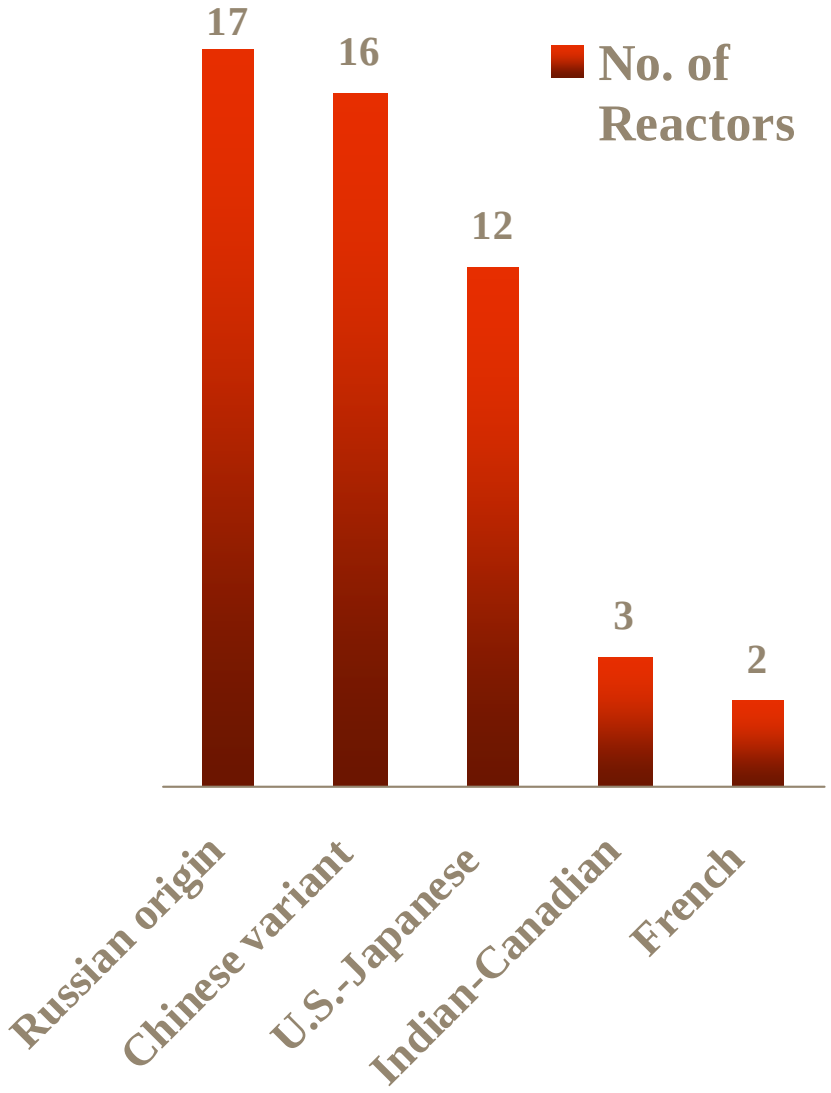
Share of Nuclear Market by Vendor



Source: Areva (end of 2007)

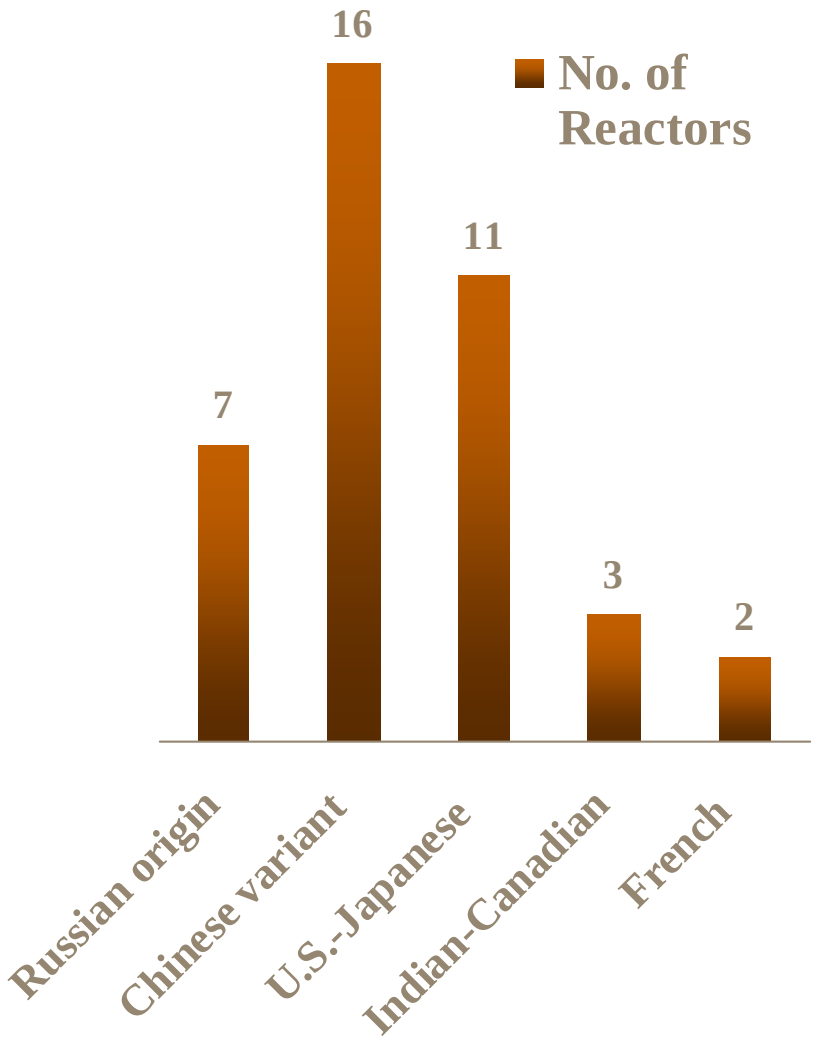
Reactors Under Construction: What Designs are Being Used?

- The IAEA currently lists 53 reactors as "under construction"
  - This is 18 more than at the end of 2008
- More than two-thirds of the reactors under construction are in China, India, Russia, and South Korea.
- Two-thirds of the reactors under construction are of Russian or Chinese (French derived) design.



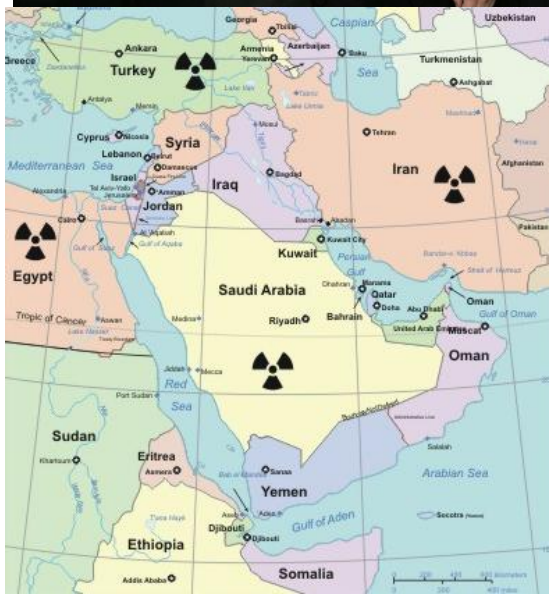
Reactor Construction since 1999

- One-quarter of reactors considered "under construction" by the IAEA have had this status for over 20 years
- If one considers only reactors for which construction has begun in the past ten years
  - Nearly two-thirds are Russian or Chinese (French tech transfer) reactors
  - **More than one-quarter are from U.S.-Japanese commercial alliances or from U.S. or Japanese companies prior to the alliances being formed**



U.S.-Japan Nuclear Alliance and Emerging Nuclear Markets

- French and Russian firms appear to have an edge in signing or nearing agreements with emerging markets.
- Since 2006, France has cooperation agreements with several Arab states as well as Thailand and Vietnam. French firm Areva appears to have the lead position with the UAE – a $40 billion market.
- Russia has several new agreements with Belarus, Jordan, Nigeria, and Turkey. It has been building reactors in India and Iran.
- The U.S. has also signed some new nuclear cooperation agreements with, for example, Egypt, Indonesia, India, Morocco, and the UAE.
- But the U.S. and Japan overall appear to have had more limited engagement with emerging markets than France and Russia.



India's Emerging Nuclear Market

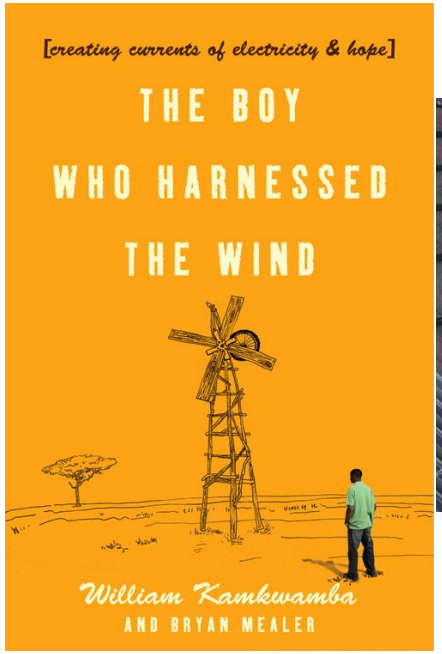
- The 2008 approval of the U.S.-India nuclear deal has opened up India for not just U.S. companies but for French and Russian firms (Russia already is building at Kundukulam).
- New foreign-supplied reactors will be under safeguards. But there are no serious constraints on India's weapons program.
- New Delhi recently announced selection of foreign vendors for reactor sites:
  - GE-Hitachi (ABWR) at Chhayamithi Virdi in Gujarat state
  - Westinghouse-Toshiba (AP1000) at Kovvada in Andhra Pradesh state
- Remaining stumbling blocks:
  - Liability agreement needed for U.S. vendors
  - Resolution of India's request to reprocess U.S.-origin spent fuel

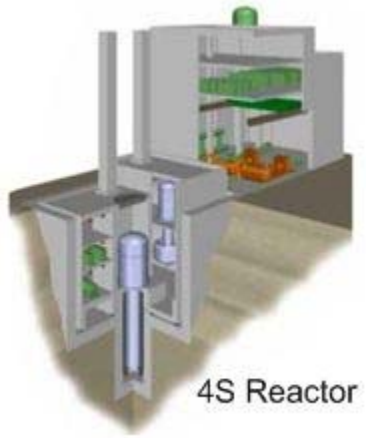
Nuclear Energy, Nonproliferation, and Global Security

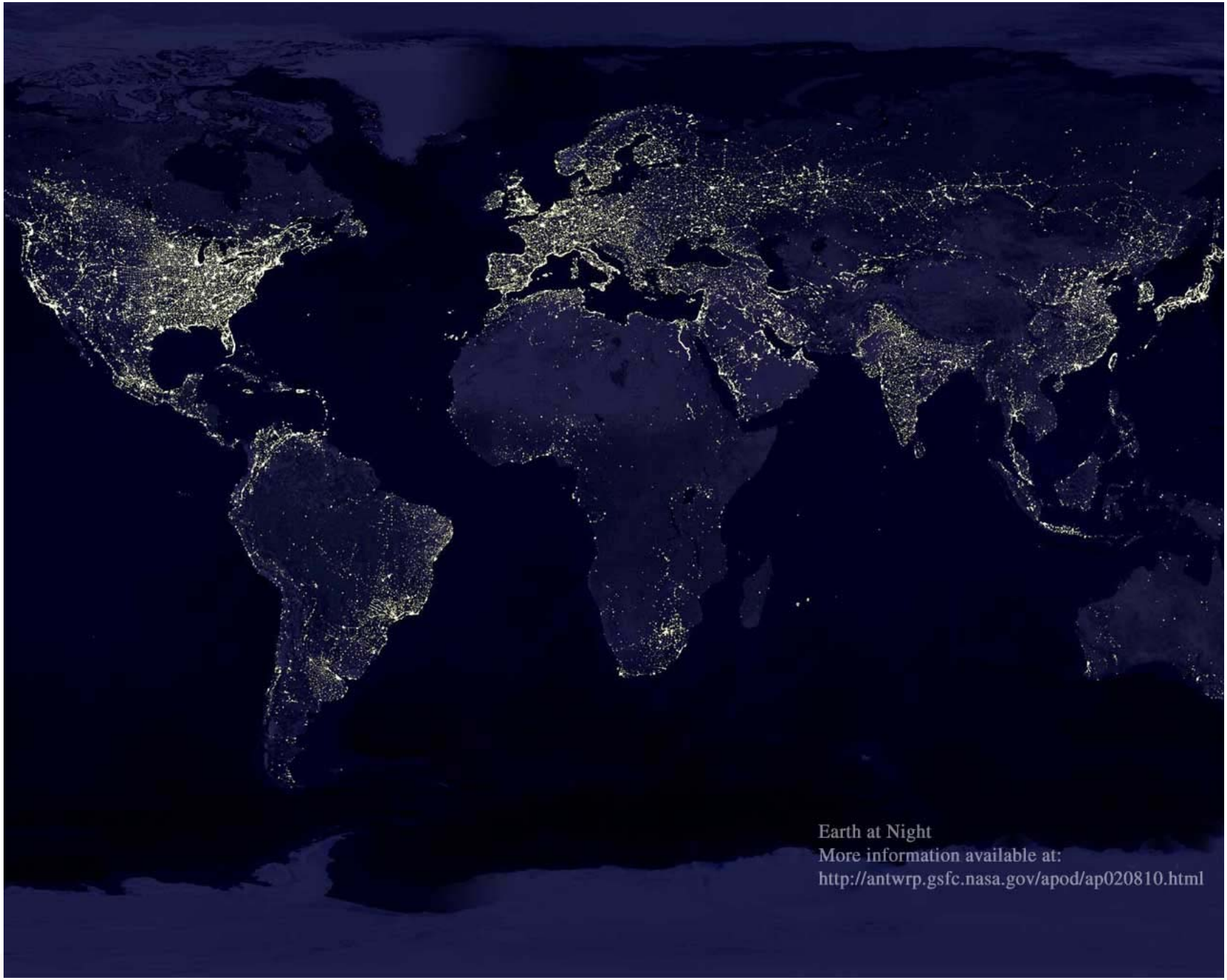
- Understand that nuclear energy use is interconnected within a global energy system and global security concerns.
- Carry out Title V of 1978 Nuclear Non-Proliferation Act—consider alternative energies to fossil fuels and nuclear energy factoring in nonproliferation and economic factors
- Identify external costs and as much as possible include external costs into internal price of energy sources
- Pursue non-discriminatory approaches—e.g., take into account developing counties concerns about fuel cycle assurances

Energy and the Developing World

- Need for comprehensive energy assessments, weighing all costs and benefits
- Must maintain the highest safety and security standards for nuclear energy use
- Potential for small and medium-sized reactors as well as “nuclear batteries” –could other proliferation-resistant benefits






Earth at Night
More information available at:
http://antwrp.gsfc.nasa.gov/apod/ap020810.html