

# New Nuclear Plants

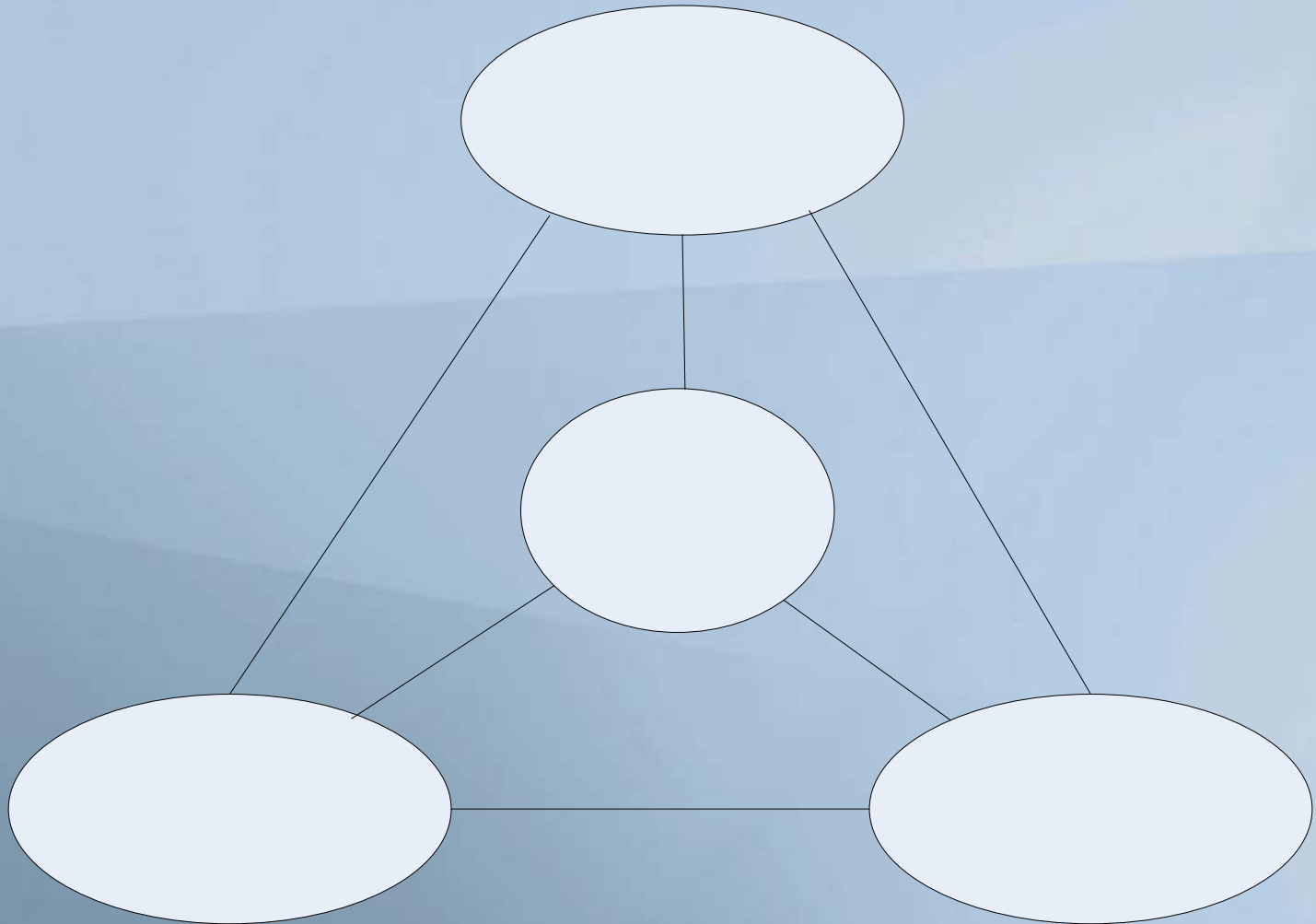
**Adrian Heymer**  
Nuclear Energy Institute  
202-739-8094; [aph@nei.org](mailto:aph@nei.org)

## Gainesville Regional Utilities Workshop

# **New Nuclear Plants**

- **Driving force for new nuclear**
- **Environmental benefits of new nuclear**
- **Nuclear Safety – new designs**
- **Integrated Spent Fuel Management**

# Nuclear Energy Institute



# US New Nuclear Plant Status

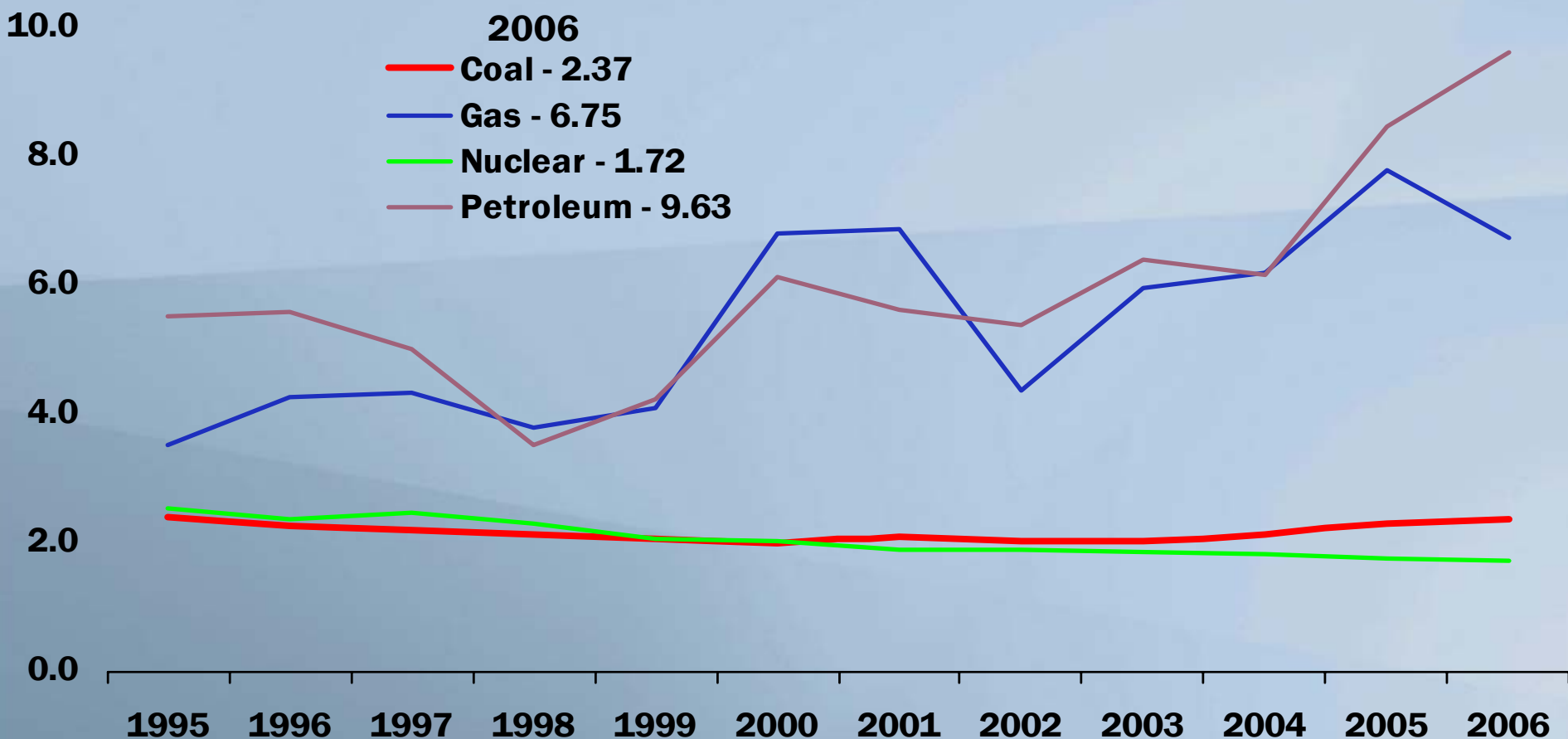
- **17 companies preparing combined construction permit and operating license applications for as many as 31 reactors**
- **4 designs certified, one under review, 2 being prepared for submittal**
- **3 early site permits issued, one under review,**
  - **6 other companies considering applications**
- **Industry expenditure on new plants – \$2+ billion**
- **First combined license applications submitted**
  - **More expected by the end of the year**

# Why New Nuclear Generation?

- **Need for power**
  - Minimal baseload generation built in last 20 years
  - US Population forecast – another 90 million by 2030
- **Climate change**
  - Need for zero/low-emission base-load generation
- **High & volatile natural gas prices**
- **US industry needs a diverse & balanced energy portfolio that provides stable low-cost electricity**
  - Nuclear lowest cost base-load generating option

# U.S. Electricity Production Costs

1995-2006, *In 2006 cents per kilowatt-hour*



Production Costs = Operations and Maintenance Costs + Fuel Costs



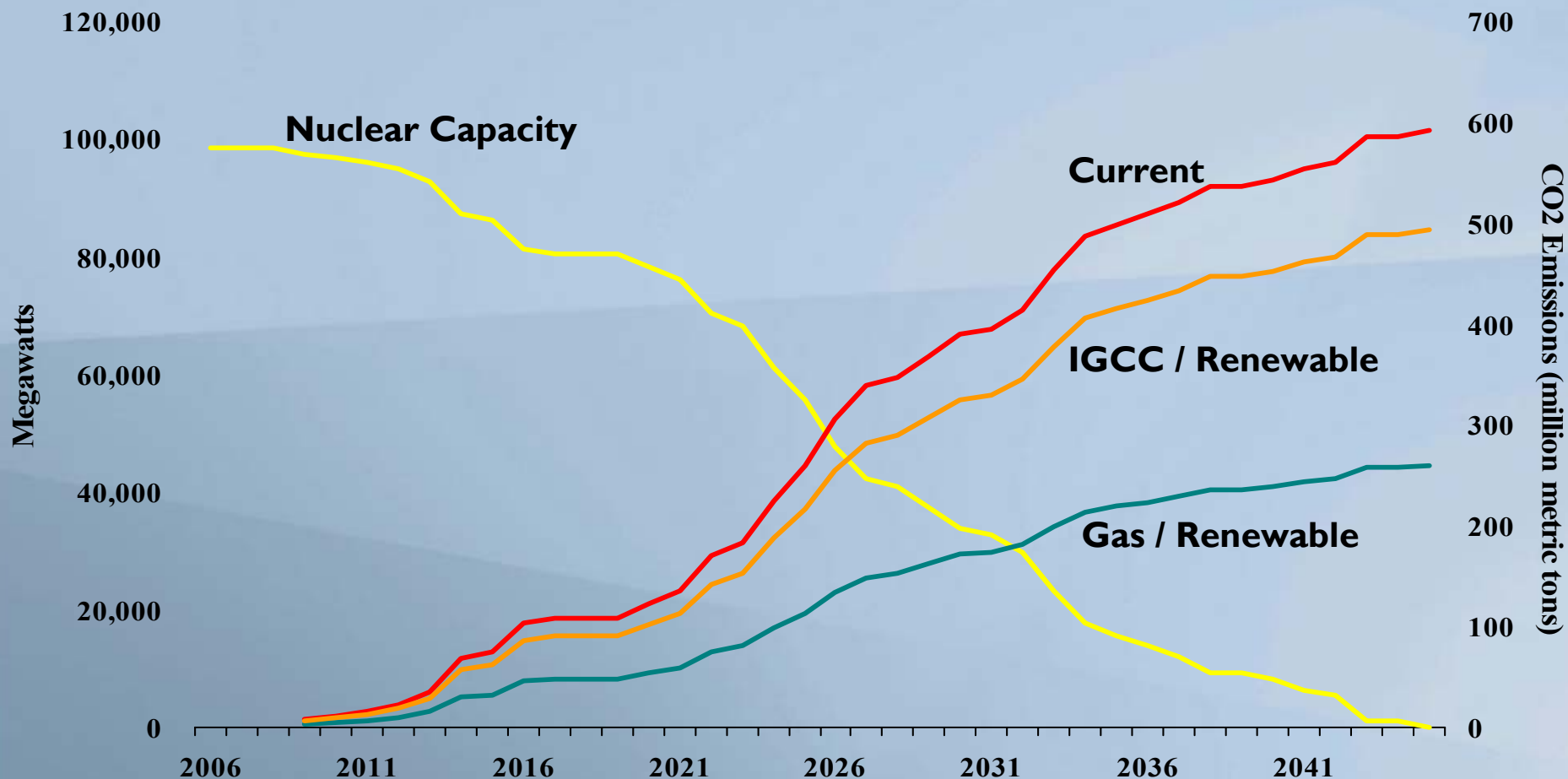
Source: Global Energy Decisions  
Updated: 6/07

# Outlook & Climate Change Impact

# **Challenging Outlook Financing & Infrastructure**

- **\$750+ Billion on US energy infrastructure plus climate change**
  - **Upward pressure on electricity & commodity prices**
  - **Increase in demand for conservation & energy efficiency**
- **World thirst for energy & electricity**
- **In US -- if not nuclear or advanced coal --?**

# CO<sub>2</sub> Emissions Resulting from U.S. Nuclear Plant License Expirations



Assumptions: Current - Nuclear capacity is replaced by 62% coal, 22% natural gas, 4% petroleum, 12% renewable and others.  
 IGCC / Renewable - 80% IGCC without sequestration and 20% renewable.  
 Gas / Renewable - 80% natural gas CC and 20% renewable. Nuclear fleet average capacity factor is 90%.

Sources: Capacity—EIA; License Expiration—NRC. Emission rates— Global Energy Decisions / EPA CEMS and EIA,

Updated: March 2006

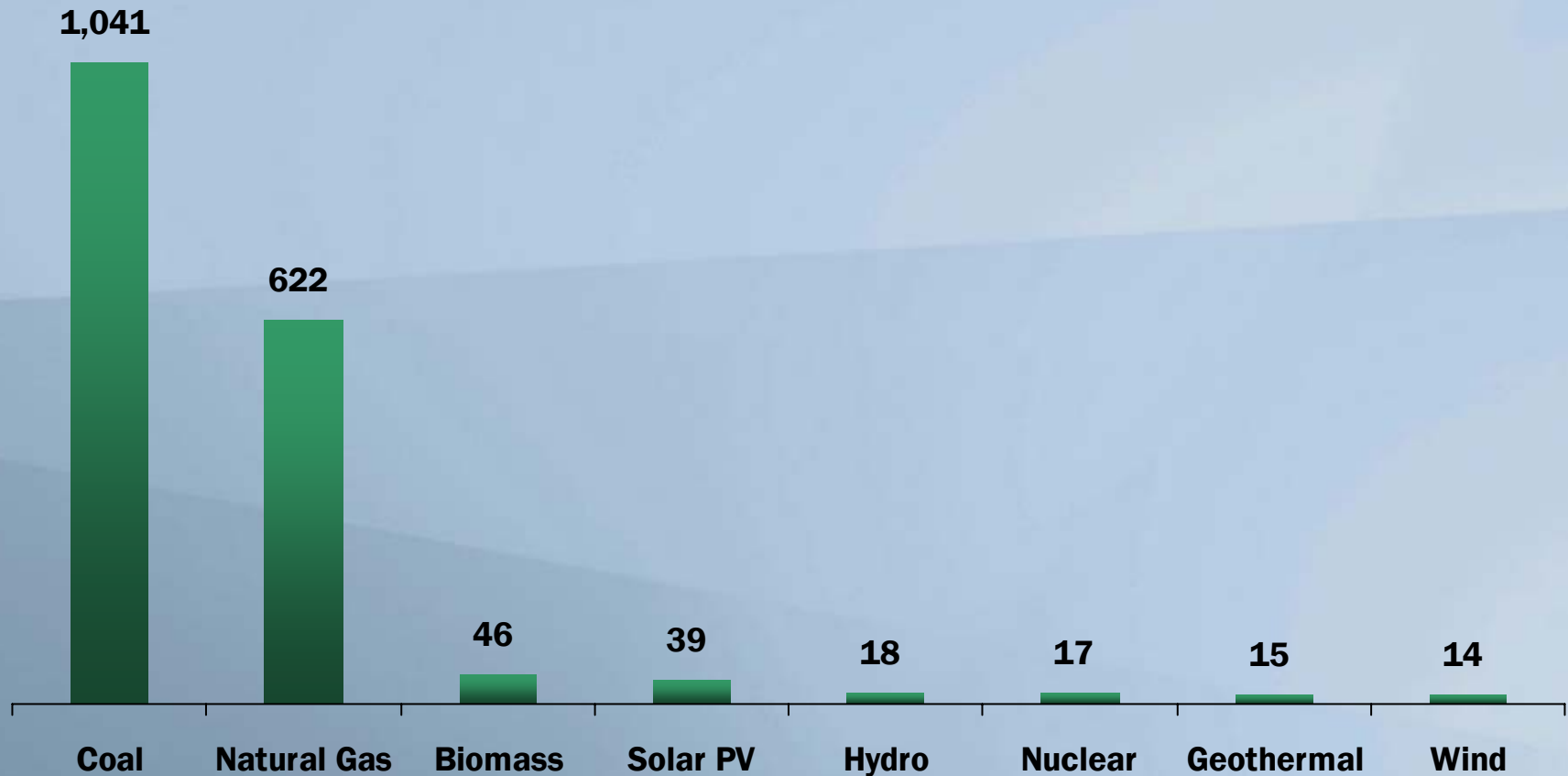
# **Nuclear Power Plants**

## **Impact on Greenhouse Gas Emissions**

- **104 US nuclear operating plants do not emit greenhouse gases**
  - **Prevent approx. 680 million tons of Greenhouse gas emissions per year**
- **Nuclear life-cycle (*manufacturing, operation and disposal*) emissions per MW generated equivalent to renewable energy**
  - **Nuclear generation -- Approx. 780 Billion kWh/yr**
- **30 countries considering plans for over 200 GW of new nuclear generation**

# Comparison of Life-Cycle Emissions

## Tons of Carbon Dioxide Equivalent per Gigawatt-Hour



Source: "Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis," Paul J. Meier, University of Wisconsin-Madison, August 2002.

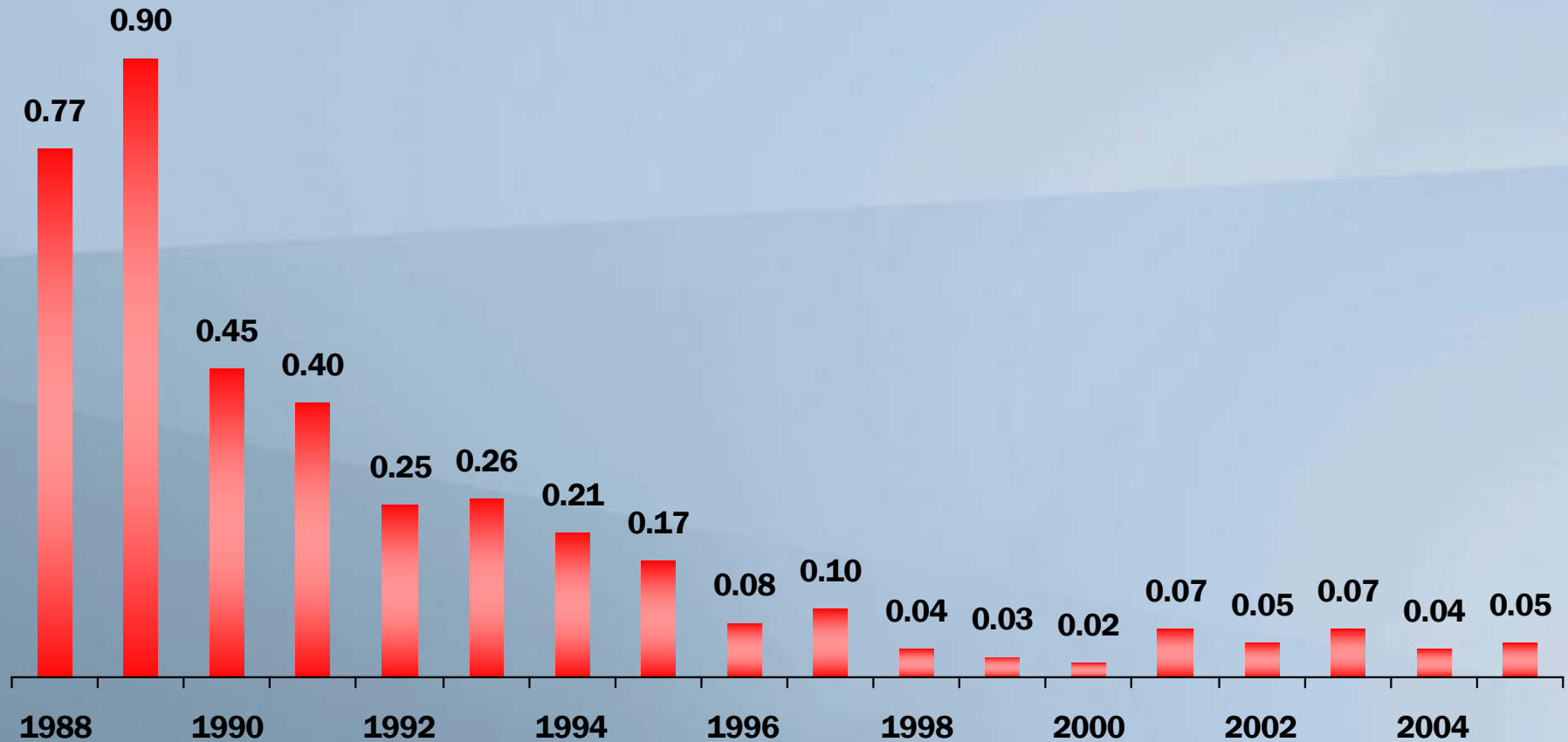
# Safety



NUCLEAR  
ENERGY  
INSTITUTE

# Significant Events at U.S. Nuclear Plants:

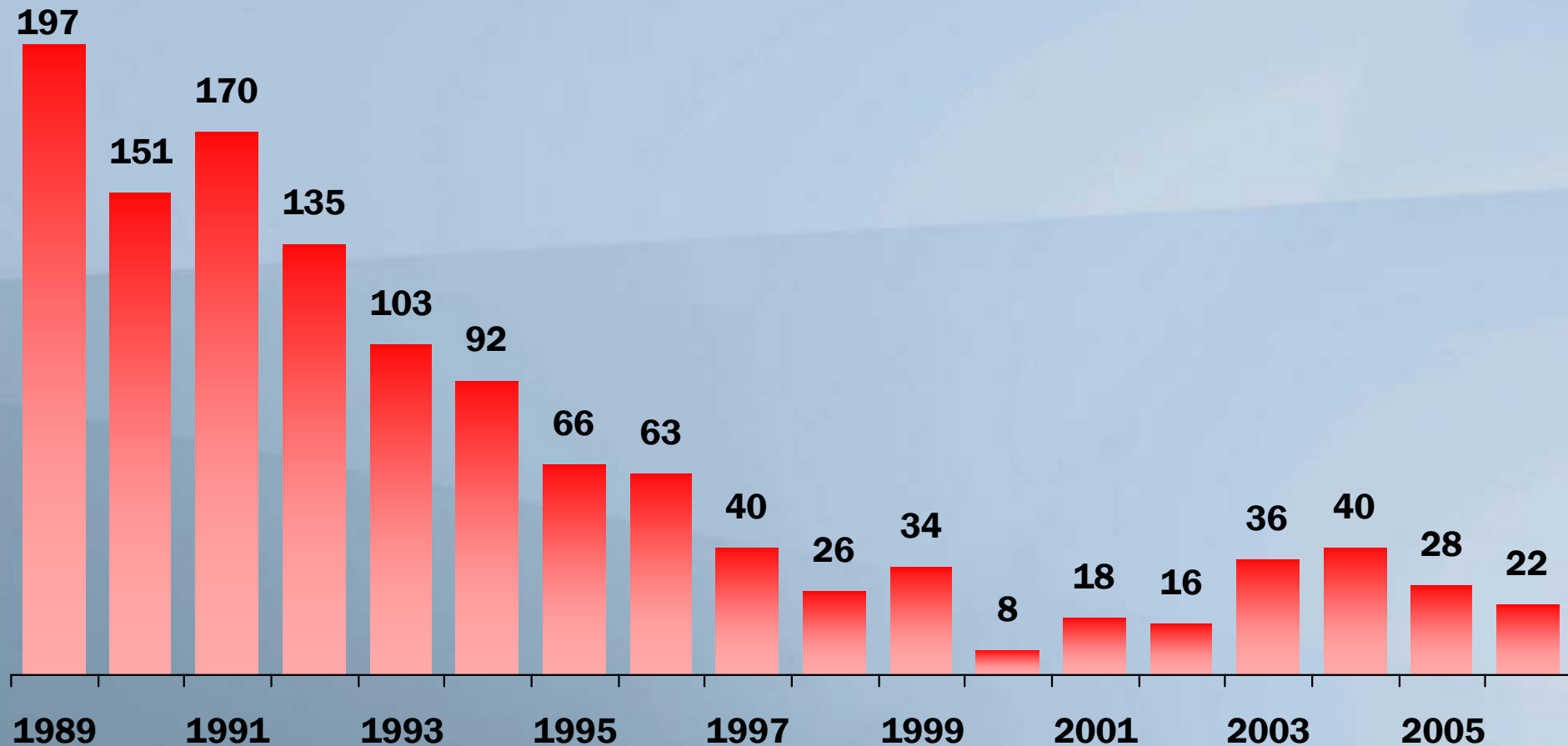
Annual Industry Average, Fiscal Year 1988-2005



Source: NRC Information Digest, 1988 is the earliest year data is available.  
Updated: 9/06

# Number of Unusual Events Reported to the Nuclear Regulatory Commission

## 1989-2006



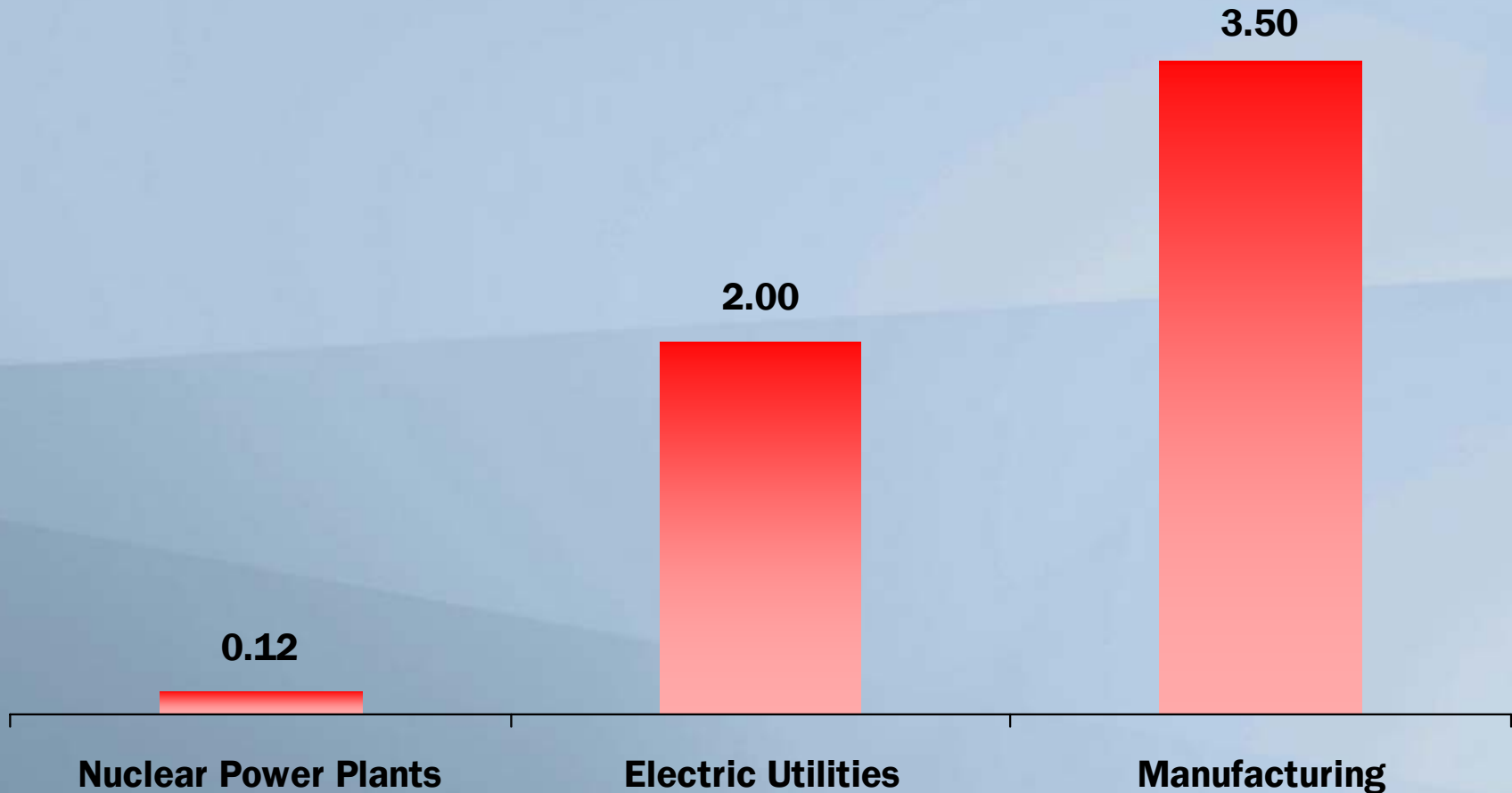
Note: A Notification of Unusual Event for power and non-power reactor licensees is a condition involving potential degradation of the level of plant safety that does not represent an immediate threat to public health and safety.



Source: Scientech  
Updated: 11/07

# U.S. Industrial Safety Accident Rate

## 2006



ISAR = Number of accidents resulting in lost work, restricted work, or fatalities per 200,000 worker hours. Electric utilities and manufacturing do not include fatality data.



Sources: Nuclear (World Association of Nuclear Operators), Electric Utilities and Manufacturing (2005, U.S. Bureau of Labor Statistics).

Updated: 4/07

# **New Designs – Safety Improvements**

- **Lessons learned from 40 years of experience incorporated into new designs**
- **Safety margins increased**
- **Probability of a Three Mile Island event less than 1 in 1,000,000 reactor years**
- **Use of natural phenomena: gravity coolant injection, natural convection and conduction for safety systems**

# **Increase in Operational and Safety Performance**

- **Standardized designs**
  - **Component level standardization within the limits of the equipment supply chain**
- **Simpler systems – fewer components**
  - **Increases reliability**
- **Improved security strategies incorporated into design**
- **Use of simulators and sharing of best practices and operating experiences**

# AP1000 Reduction in Components

## Standard 1000MW PWR

- Safety Valves 2850
- Pumps 280
- 20.8 miles, nuclear piping
- 1725 miles, electric cable
- Pressurizer – 1400 cu. Ft
- SG Tube Rupture – Operator action within 10 mins

## AP1000

- Safety Valves 1400
- Pumps 184
- 3.6 miles nuclear piping
- 227 miles, electric cable
- Presuureizer 2100 cu. Ft
- SG Tube Rupture – No operator action
- 65% fewer welds

# **Security**

## **Industry Post 9-11 Actions**

- **\$1.6+ Billion in plant security upgrades**
  - Increased security workforce by 60%
  - Additional equipment & modifications
- **Force-on-force exercises**
  - Includes extensive insider role
- **Industry & NRC aircraft impact assessments**
  - Public health & safety assured
- **Communication protocols established with Federal, State and Local authorities including NORAD**

# **Aircraft Impact New Designs**

- **Insights from existing plant security evaluations incorporated into the designs**
- **Aircraft impact event being addressed during design certification for all designs under active consideration**
  - **Assessment of large fire and explosions**
  - **Changes to design being made, where necessary**

# **Loan Guarantees Investment not a Subsidy**



NUCLEAR  
ENERGY  
INSTITUTE

# Loan Guarantees

- **Not unique to nuclear**
  - **EPAct – For zero/low CO<sub>2</sub> emitting technologies**
    - Wind, Biomass, Advanced Coal, Solar, Nuclear...
  - **Shipbuilding, rural projects, subway systems, roads, bridges, airports...**
- **US Loan guarantee portfolio – \$1.1 trillion**
- **2008 loan guarantee authorization – \$290 billion**
- **Reduces project cost**
- **Reduces cost of electricity**

# **Loan Guarantees Not a Subsidy**

- **Subsidy: Entity receives money from the government**
- **Loan guarantees for nuclear: Entity pays government**
- **History indicates government and the public benefit from loan guarantees**

# Spent Nuclear Fuel Management Program

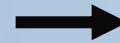
# The “Once Through” Fuel Cycle: Current View of Used Fuel Management



**Nuclear Plant**



**Used Fuel**

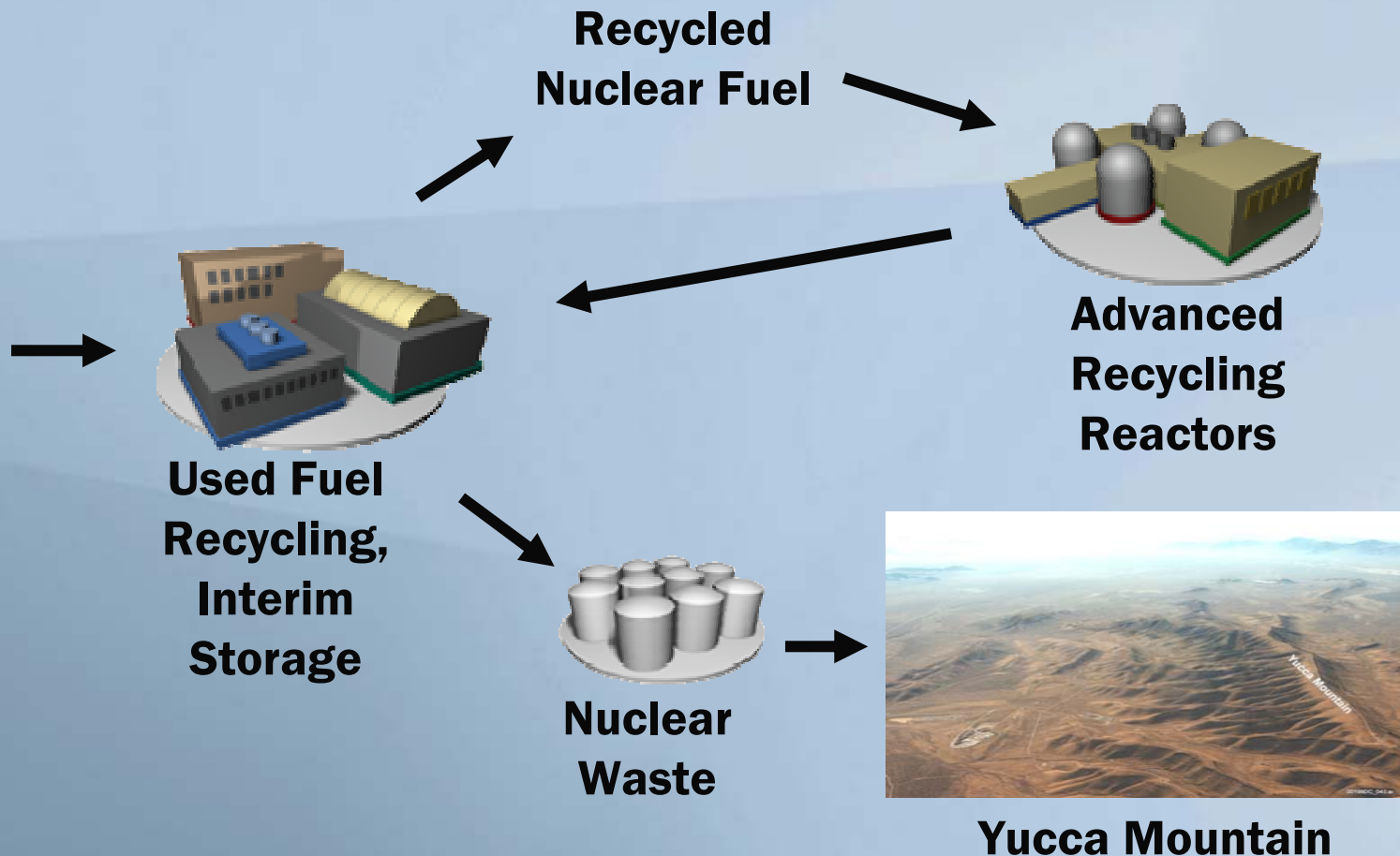


**Yucca Mountain**

# Used Fuel Management: New Strategic Direction



**Used Fuel**



# **Integrated Spent Fuel Program**

- **Move forward with closing the fuel cycle over the long term**
  - **Recycle spent fuel at least once**
  - **Reduce toxicity, volume, heat load & storage time**
  - **Reduce proliferation risk**
- **Identify and develop sites for interim storage co-located with advanced reprocessing facilities**
- **US Government to take title and move fuel to interim storage locations**
- **Continue process of licensing and building Yucca Mountain project**

# **Integrated Spent Fuel Program**

- **Begin well-defined program for advanced nuclear fuel recycling**
- **US Government to take title and move fuel to interim storage locations**
- **Develop and demonstrate recycling technologies**
  - **Fabricate fresh fuel**
- **Continue consolidation of used fuel at fuel treatment centers for recycling**
- **Complete construction start operations at Yucca Mountain facility**
  - **Ship waste products and legacy fuel to facility**

# The Future

- **Economy & environment demand**
  - Clean, low-cost stable electricity supply
  - Revitalized energy infrastructure
- **A diverse and balanced energy portfolio**
  - Conservation & Energy Efficiency
  - Nuclear
  - Renewables
  - Advanced coal
  - Natural gas
  - Improved transmission & distribution