

Turning Off the Heat

How to save money & mitigate climate change by unleashing competition and eliminating barriers to efficiency

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Presentation Summary

- **Situation Report**
 - **U.S. energy infrastructure is obsolete.**
 - **Climate change is a problem**
 - **U.S. wastes > \$100 billion/year on energy**
 - **Why no electric generation efficiency gains in 40 years?**
- **Trigen has pioneered economical solutions**
- **A proposed solution -- ERRATA -- Energy Regulatory Reform And Tax Act**

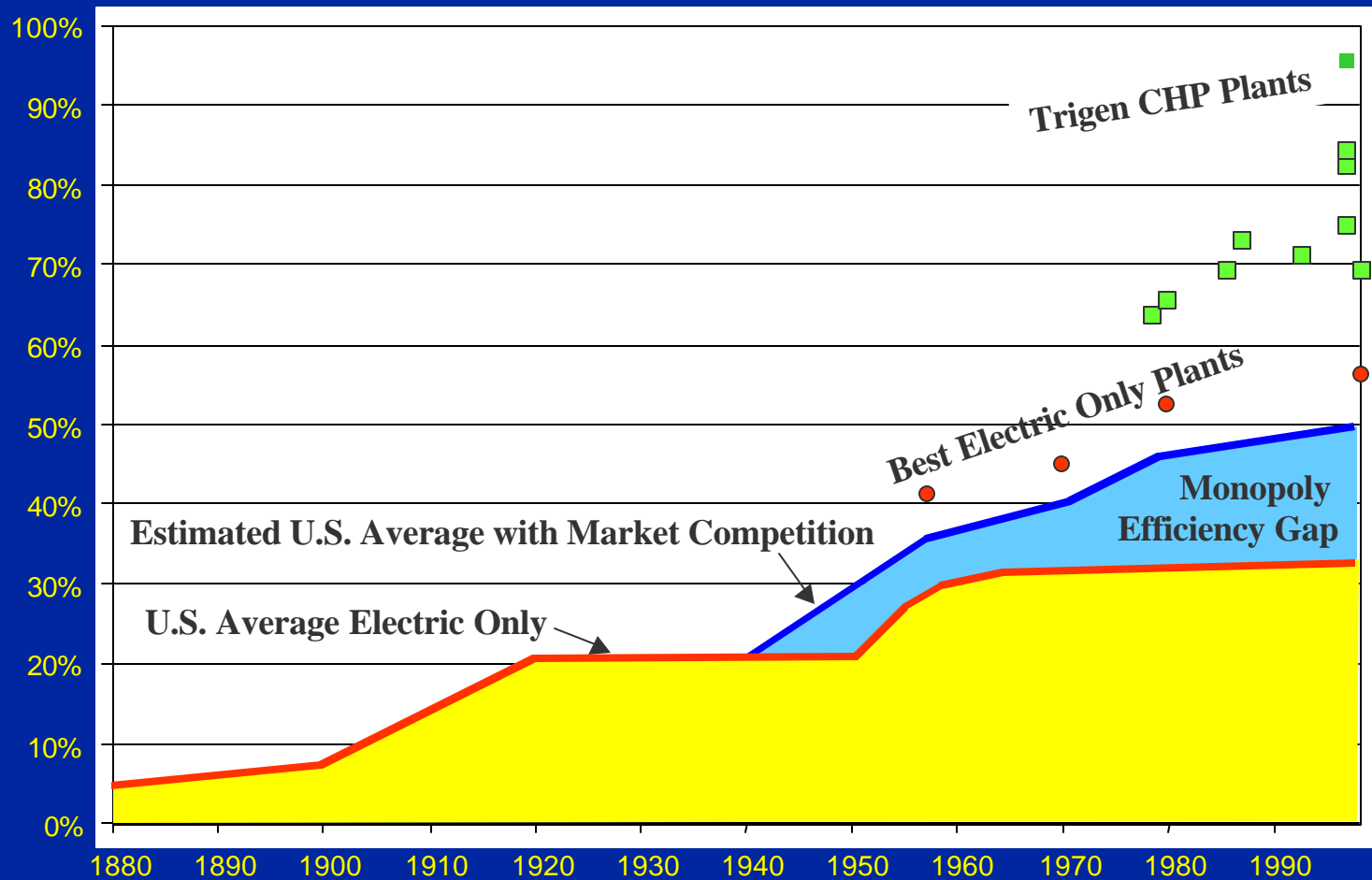
Situation Report

***External Forces that Cause
Inefficient, Dirty, Expensive
Energy Production,
Distribution, and Use***

US Energy Infrastructure Old

- **Average US electric plant built in 1964**
 - **33% delivered efficiency, wastes the rest**
 - **100 times more polluting than today's best**
- **Costs 2 to 2.5 ¢ / kWh to transmit power**
- **Thermal energy is non-core & neglected**
 - **Little investment for efficiency**
 - **Skill sets inadequate**
 - **Massive distribution & conversion losses**
 - **Little physical arbitrage capability**

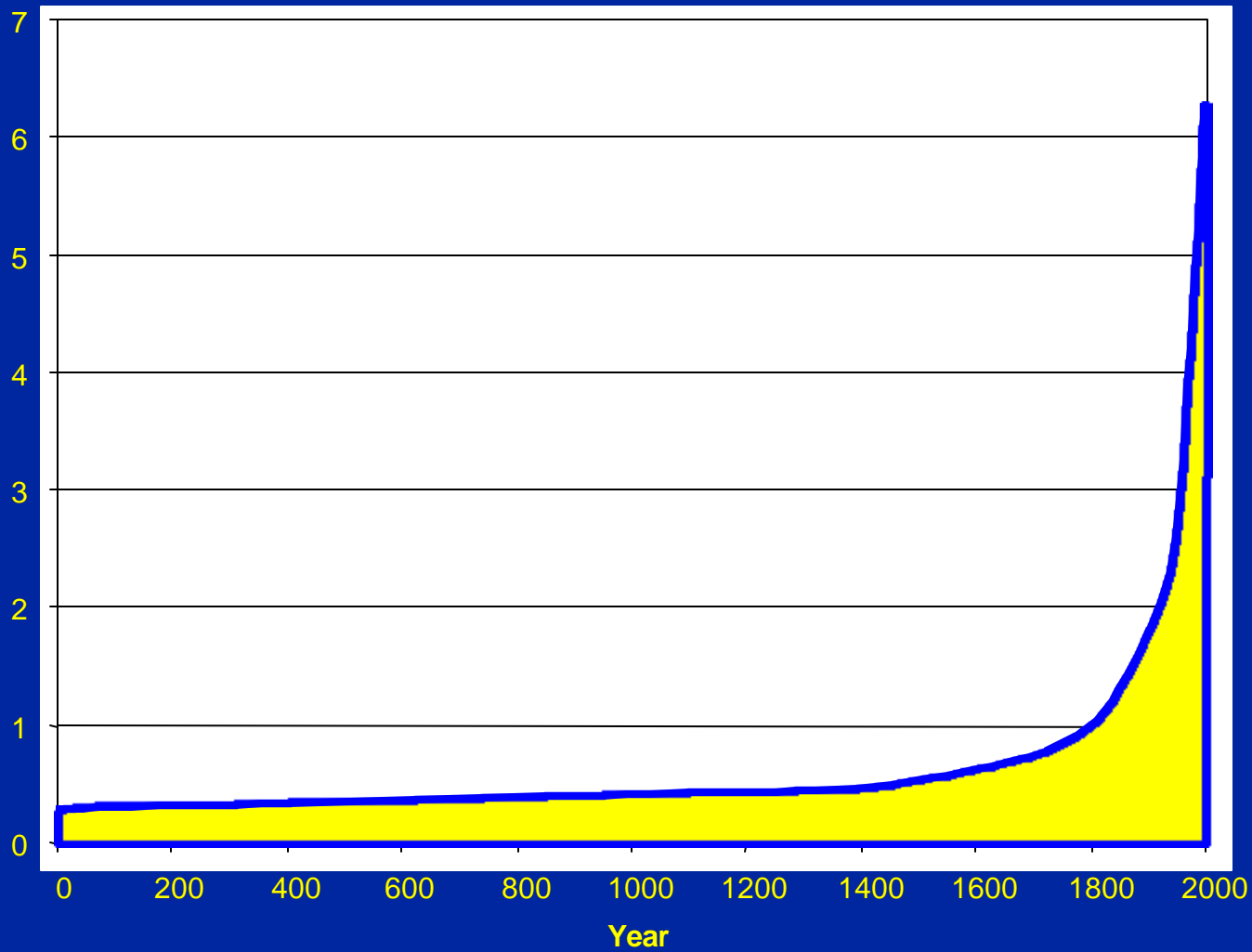
Energy Generation Efficiency Curve



Climate Change is a Problem

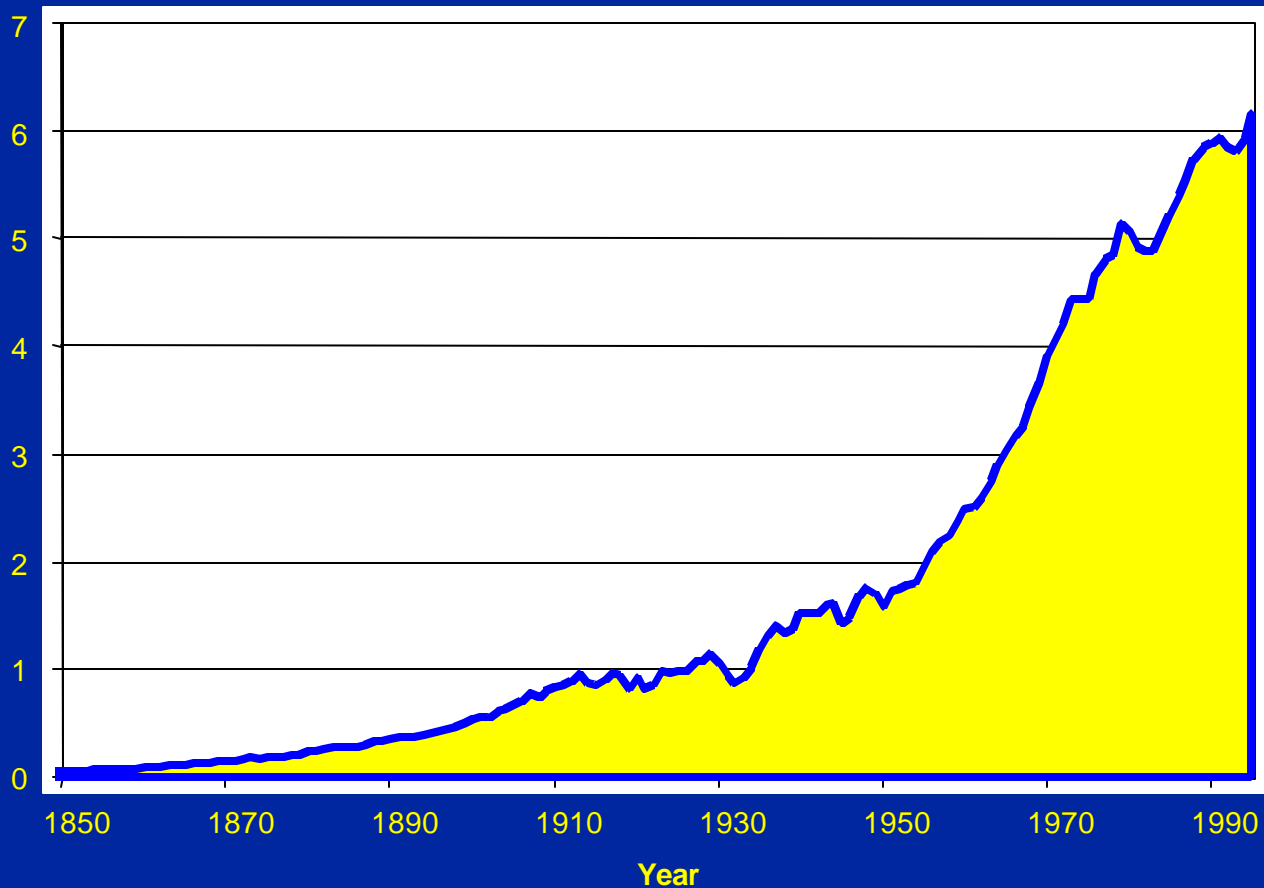
World Population Growth

Population in
Billions

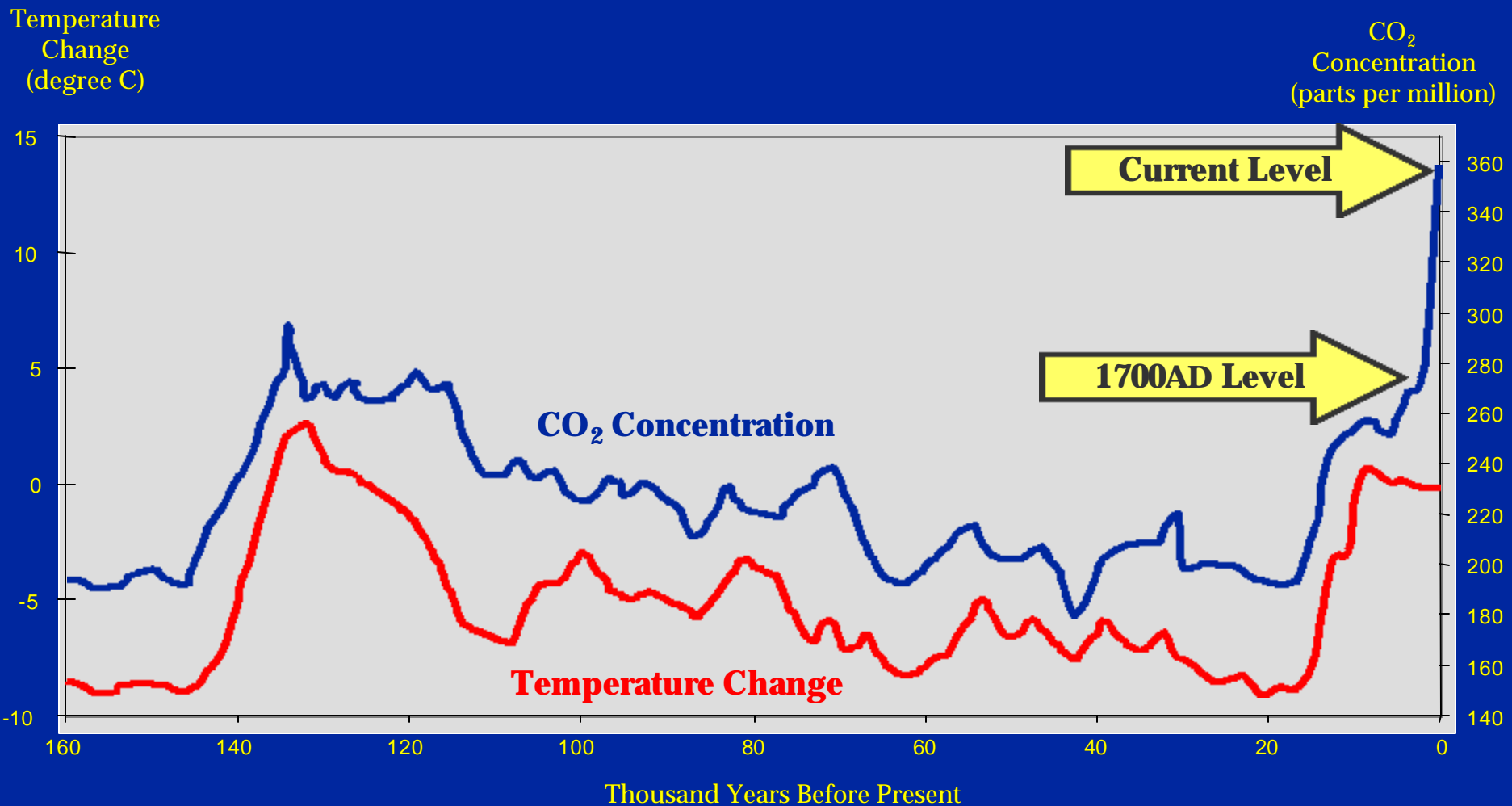


World Carbon Dioxide Emissions from Fossil Fuels

Billion Metric
Tons
of Carbon

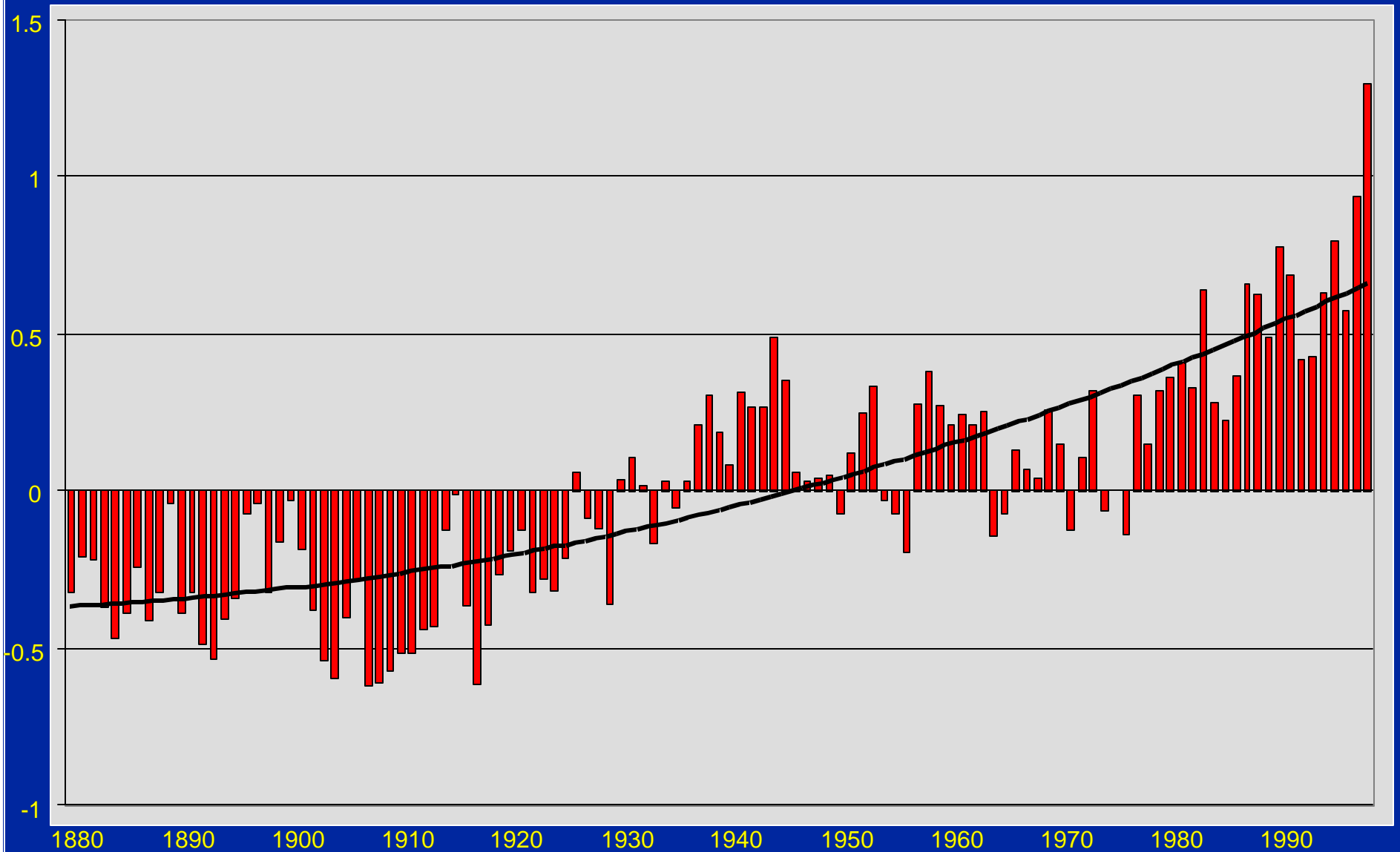


Atmospheric CO₂ Concentration and Associated Temperature Changes



Global Temperature Anomalies (1880 - Present)

Temperature Deviation
from 1880-1998 Mean
(deg. F)



Greenhouse Gas Problem

- Highest level of CO₂ in 160,000 years
- Ice core data shows ten times the correlation of CO₂ and temperature
- Government leaders seek ways to reduce CO₂ that won't disrupt the economy
- 68% of CO₂ comes from heat and power production
- **Combining heat and power generation on-site saves money and cuts CO₂**

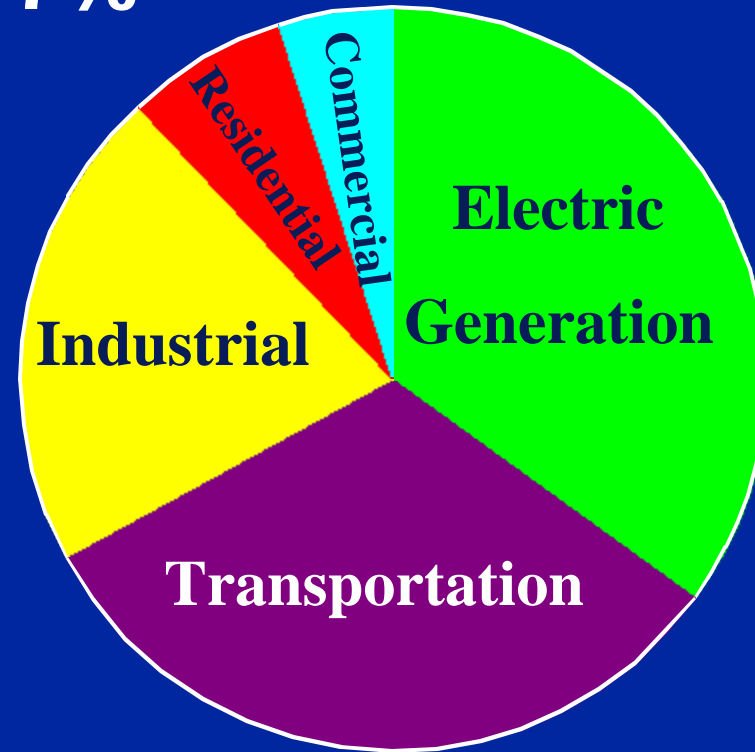
CO₂ Emissions by Sector

33%

Thermal

7%

5%



21%

Industrial

Transportation

32%

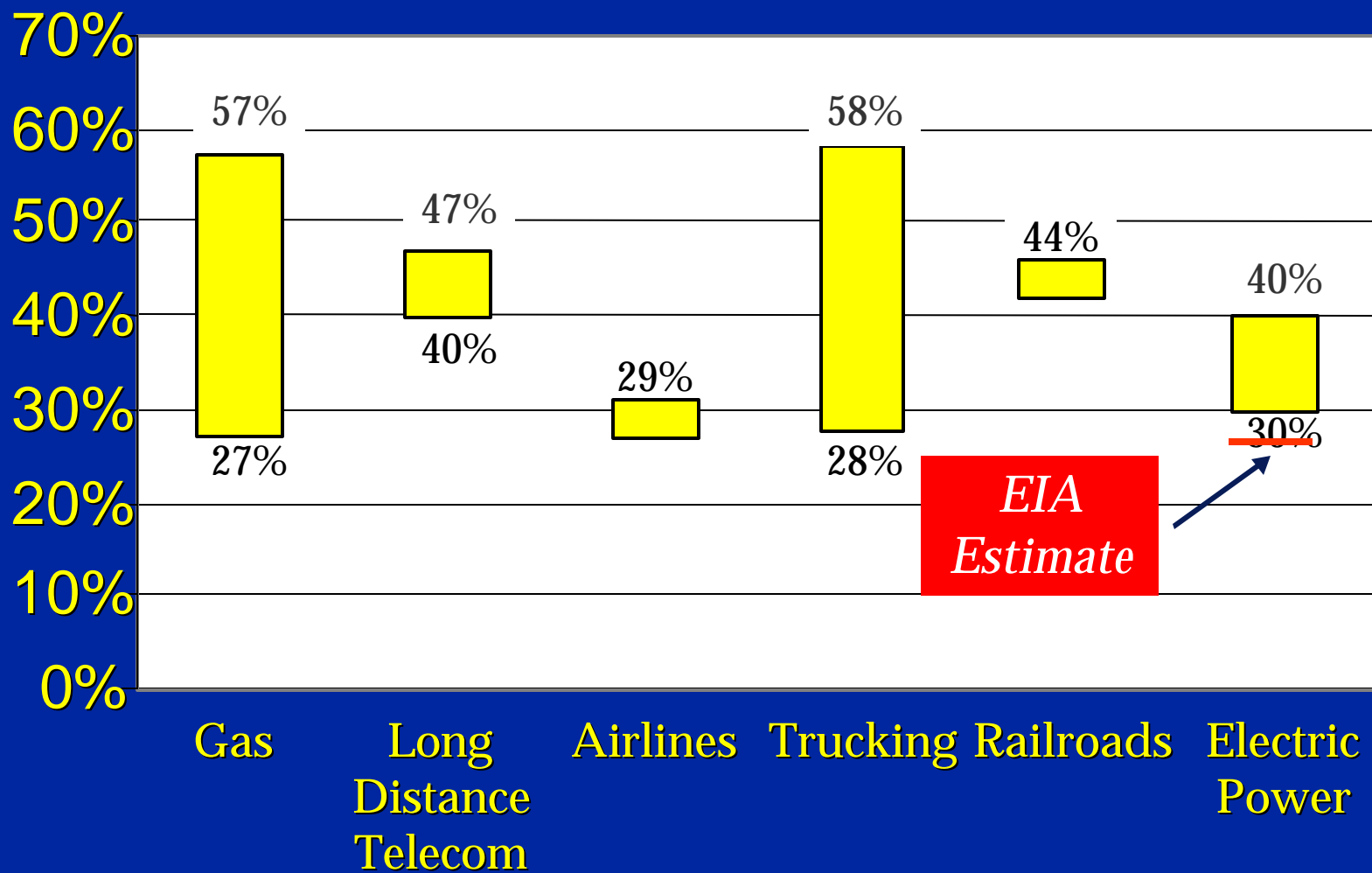
35%

**CO₂ from
heat &
power**

68%

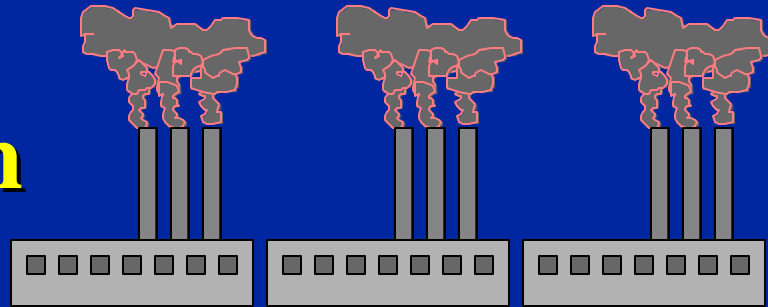
***U.S. Wastes > \$100
Billion/Year on Energy***

Real Cost Savings 10 Years after Deregulation



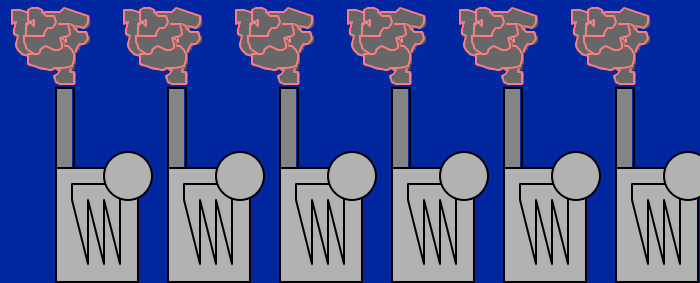
U.S. Energy Market 1995

\$207 Billion



**All U.S.
Electric**

\$157 Billion

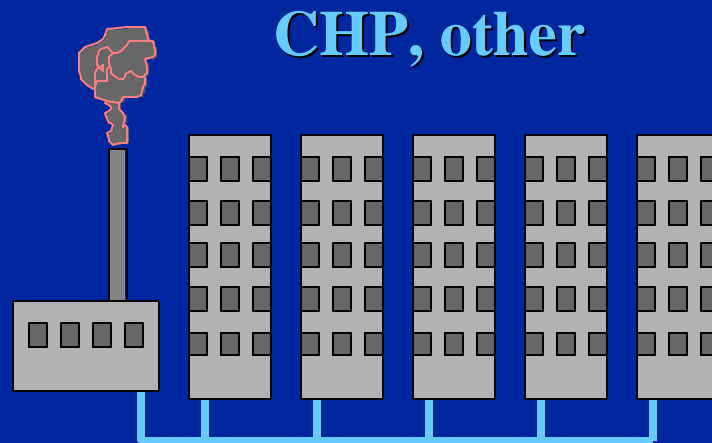


**All U.S.
Heating**

Annual Costs - \$364 Billion

U.S. Energy Cost with Deregulation

\$255 Billion



**All U.S Heating
and Electric**

Customer Savings per Year = \$109 Billion

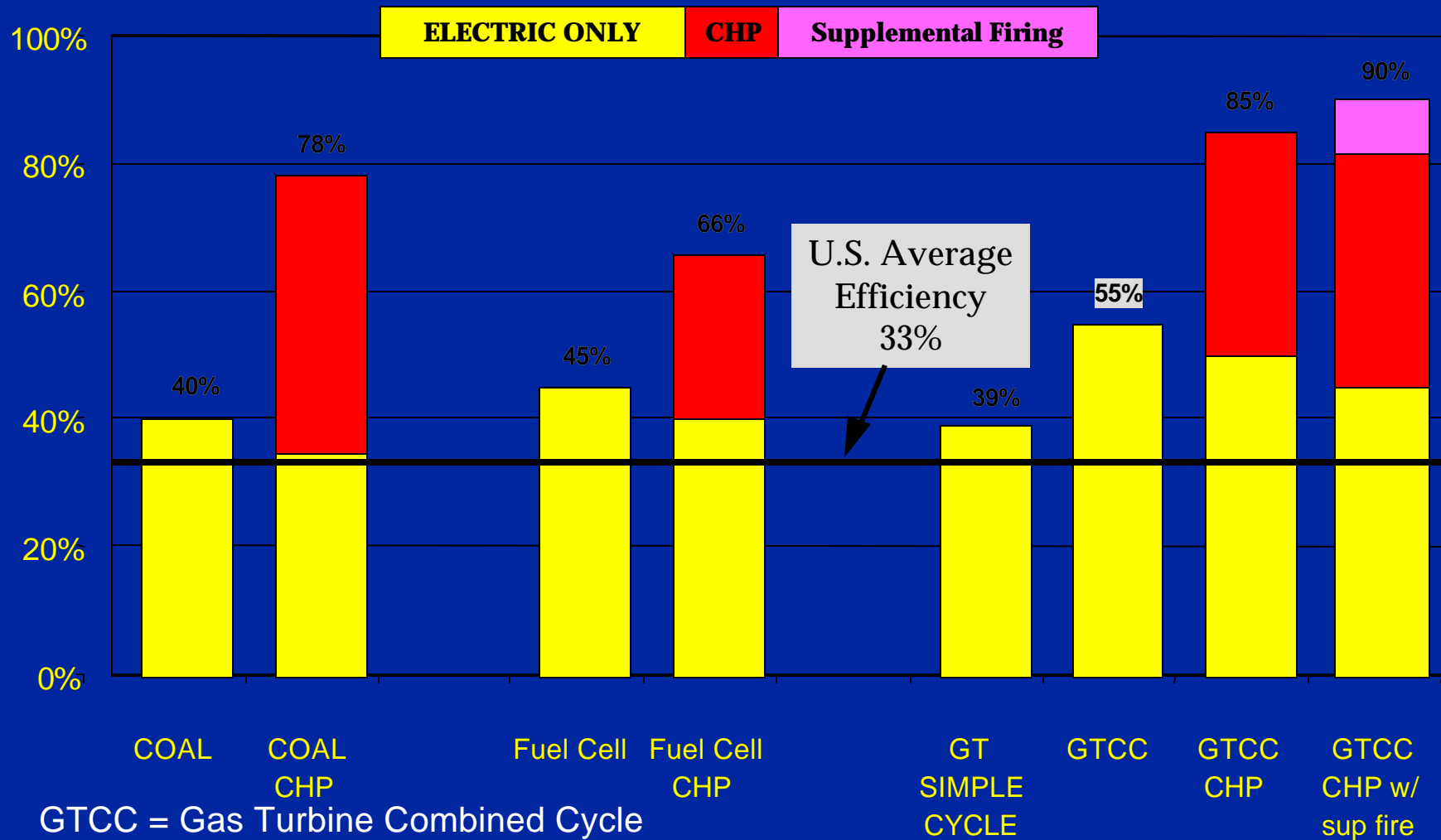
Why No Electric Industry Progress in 40 Years?

- **Intelligent energy policy must answer this question. Subordinate questions:**
 - Is better technology available?
 - Will replacing present generation lower costs.
 - Will new plants decrease pollution?
 - Does central generation idea block progress?
 - Does monopoly protection block progress?
 - Have environmental regulations kept up with technology?

***Is better technology
available?***

YES

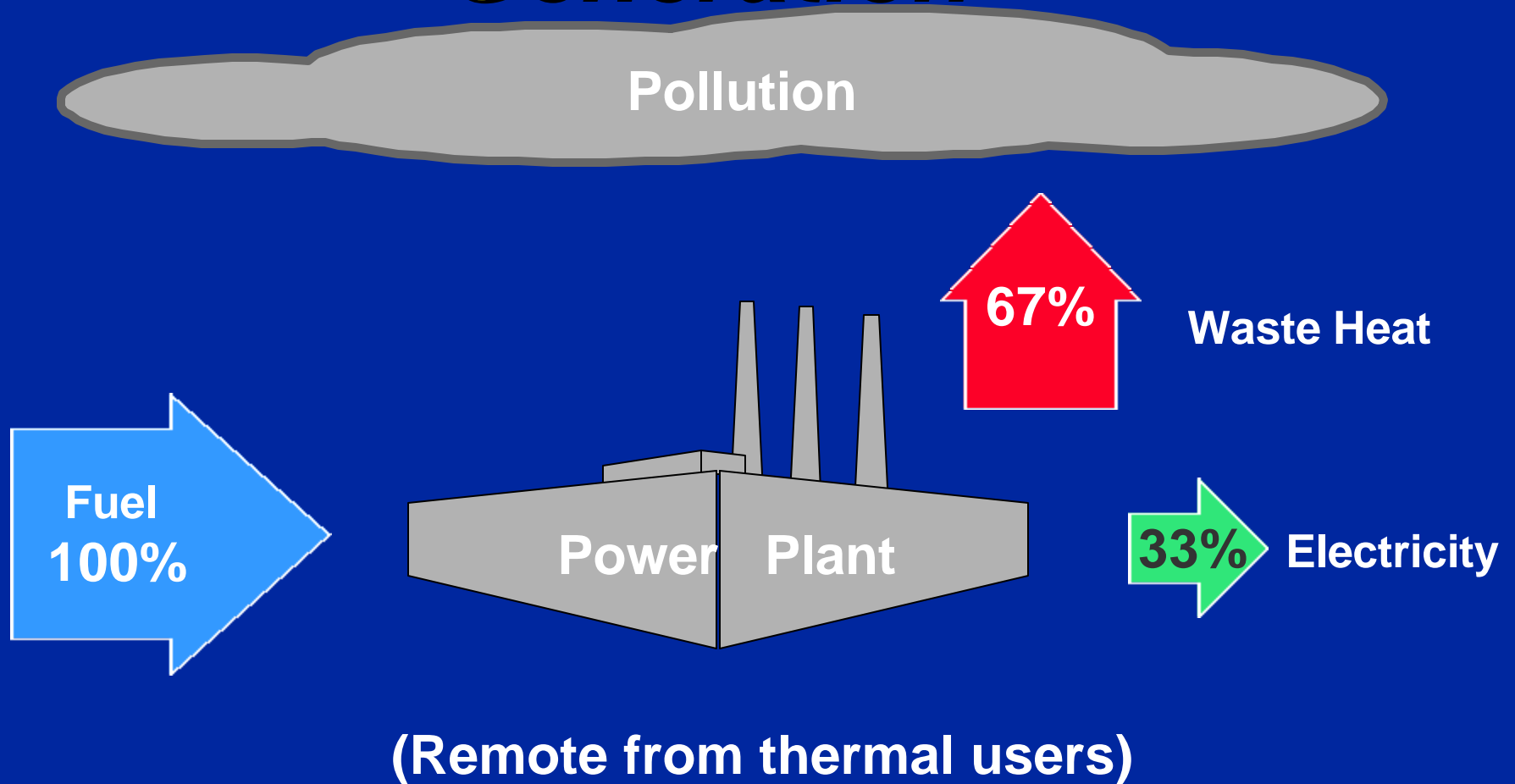
Generating Efficiencies of Various Technologies Today



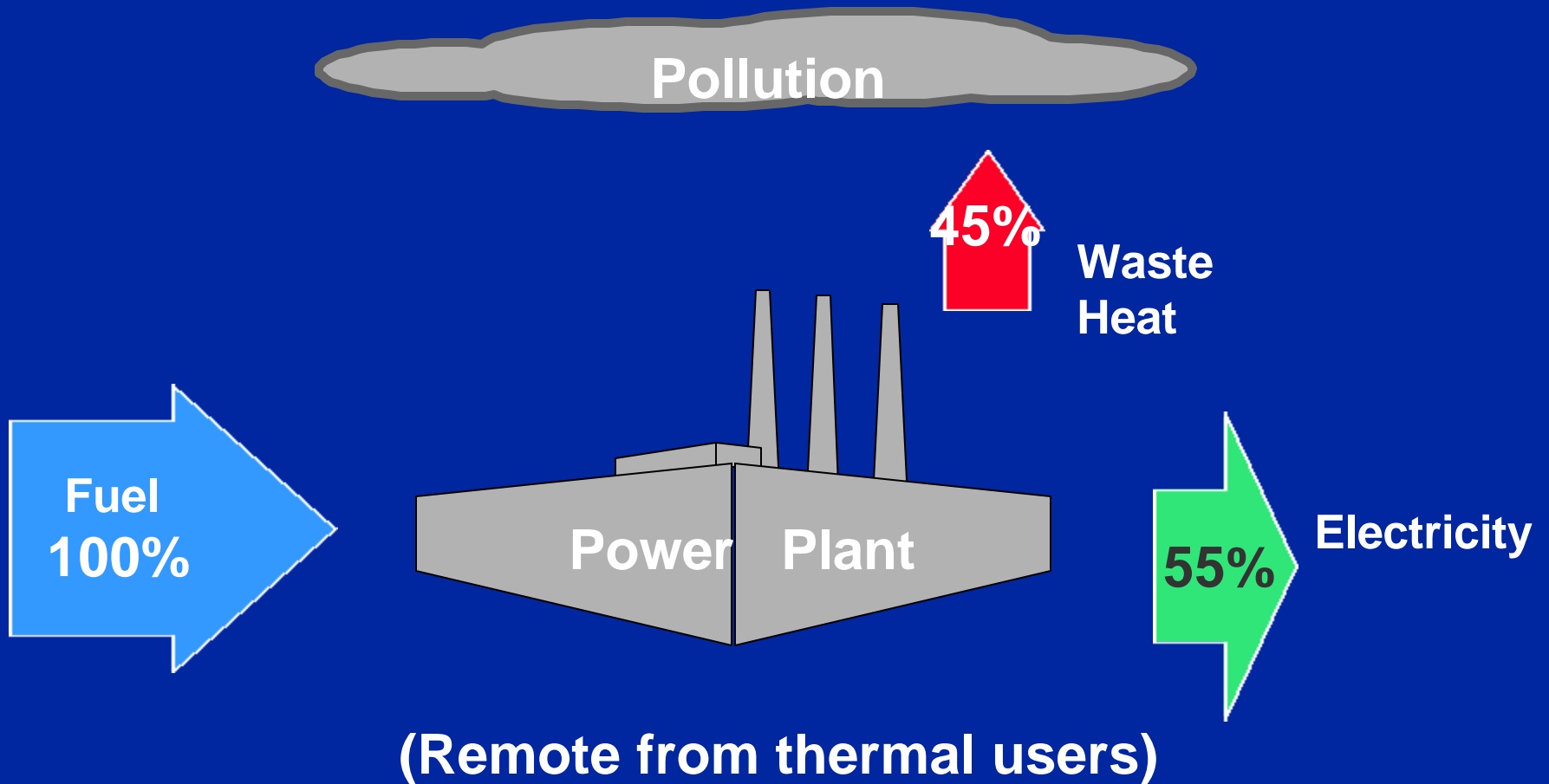
GTCC = Gas Turbine Combined Cycle

CHP = Combined Heat and Power

Conventional Thermal Generation

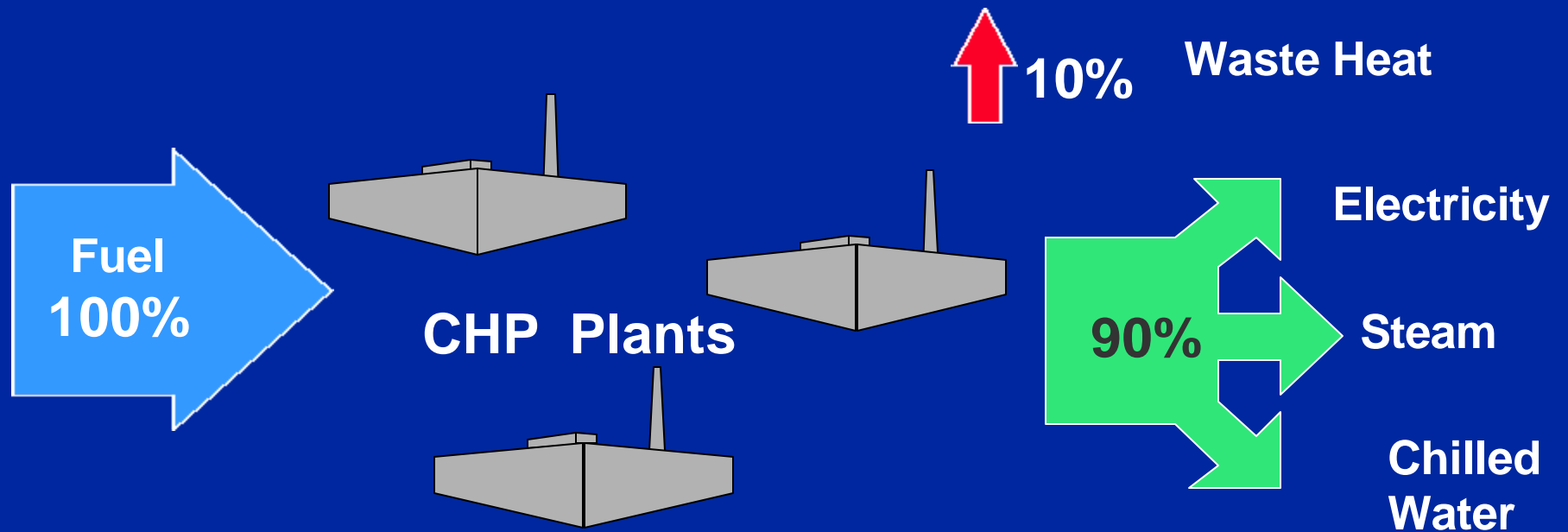


Combined Cycle Gas Turbine Generation



Combined Heat and Power (CHP)

Pollution



(On or near thermal user sites)

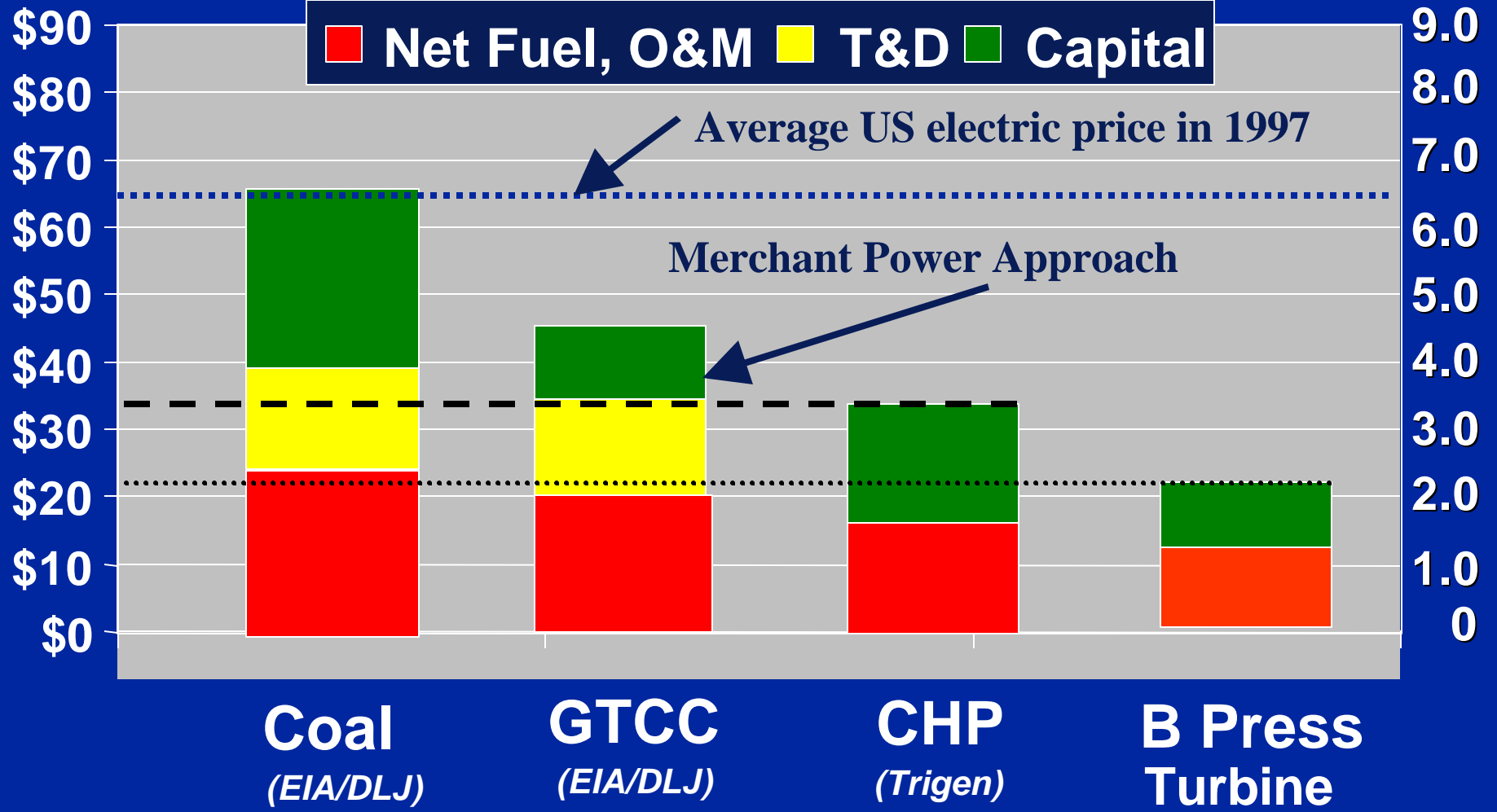
***Will replacing existing
generation lower costs?***

Yes

Marginal Electric Costs

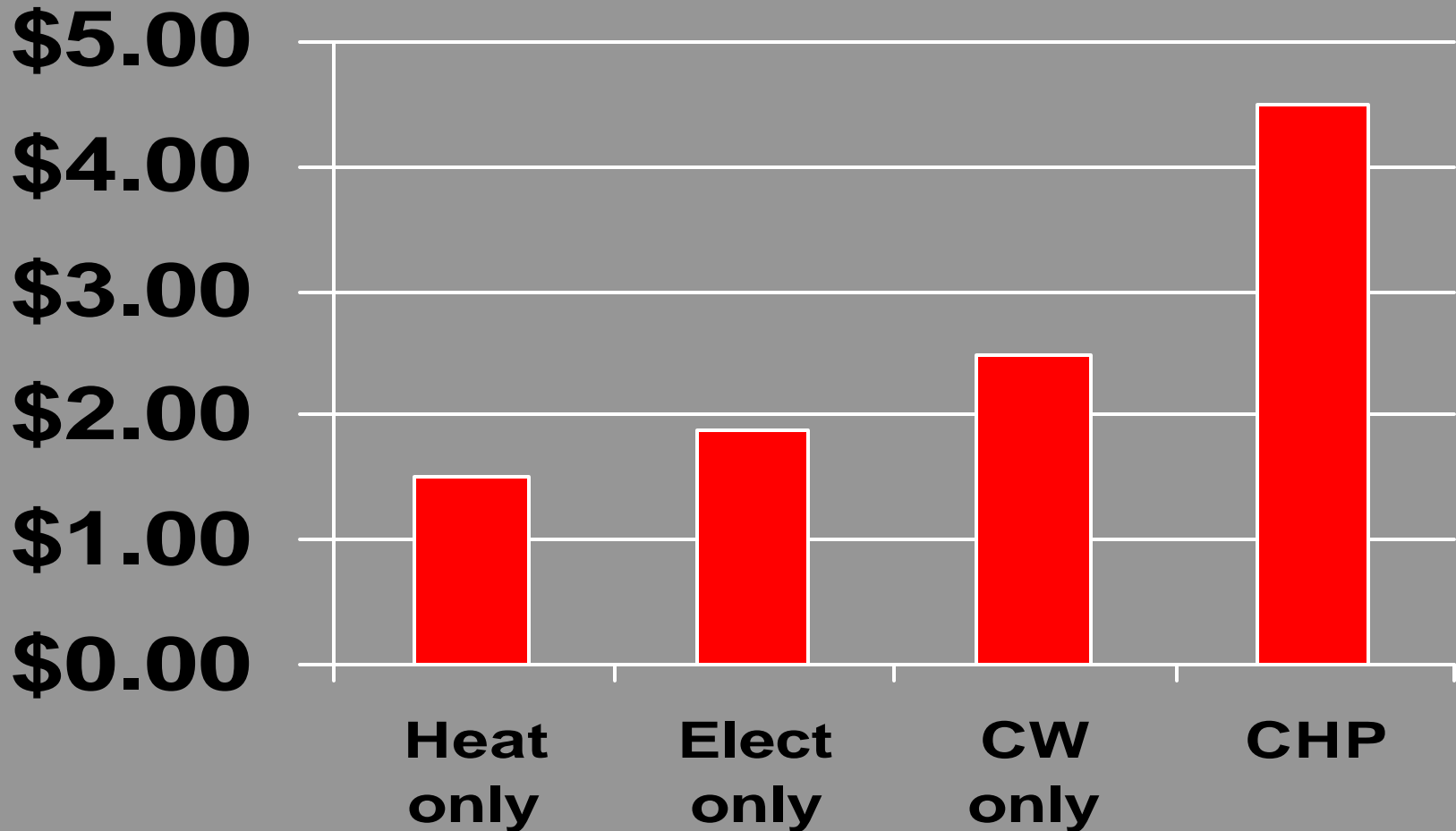
\$/MWh

cents/kWh



Closing Monopoly Efficiency Gap

Dollar value/dollar fuel cost



***Will new plants decrease
pollution?***

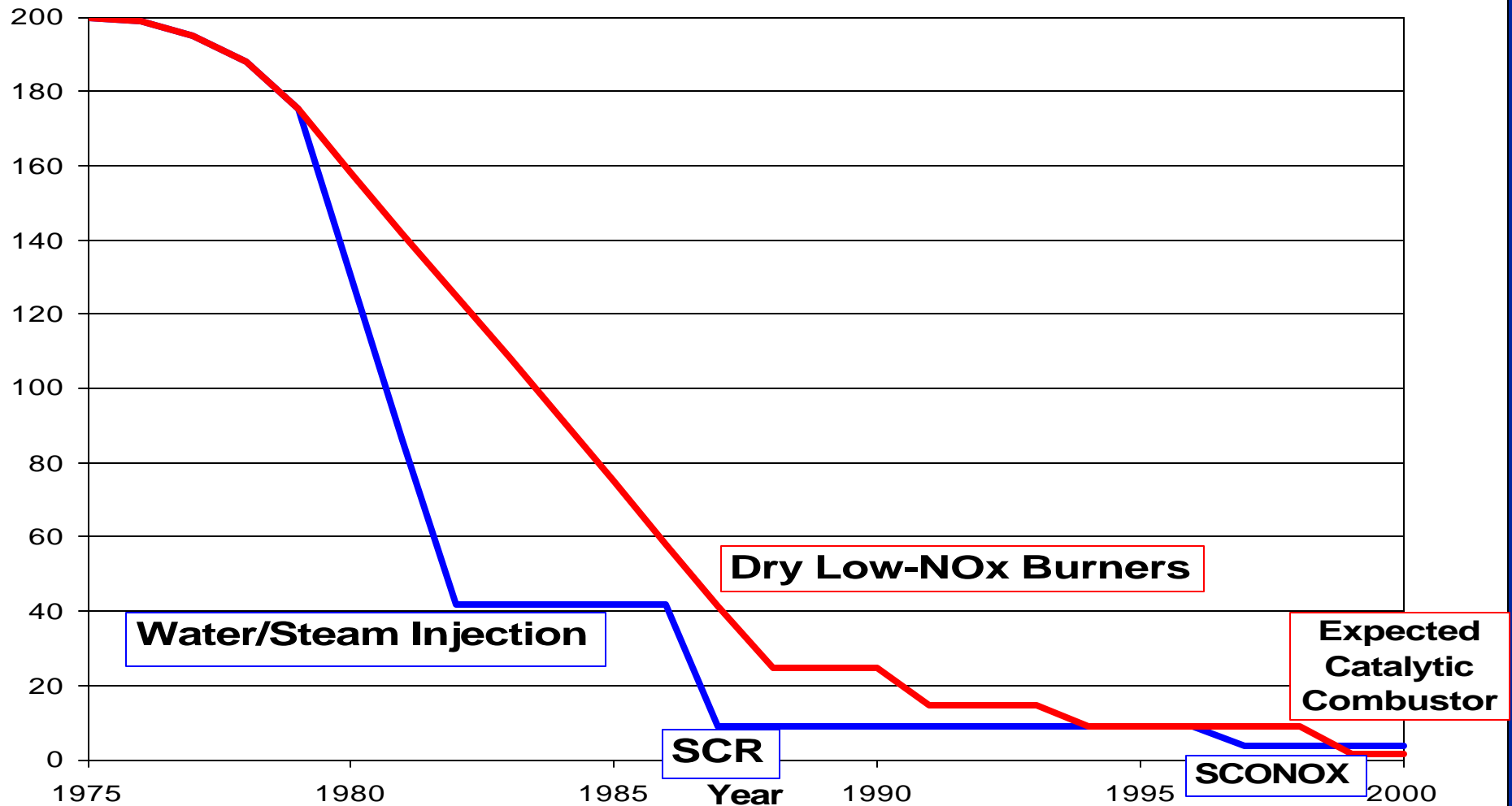
YES

***New Technology Emits 1%
of the Pollution of Older
Plants***

**Average age of US generation
plant is 1964 -- 35 years old**

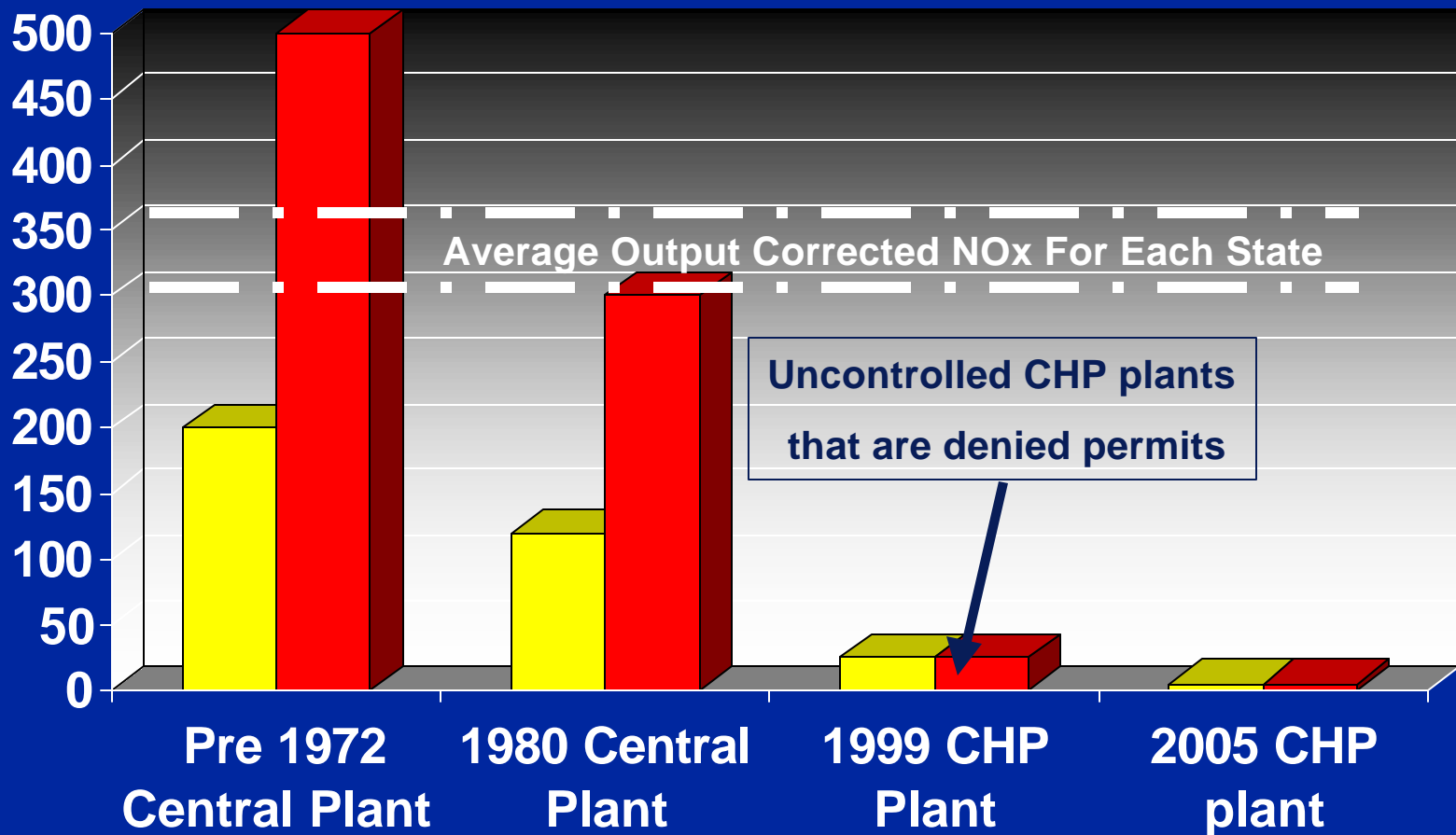
History of Gas Turbine NOx Controls

NOx Emissions
(parts per million)



Pollution/mWh of Energy Output

■ Input Based NOx PPM ■ Output Corrected NOx PPM



***Does the central generation
paradigm block progress?***

Yes

Energy Market Failures From Central Generation Paradigm

- **90 years of monopoly have created central generation paradigm**
 - **Distributed power blocked by monopolies**
 - **Failure to focus on using waste heat**
 - **Unintentional barriers to efficiency enacted**
- **Regulations lock in obsolete generation**
- **Environmental laws penalize efficiency**

Monopoly Protection Blocks Efficiency

- **Regulator focus on rate of return**
 - Utilities seldom allowed to keep efficiency savings -- **YOU GET WHAT YOU REWARD**
 - Monopolies over built to increase profits
 - Long lived plants are economically obsolete & protected; result is needless cost and pollution
- **Competition blocked -- slows innovation**
- **Utilities' costs of fighting distributed power are added to rates -- consumers pay twice**

State Rules Block Efficient and Cheap Generation

- **Non-utility retail sales prohibited**
- **Connection to neighbors prohibited**
- **Third parties banned from generation**
- **Manning rules based on 1930 technology penalize distributed power**
- **Market sourcing of backup power illegal**

Other State Laws Are Barriers to Efficiency

- **Siting review of all power plants**
- **Electric companies allowed to bundle services (Violation of antitrust laws?)**
- **Utilities use interconnection rules to discourage distributed power**
- **Revisit history to learn what could have happened to US generation efficiency**

***Have environmental
regulations kept up with
technology?***

NO

Emission Rules Block Efficiency

- **Input based standards ignore efficiency**
- **Old plants main pollution source, but grandfathered**
 - **Old plants are up to 100 times more polluting than new plants, 1/2 as efficient**
- **Air rules make modernizing old plants prohibitively expensive**
- **Ever tougher standards for new plants raise costs, slow deployment**

Trigen Energy Corporation Has Pioneered Solutions

**What Can Be Learned from
Trigen's Approach and
Experience?**

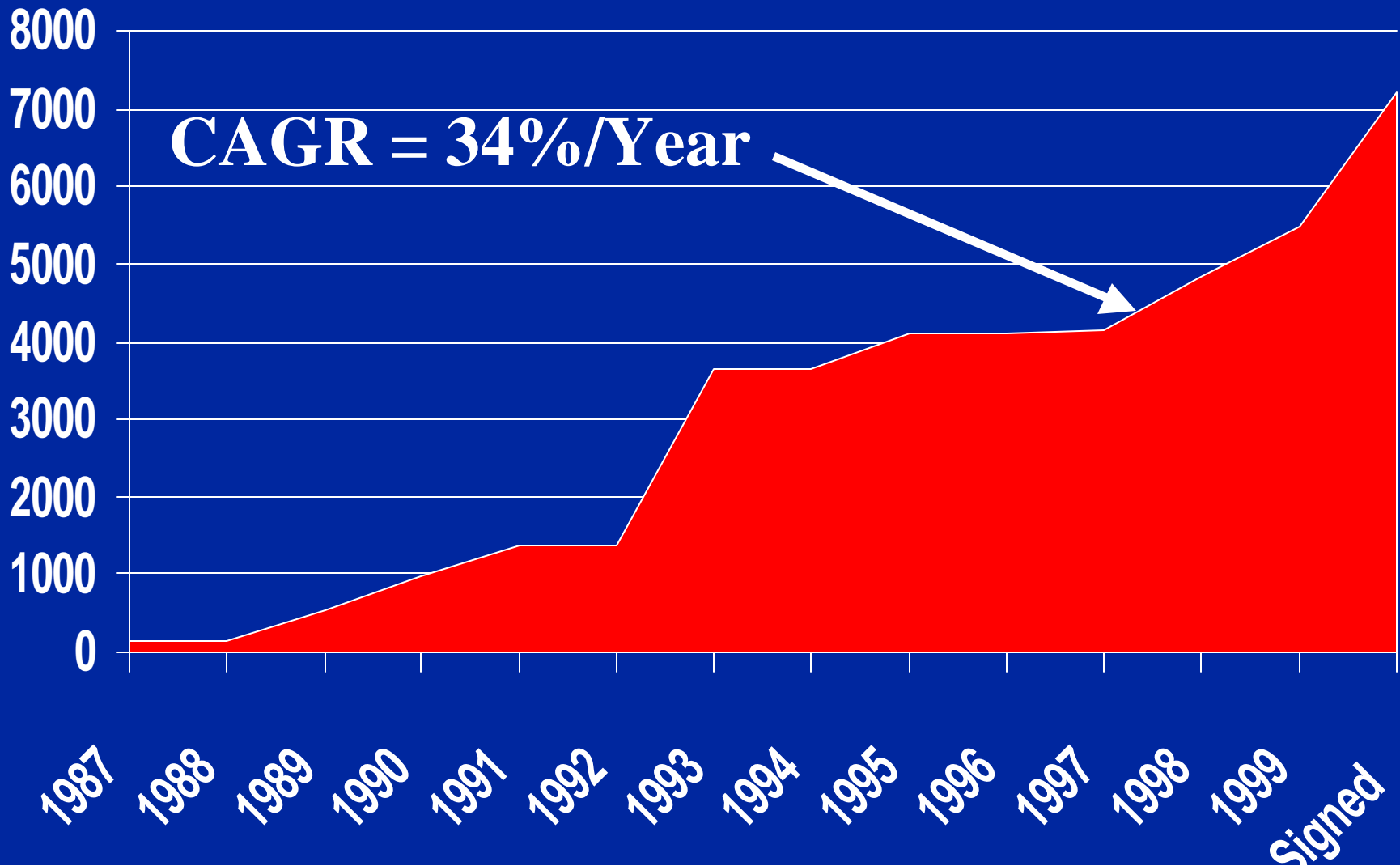
Trigen Energy Corporation Mission Statement

**Provide heating, cooling and electricity
with half the fossil fuel and half the
pollution of conventional generation**

Reasons for Mission:

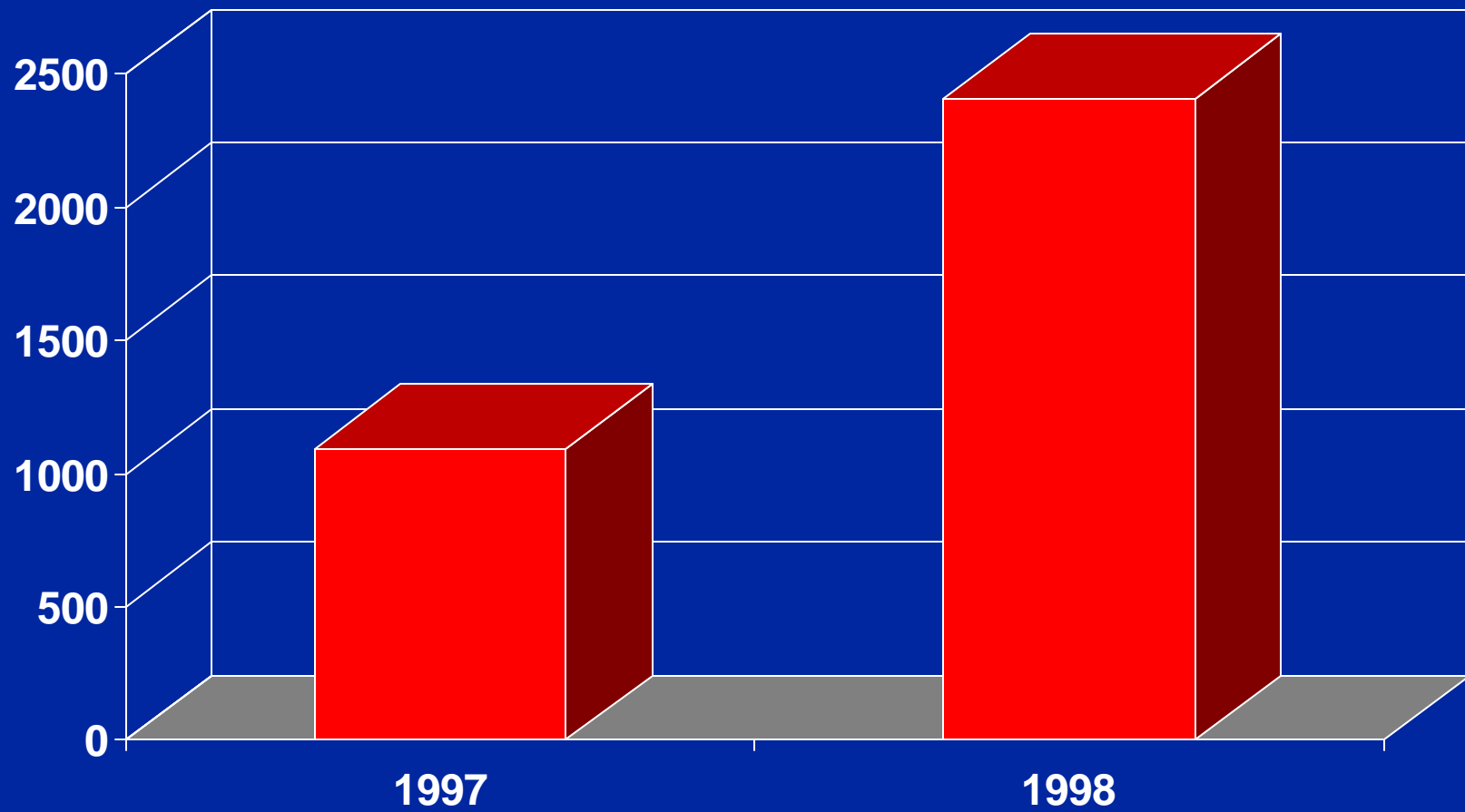
- Electric generation efficiency is very low and stagnant -- market failures
- All vectors point to CHP
- Best ways to mitigate climate change must:
 - Extract more value from all fuel
 - Reduce fossil fuel use and pollution.
 - **SAVE USERS MONEY!**

Total Trigen Capacity in Megawatts



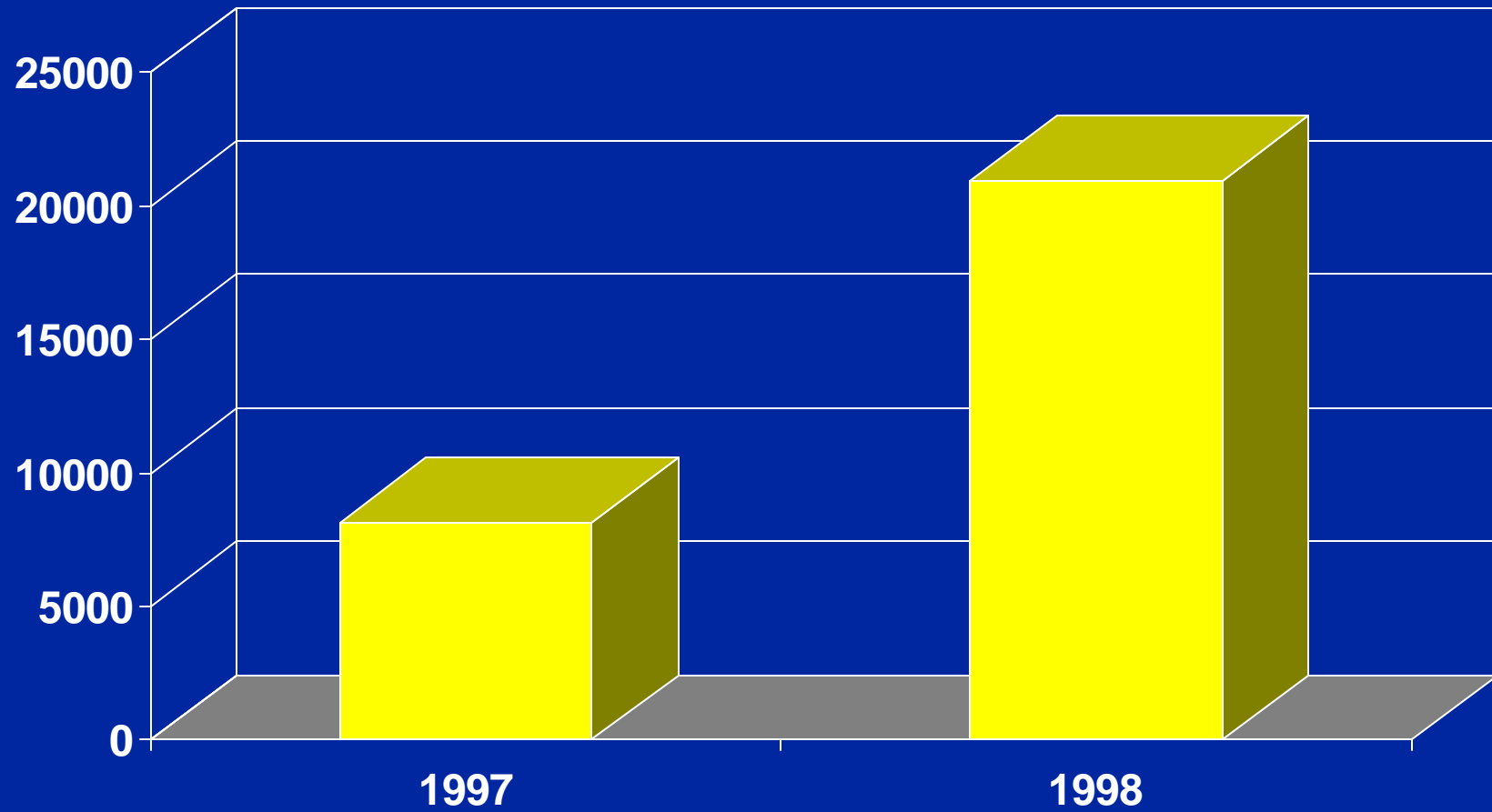
GHG Saved by Trigen

■ **GHC M Tons**



Criteria Pollutants Saved by Trigen

■ M tons



Why Haven't More Followed?

- **Difficult to generate profits with on-site CHP because of barriers to efficiency**
 - **Protected distribution monopolies block on-site generation**
 - **Environmental rules preserve status quo and penalize efficiency**
- **Energy entrepreneurs thus focus on central generation - AES, Calpine, others**
- **Equipment suppliers follow, focus on central generation sized plants**

Who Will Invest in Conservation?

- **Monopoly DSM is an oxymoron, will never produce significant savings**
- **Retail competitors for centrally generated power lose with DSM**
- **On-site power provider gains sale with savings and increased quality**
 - **must learn customer's processes**
 - **specializes by industry**
 - **reduces energy/unit of production**

NEEDED:
***Path to sustainable future
with lower costs and less
pollution***

How?

- Modernize regulation, eliminate barriers to efficiency
- Unleash competition to reduce costs

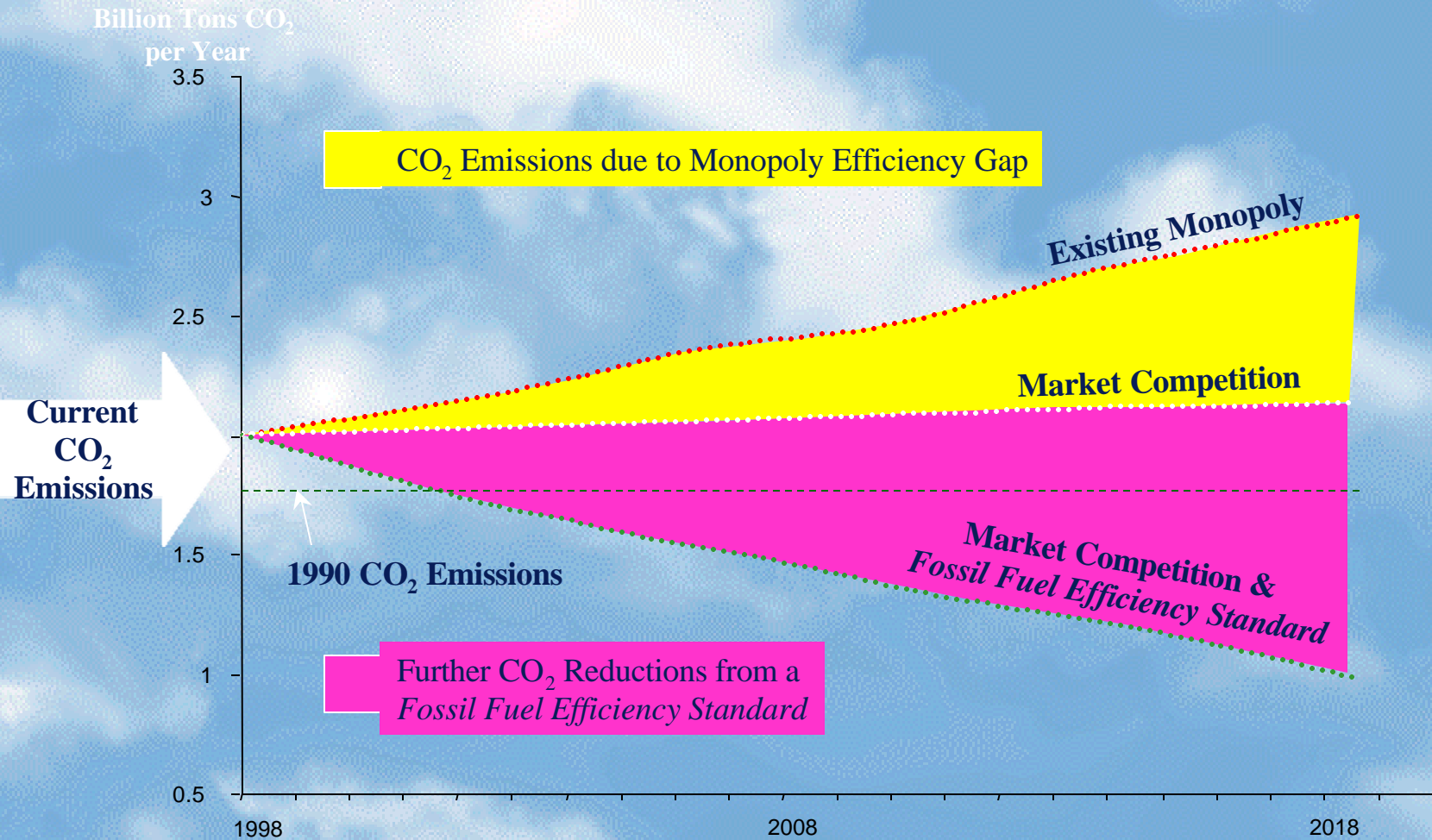
***A Proposed Solution --
ERRATA***

**The Energy Regulatory Reform
And Tax Act**

Energy Regulatory Reform And Tax Act

- **National deregulation of electricity**
- **Repeal PUHCA and most of PURPA**
- **Output based environmental regulation**
 - **Replace BACT, LAER, NSPS with fossil and NOx allowances/mWh of heat & power**
- **Eliminate barriers to efficiency**
- **End tax penalties on efficiency**
- **Federal purchase of energy efficiency**

CO₂ Emissions from U.S. Electric Power Generation



Who are the **WINNERS & LOSERS**

- Boilermakers and steamfitters
- Equipment makers
- Engineering, procurement and construction firms
- Energy research
- All consumers
- The environment
- The planet
- OPEC
- Coal miners
- Oil lease holders
- Oil exploration firms
- Countries that do not follow suit, keep energy protected, efficiency low, costs high

US Gains From ERRATA

- **\$200 billion work for EPCs, craft persons, & equipment manufacturers**
 - **Substitute capital and knowledge for fossil fuel**
- **Competition will lower costs and lessen fossil fuel and NO_x per megawatt hour**
 - **Heat & power costs drop by > \$109 billion**
 - **CO₂ from electric will be halved in 20 years**
- **US gains competitive advantage over countries that do not follow suit**
 - **Inverts anti-Kyoto arguments**

Other Countries Gains From US Passage of ERRATA

- **Companies with US operations will carry on-site power globally**
- **Growing on-site power market --> better equipment value --> cheaper heat & power**
- **Developing economies skip central generation step, go directly to CHP**
- **Renewable energy and waste fuel both gain from move to on-site power**

For More Complete Explanation, See:

- **“Turning Off The Heat,” Prometheus Press**
 - **Published October 1998**
 - **Forward by former DOE Secretary Federico Peña**
 - **Recommended by Bennett Johnston, former Chair, Senate Energy Committee**
 - **Reviewed by Len Hyman, senior utility analyst, Salomon Smith Barney**
 - **Available from publisher, web booksellers**

***Thank You For
Listening***

