ASME Annual Meeting

Plenary Session: Carbon Reduction in our Energy Intensive Future

The ASME Members Must Face the Facts of Why Coal is Important for

America?

Our Key to Economic Prosperity and A Strong America

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ASME
SETTING THE STANDARD

Why Coal is Important for America

The Goal of My Message is to Emphasize 4 Facts

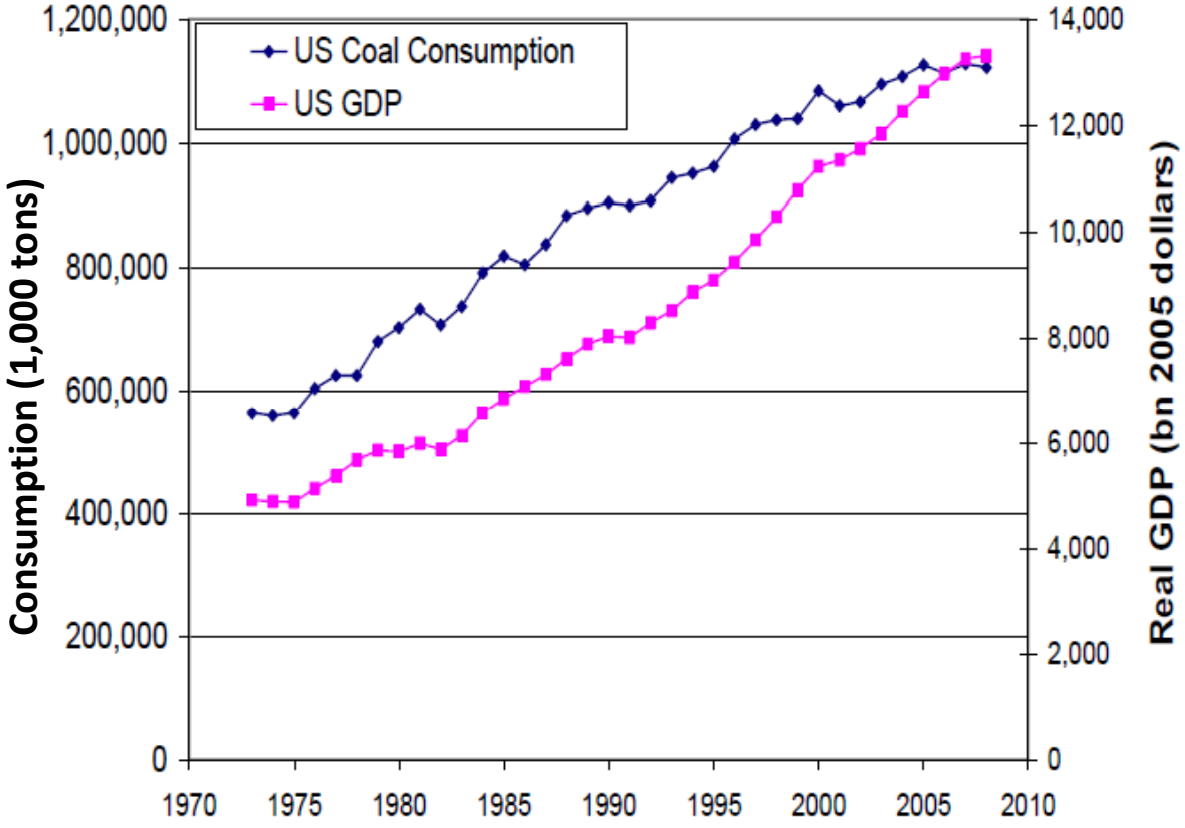
When energy options are considered, all forms of energy should be objectively considered. Here are 4 facts engineers need to keep in mind with regards to our professional responsibility:

1. ~ 82% of America's energy is from fossil fuels
2. About 250 million autos, light trucks and the best air transportation system in the world cannot be replaced in even a decade. These vehicles need oil!
3. Traditional fossil fuels will be needed for decades – This conclusion is projected by the Energy Information Administration (EIA), Electric Power Research Institute (EPRI), Exxon or any other expert. **Coal is needed to maintain America's economic prosperity.**
4. Engineers that understand energy issues are vastly outnumbered by politically correct **"Greenies."** Much damage has already been done from politically correct green energy policies.

Coal – Important in the 20th Century

Also Important in the 21st Century

Coal-fired generation and GDP have grown at nearly the exact same pace over the last 30 years.



U.S. Energy Information Administration, MER Sept, 2009 & US Bureau of Economic Activity.

Get the Facts About Coal

Coal's Potential to Restore Economic Strength to the USA

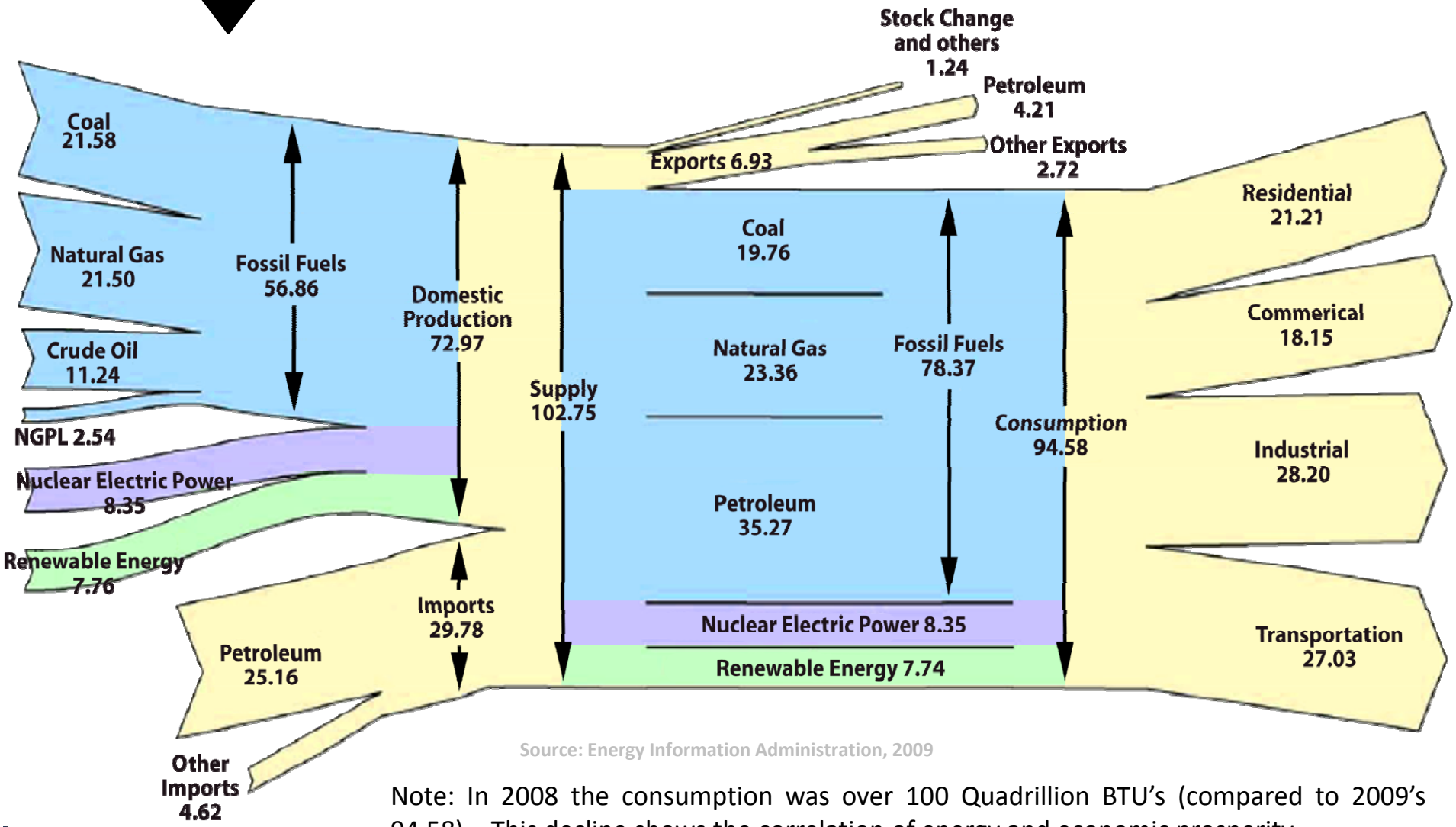
- Coal is America's most abundant energy resources .
- Coal is used to generate about half of the electricity consumed in America.
- Coal is the largest domestically-produced source of energy.
- Coal can be stored safely on site in large quantities.
- Technology exist today that can transform coal into clean, affordable transportation fuels, provide industrial fuels and supplement energy for armed forces.
- Using today's technologies, coal can create millions of jobs across America.
- More energy resides in American coal than oil of the Persian Gulf.
- Our coal reserves can supply more than 3 times the amount of fuel energy than what is contained in Saudi Arabia's proven oil reserves.
- Coal produced in America, improves our balance of trade, keeps jobs in America

Source: National Mining Association (NMA) President and CEO Hal Quinn statement in response to President Obama's address on strengthening US independence from foreign oil.

All Energy Flow to Power America

2009 (Quadrillion Btu)

Coal remains an important fuel for America at about 20% of our total energy. Coal is needed for national security and continued economic prosperity.



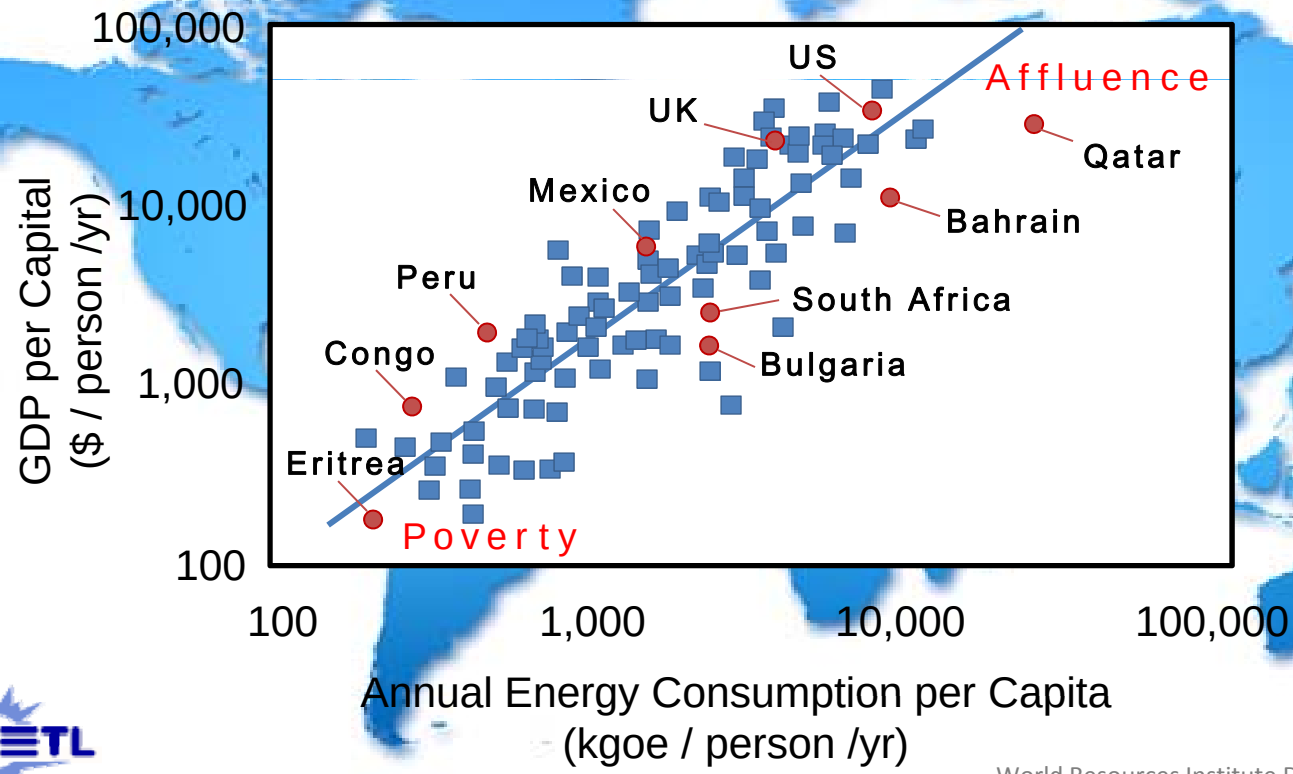
Source: Energy Information Administration, 2009

Note: In 2008 the consumption was over 100 Quadrillion BTU's (compared to 2009's 94.58) – This decline shows the correlation of energy and economic prosperity

What Coal Does for America

Prosperity, Life, Wealth

Energy = Quality of Life



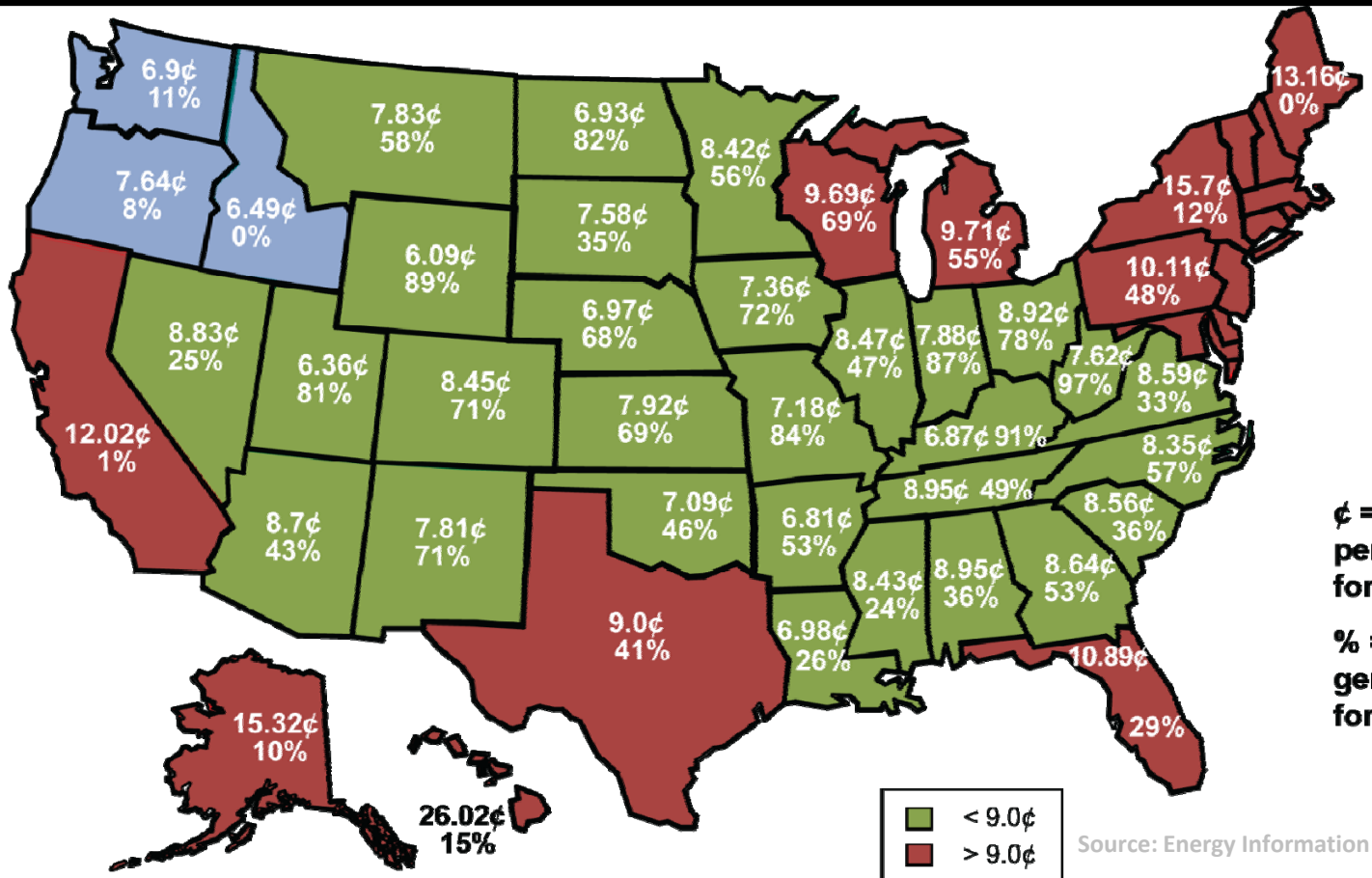
World Resources Institute Database, accessed June 1, 2005
http://earthtrends.wri.org/searchable_db/

America Relies on C O A L

States that Rely on Coal Have Low-Cost Electricity

18 States and District of Columbia: 24% from Coal & 13.50 Cents/kWh Average

29 States: 59% from Coal & 7.85 Cents/kWh Average



MA	14.4¢	20%
CT	17.01¢	9%
NH	14.89¢	17%
RI	13.44¢	0%
NJ	14.03¢	11%
VT	13.49¢	0%
MD	12.29¢	58%
DE	11.94¢	63%
DC	13.26¢	0%

¢ = average retail price per kilowatt hour for 2010

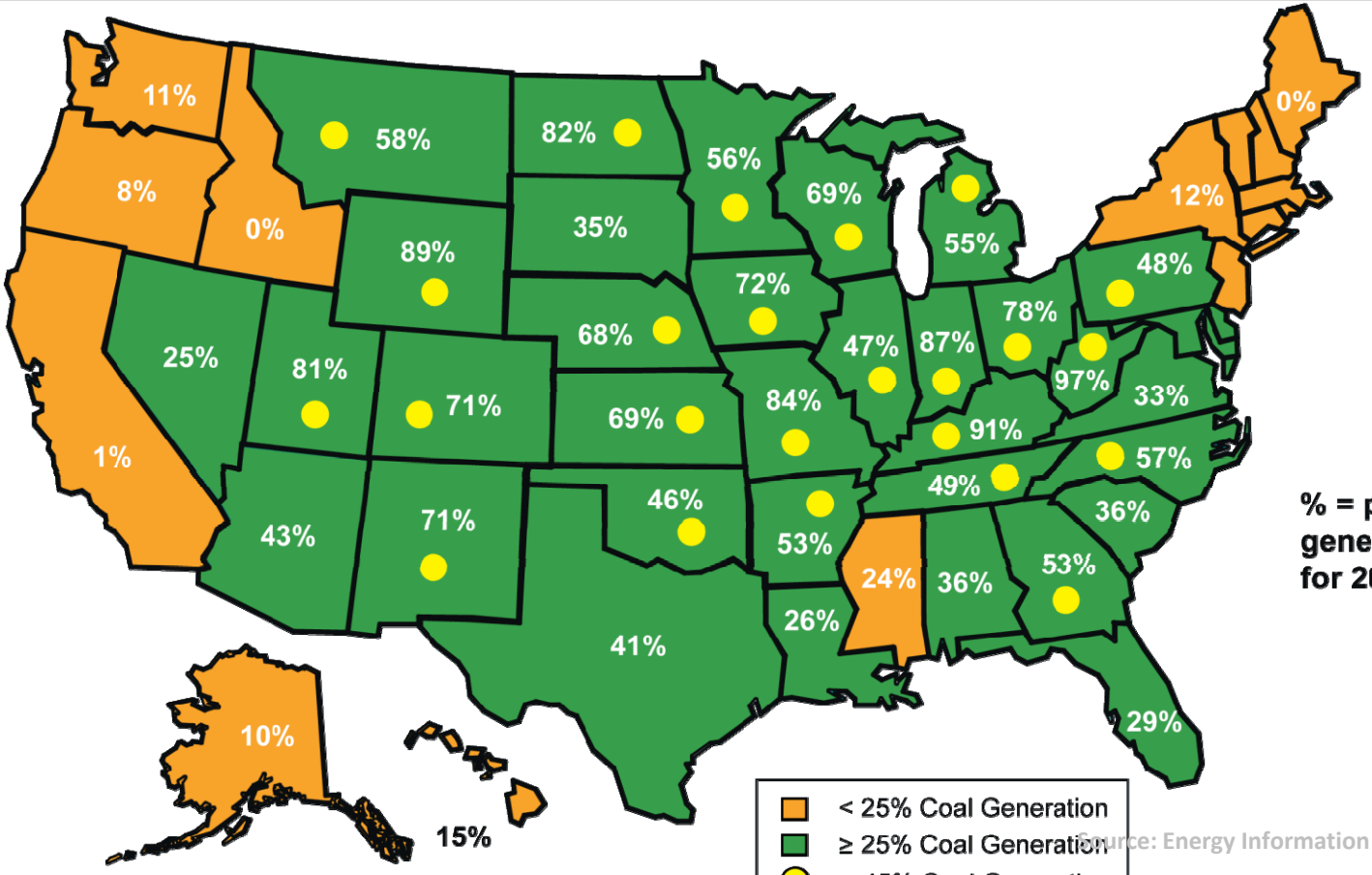
% = percent of total generation from coal for 2010

Source: Energy Information Administration, 2010

Coal and Electricity Keeps America on the Move

States that Rely on Coal Have Low-Cost Electricity

35 States obtain at least 25% of their electricity from coal
24 States obtain at least 45% of their electricity from coal



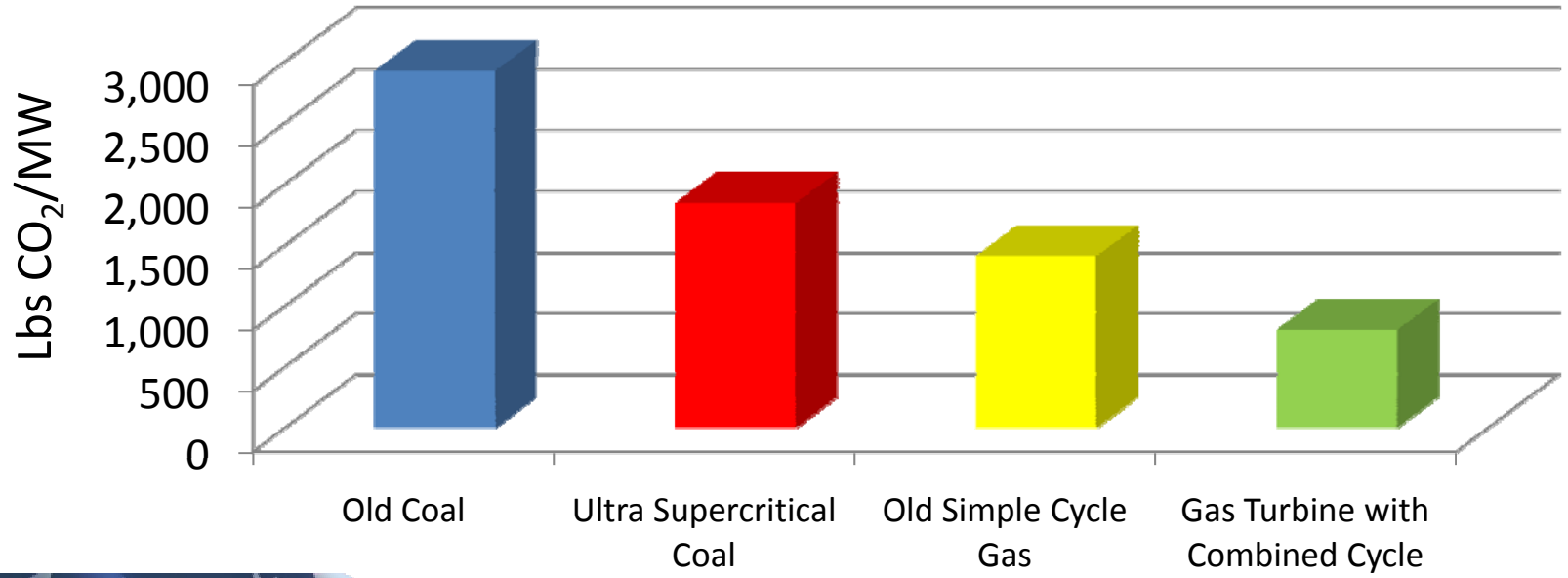
MA	20%
CT	9%
NH	17%
RI	0%
NJ	11%
VT	0%
MD	58%
DE	63%
DC	0%

% = percent of total generation from coal for 2010

Source: Energy Information Administration, 2010

CO_2 Production per MegaWatt

Natural Gas does emit less CO_2, but it is not carbon free. Depending on the efficiency of the end use, natural gas may result in a carbon footprint that is 70% or more of an equivalent amount of energy from coal.



Coal to Generate More Electricity

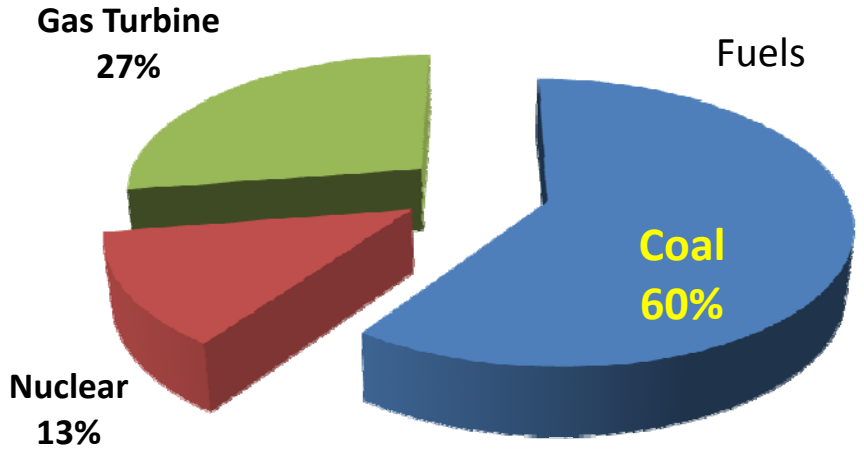
Coal fuels the industrialized world to power manufacturing to "build things" and create wealth.

That is how the USA obtained our wealth and strength in the 20th century – and how Asia is gaining theirs in the 21st century.

International Coal Facts

Source: eia.gov

- 2008 – 78% of electricity generation in China was from coal.
- 2009 – China coal consumption was at 3.5 billion tons per year vs. US coal consumption at 1.0 billion tons per year.



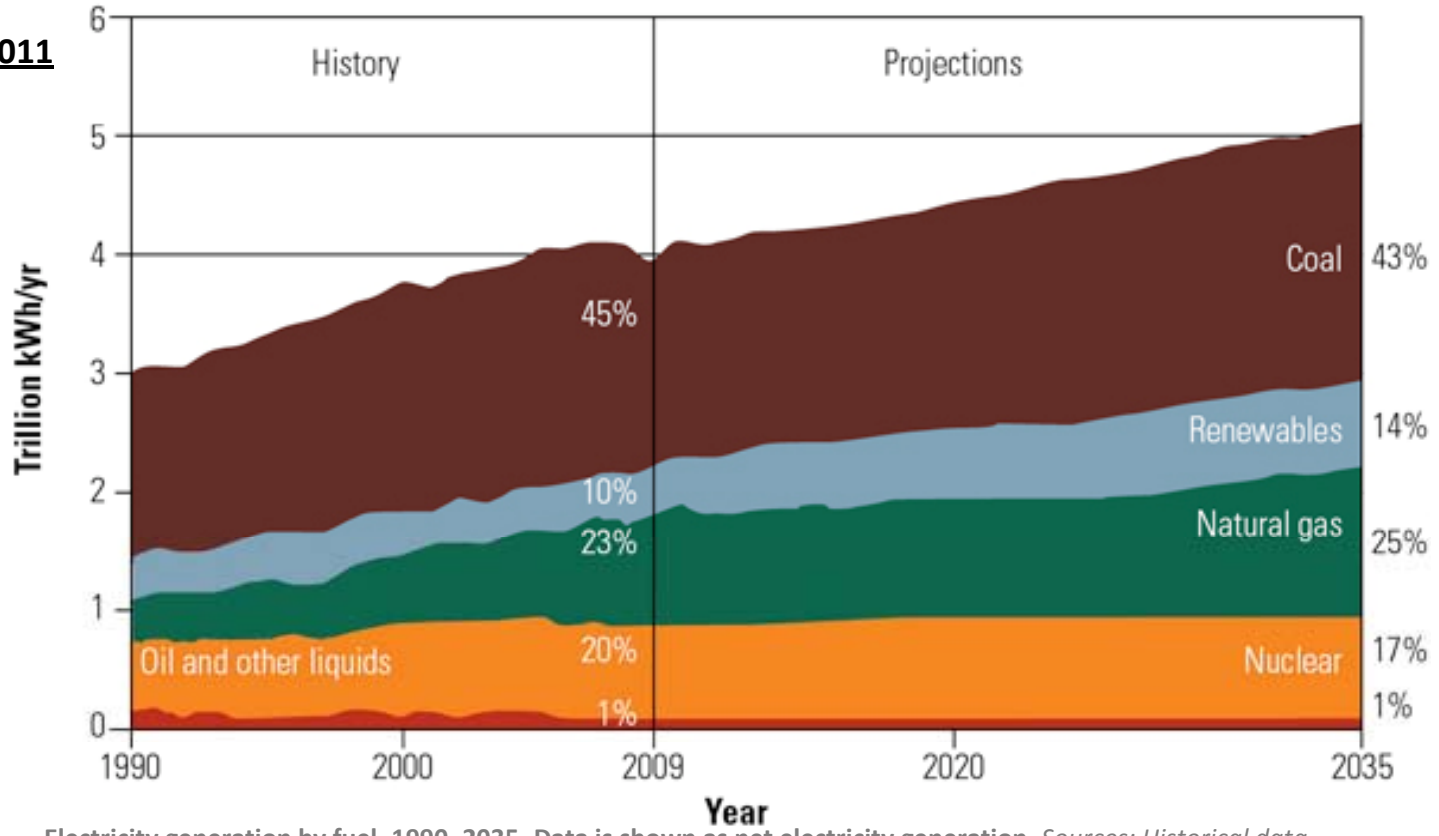
Global Electric Generating Capacity, 2020
(1000 MW)
Source: Mcilvaine Company

Coal Fired Generation Prediction

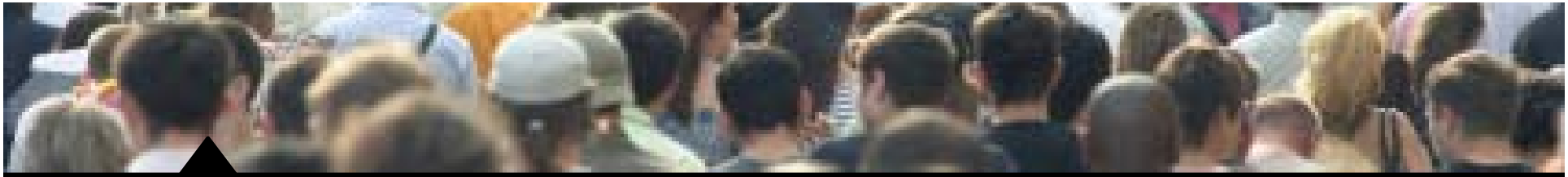
U.S. Energy Information Association (EIA) predictions of U.S. electricity generation estimate that the percentage of U.S. electricity generated by the combustion of coal will decline by 2%, from 45% to 43%, between 2009 and 2035.

EIA Annual Energy Outlook 2011

- An estimated 21 GW will be added during this 25 yr period.
- Coal will remain the dominant energy source.
- Heavy reliance on the existing coal-fired fleet to meet nation's demand.



Electricity generation by fuel, 1990–2035. Data is shown as net electricity generation. *Sources: Historical data from EIA, Annual Energy Review 2009; projections from National Energy Modeling System, run REF 2011, D120810C*

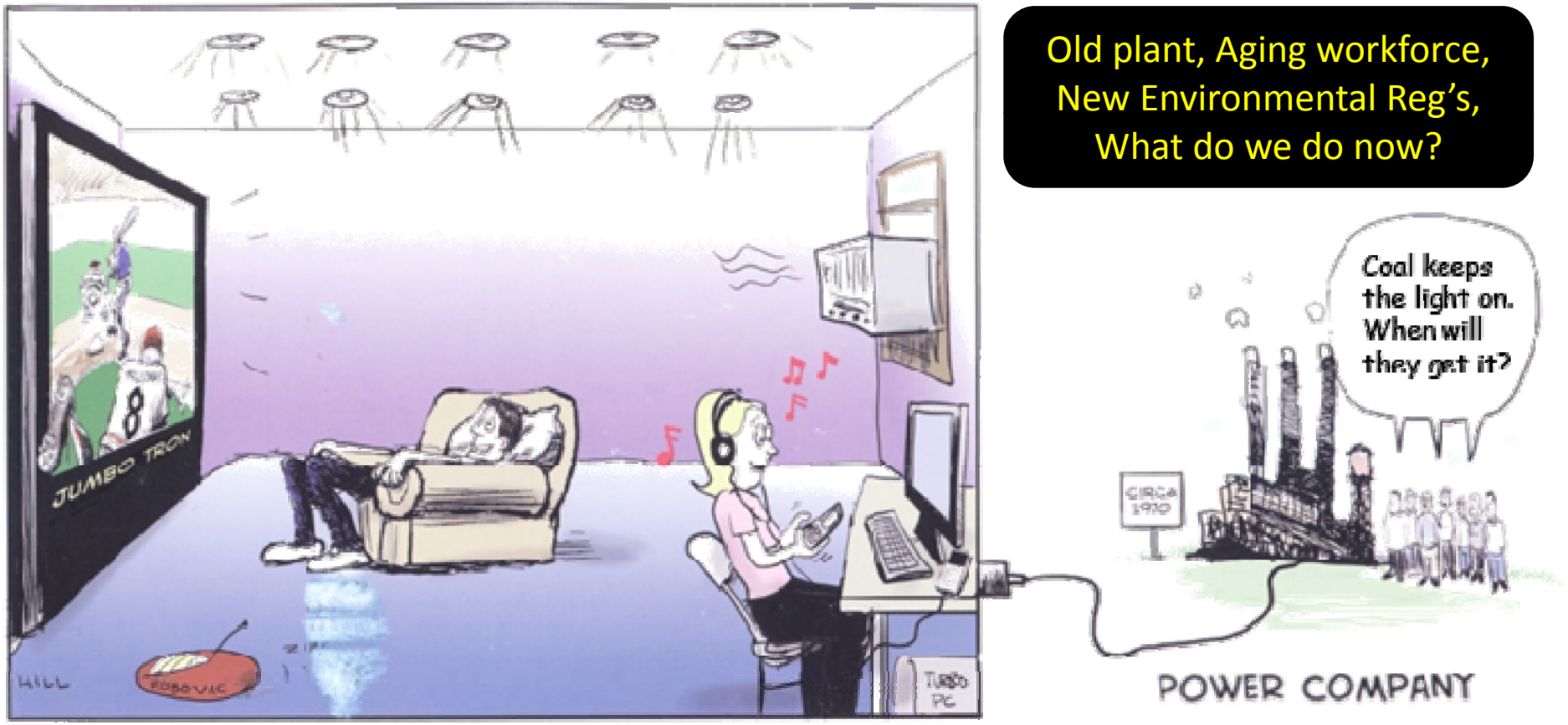


Political Correctness Is…

Against any Coal Plants – One young university student referred to coal as the "New Tobacco."

Electric Power demand is growing at 1-2% per year. America still depends on 35+ year-old, average age, power plants for 50% of its power. (Duke's coal fleet is average age 47 years old.)

Old plant, Aging workforce, New Environmental Reg's, What do we do now?

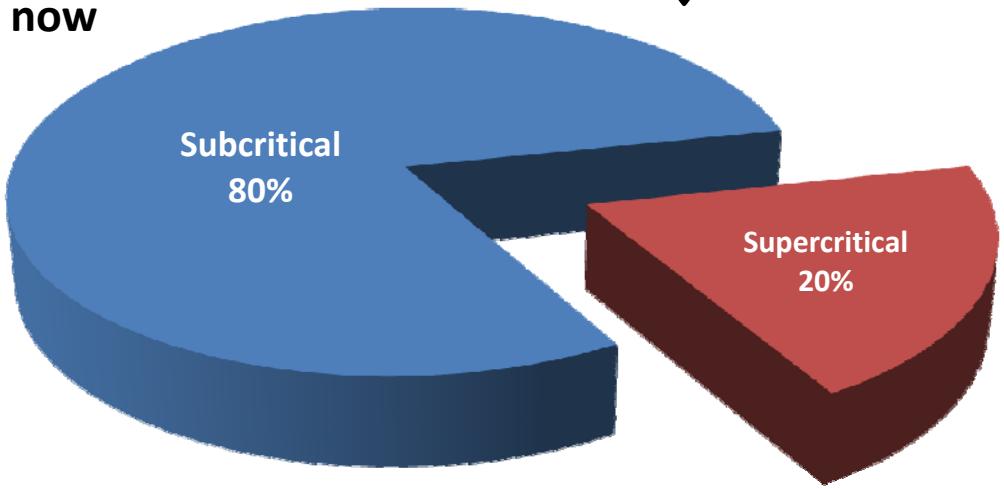


The Existing Coal-Fired Fleet

The current portfolio of coal-fired generation in the U.S. was a shade over 338 GW of installed nameplate capacity for 1,436 units at the end of 2009, the last full year for which EIA data is available. These units are generally conventional pulverized coal (PC) plants based on either subcritical (80% of the units) or supercritical (20%) boiler technology.

3 Conventional Boiler Technologies available now

1. Subcritical steam generators
   - Operates at steam pressure < 3,208 PSI
2. Conventional supercritical steam generators
   - Operates at steam pressure > 3,208 PSI and steam temp generally in 1,000F – 1,050F
3. Ultrasupercritical (USC) steam generators
   - Operates at steam pressure > 3,208 PSI and steam temp > 1,100F

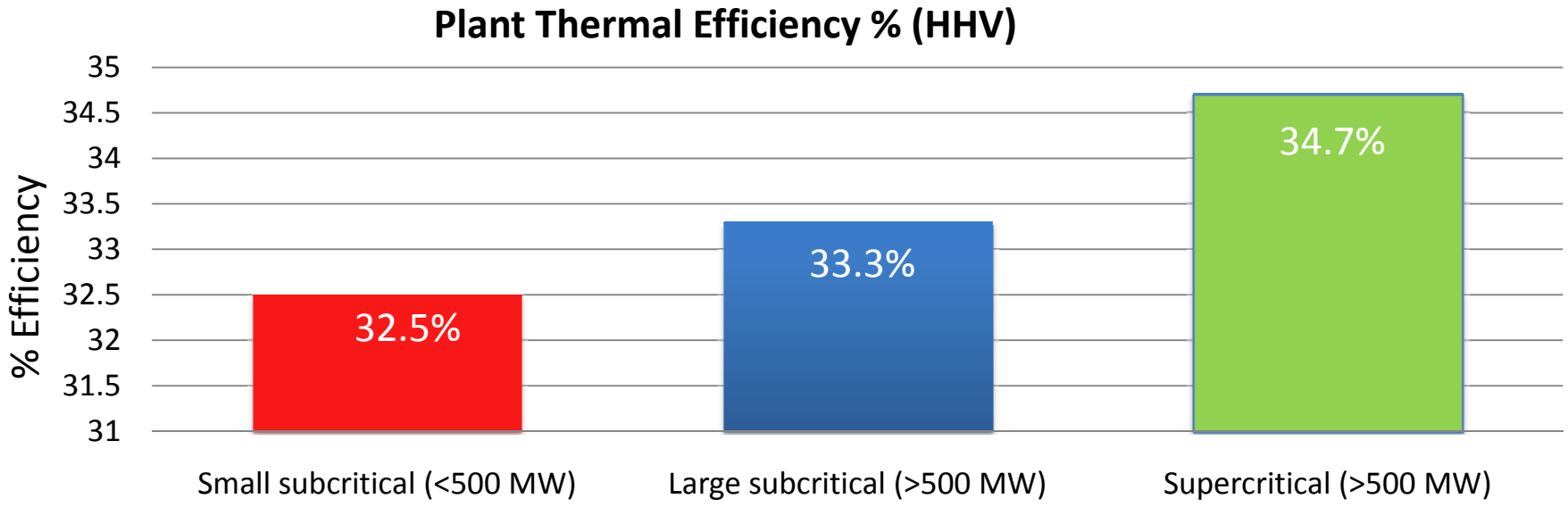


Today's Coal-Fired Fleet

Coal-Fired Generation Cost and Performance Trend. *Sources: Power Magazine, May 2011. Article by Dale Probasco, managing director with Navigant's Energy Practice and Bob Ruhlman, associate director with Navigant's Energy Practice.*

Cost Evaluation For Today's Coal-Fired Fleet

Supercritical Units = Better Efficiency



Coal-Fired Generation Cost and Performance Trend. *Sources: Power Magazine, May 2011. Article by Dale Probasco, managing director with Navigant's Energy Practice and Bob Ruhlman, associate director with Navigant's Energy Practice.*

Why Ultra Supercritical Units?

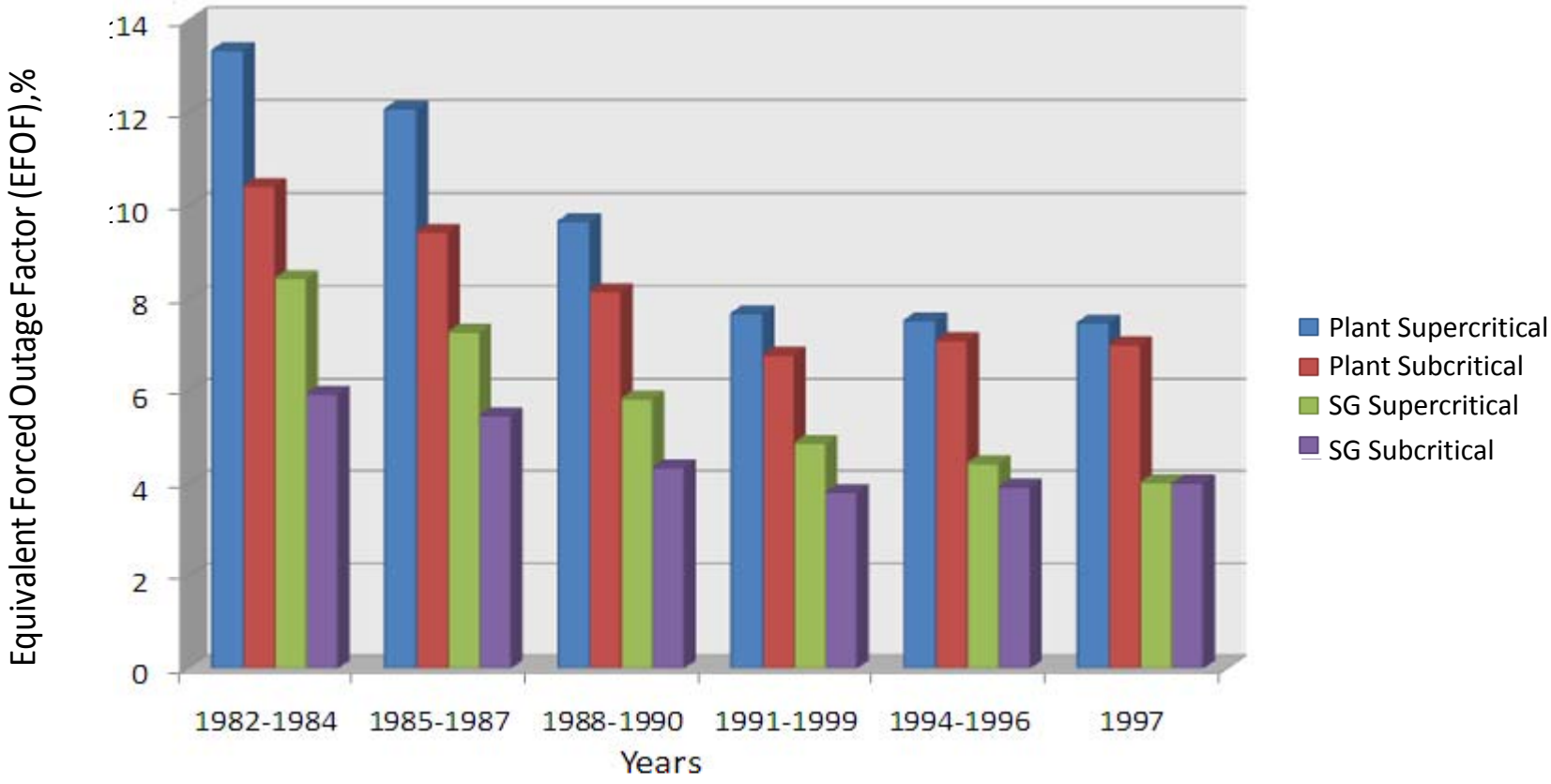
Dramatic Improvement in 39% Efficiency

- Most efficient technology for producing electricity fueled by pulverized coal.
- Operates at supercritical pressure and steam temp. of 1,100°F
- Temp and pressures enable more efficient operation of Rankine cycle.
- Increase in efficiency reduces fuel consumption, and thereby reduces emissions.
- Turk plant shown at right has 39% efficiency, while other USC has ~40-41% efficiency.

Architect's rendering of AEP's John W Turk Jr Plant, the first ultra-supercritical generating unit.

Source: www.aep.com - Supercritical Fact Sheet

Availability of Subcritical versus Supercritical Units – N. America



Source: NERC 1982-1997

Advanced Designs and Materials

(Courtesy MitsuiBabcock) Pressure (psi) Main Steam/Reheat Temp	**SUBCRITICAL** 2400 1005F/1005F	**SUPERCRITICAL** 3600 1060F/1055F	**SUPERCRITICAL** 3800 1075F/1075F	**ULTRASUPERCRITICAL** 4200 1110F/1150F
High Temperature Superheater and Reheater	**T22**	**T91**	**TP347H**	**TP310HCbN**
Primary Superheater, Intermediate & Outlet Surfaces	**T12**	**T23**		**T91**
Primary Superheater Inlet	**T1a**	**T12**	**T23**	
Reheater Inlet Bank in Rear Pass	**SA192**		**SA210C**	
Waterwalls	**SA210C** **T1a**	**T12**		**T23**
Furnace Roof	**T12**		**T23**	
Rear Cage	**T1a**	**T12**	**T23**	

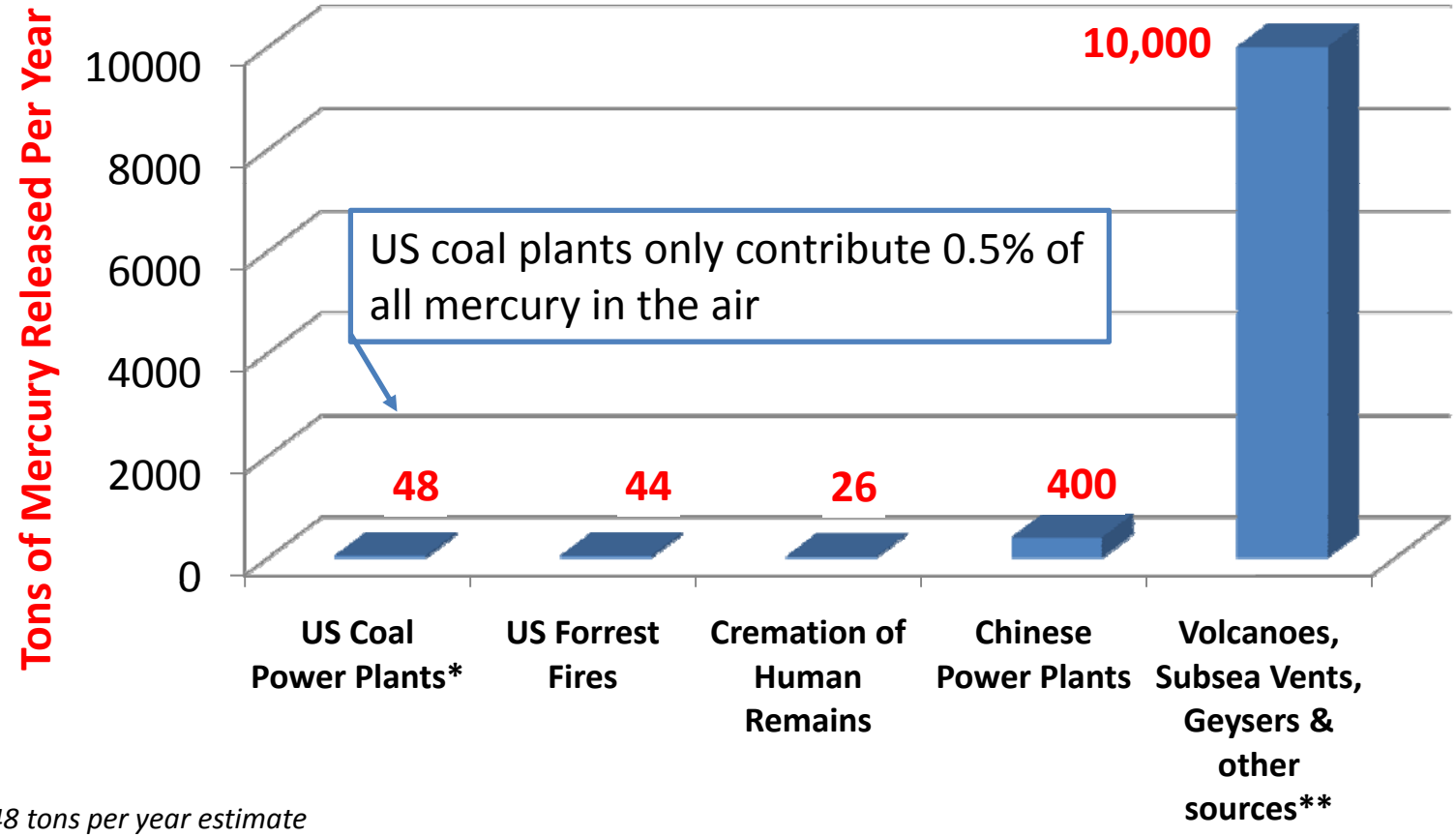
Source: Worley Parson Resources and Energy

Supercritical State of the Art Technology

- Latest units in Europe 4000 psig, 1105/1110°F (Ultra Supercritical)
- China moving up to 3800 psig, 1120/1135°F
- Most aggressive unit in Japan 3950 psig, 1121/1153°F
- Typical U.S. supercritical boilers are generally around 3700 psig, 1080/1080°F
- Most advanced U.S. plant in Engineering Phase at 3800 psig, 1112/1135°F
- With advanced materials and careful design, ultra supercritical units have maintenance and availability similar to more recent standard supercritical units.
- An ultra efficient, clean coal fleet would reduce emissions further for all pollutants.

Source: Worley Parson Resources and Energy

The Myth of Killer Mercury



**41-48 tons per year estimate*
***9,000-10,000 tons per year estimate*

Source: Wall Street Journal

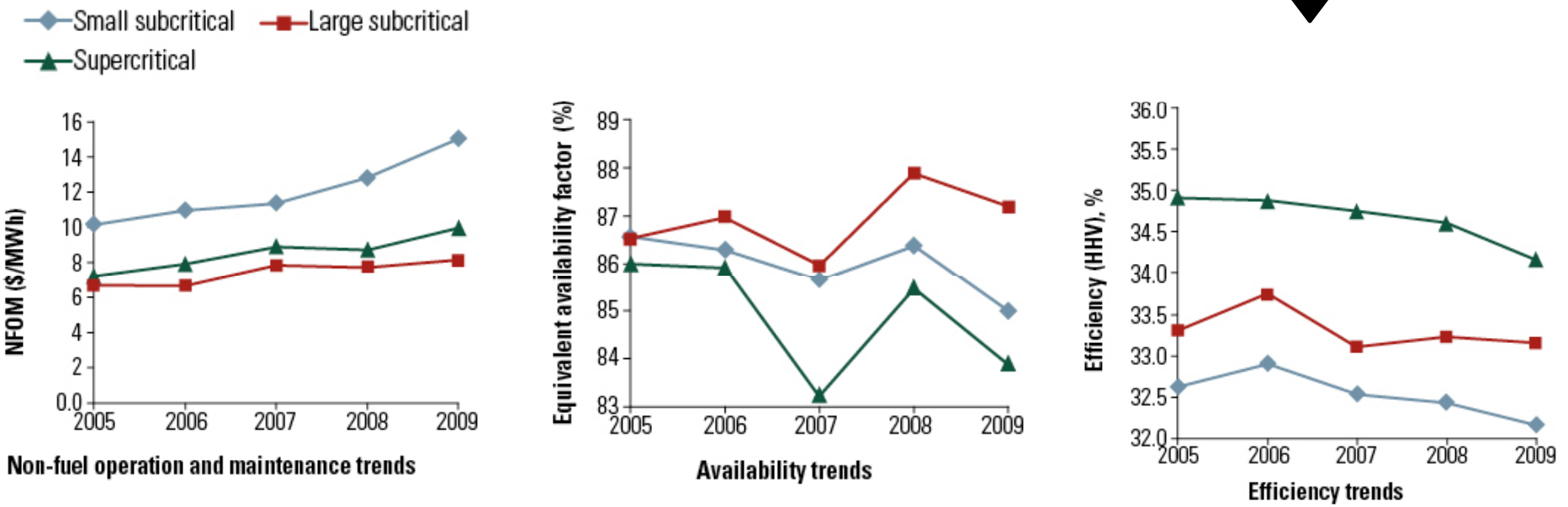
The Straight Facts on Mercury

- Mercury has always existed naturally in Earths' environment.
- 2009 study found mercury deposits in Antarctic ice across 650,000 years.
- Mercury is found in air, water, rocks, soil and trees.
- 200 Billion tons of mercury presently in seawater have never posed a danger to living beings.
- America's coal-burning power plants emit an estimated 41-48 tons of mercury per year.

- **<u>Bottomline</u>: An ultra efficient, clean coal fleet" would not only create millions of jobs and revitalize American manufacturing, but it would also reduce emissions further for all pollutants.**

Existing Coal-Fired Fleet Performance Trends, 2005-2009

The net drop in average efficiency is greatest for supercritical units (–0.7%), followed by small subcritical units (–0.4%) and large subcritical units (–0.2%).



Coal-Fired Generation Cost and Performance Trend. *Sources: Power Magazine, May 2011. Article by Dale Probasco, managing director with Navigant's Energy Practice and Bob Ruhlman, associate director with Navigant's Energy Practice.*

We Need to Build More Coal-Fired Plants

At What Cost?

Capital costs for coal-fired generation are rising sharply

Technology	Project	Nominal capacity (MW)	Year completed	Approximate total cost ($/kW)
Subcritical	JK Spruce	750	2010	1,333
	Plum Point	720	2010	1,388
			Subcritical average cost	**1,361**
Conventional supercritical	Comanche	750	2010	1,733
	Iatan	850	2010	1,470
	Oak Creek	1,230	2011	1,935
	Trimble County	750	2011	1,579
			Supercritical average cost	**1,679**

Average Cost

Capital cost review of recently completed projects employing both subcritical and supercritical technology

New coal plants designed today will likely cost

$3,000/kWh

installed cost

Coal-Fired Generation Cost and Performance Trend. *Sources: Power Magazine, May 2011. Article by Dale Probasco, managing director with Navigant's Energy Practice and Bob Ruhlman, associate director with Navigant's Energy Practice.*

EIA Cost Estimates for Coal-Fired Units

Construction Cost Will Continue TO RISE

Estimates Cost

Technology	Nominal capacity (MW)	Efficiency (%)	Overnight capital cost (2010 $/kW)	% change from previous year
Coal				
Single-unit advanced PC	650	38.8	$3,167	
Dual-unit advanced PC	1,300	38.8	$2,844	25%
Single-unit advanced PC with CCS	650	28.5	$5,099	
Dual-unit advanced PC with CCS	1,300	28.5	$4,579	
Gas				
Advanced natural gas combined cycle	400	53.1	$1,003	1%

Notes: CCS = carbon capture and sequestration, PC = pulverized coal.

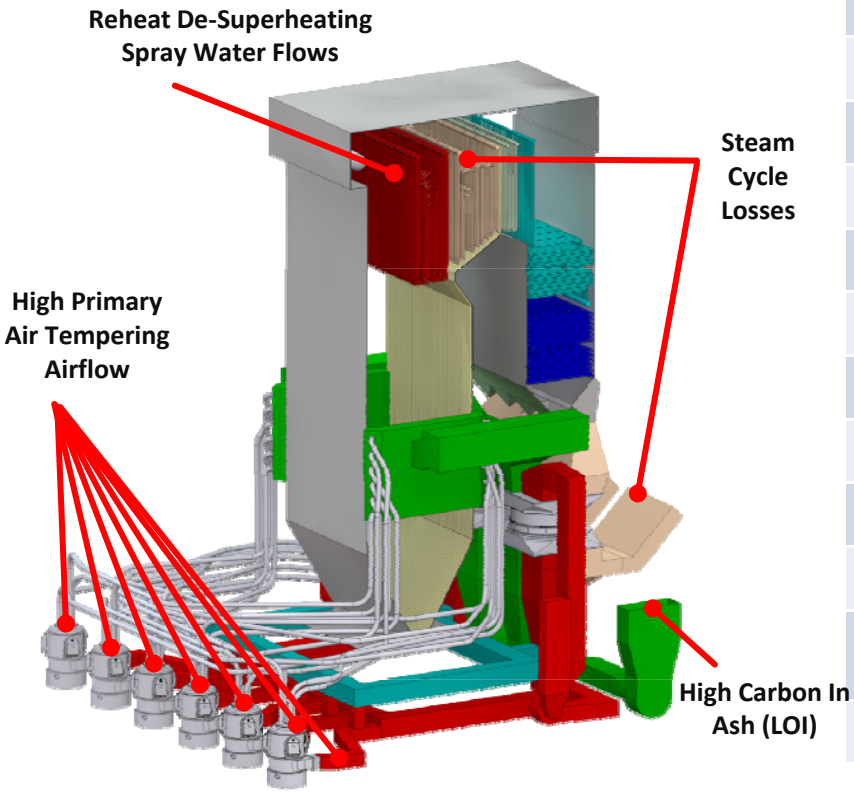
Single-unit advanced PC option nearly double the average cost. Note: The cost of the coal option increased by 25% while the gas option rose by a meager 1%

Construction costs are one factor, fuel costs over the life of the plant will have more of an impact for our children's generation. Also natural gas is not likely to remain at $4.00 per million Btu's as demand doubles. Multiple fuels should be depended upon.

Coal-Fired Generation Cost and Performance Trend. *Sources: Power Magazine, May 2011. Article by Dale Probasco, managing director with Navigant's Energy Practice and Bob Ruhlman, associate director with Navigant's Energy Practice.*

Stealth Opportunities

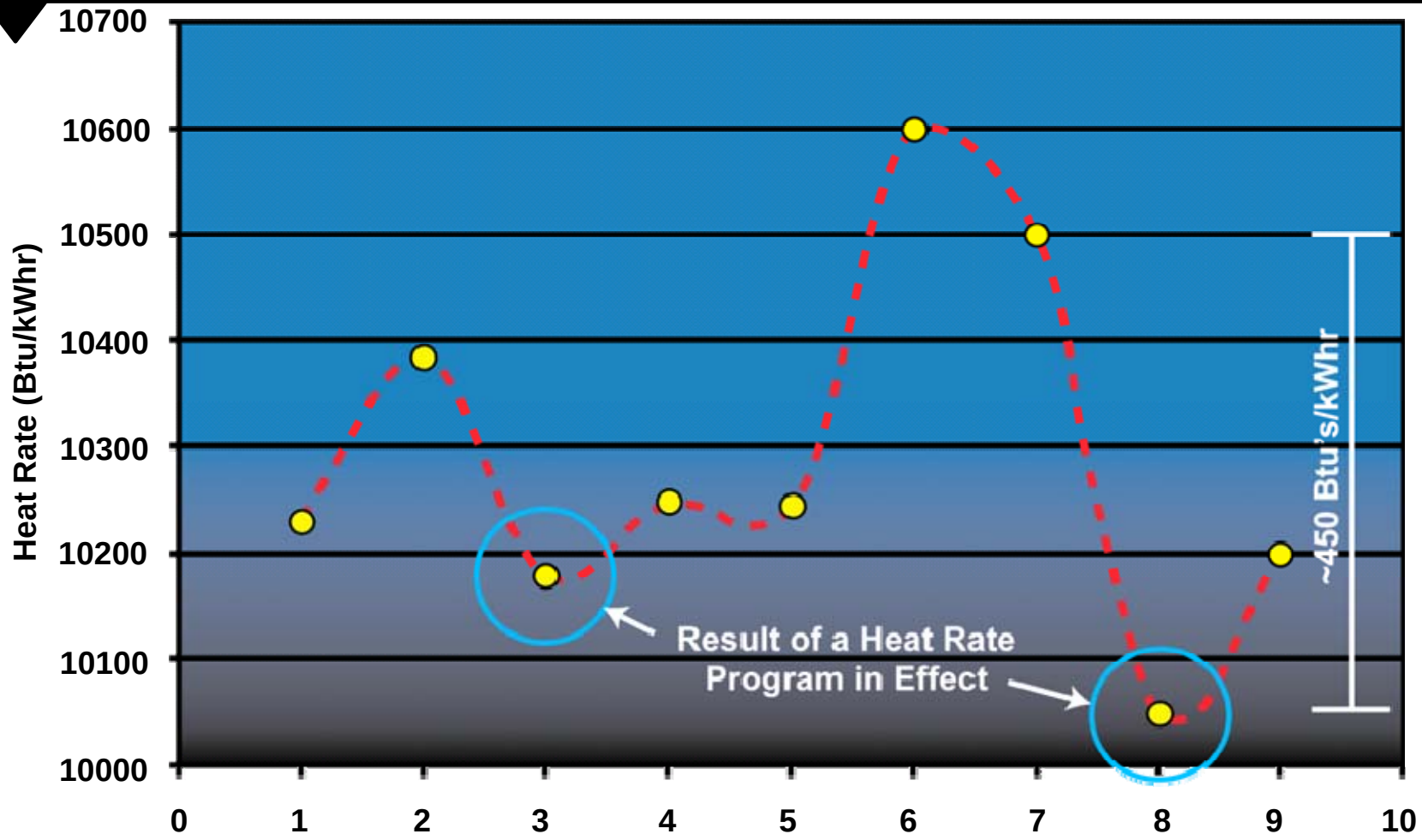
There is still room for Excellence in Operations and Maintenance!



Variable	Potential Heat Rate Improvement (Btu/kWh)	Potential Annual Fuel Savings
Boiler & ductwork ambient air in-leakage	300	$819,000
Dry gas loss at the air heater exit	100	$273,000
Primary airflow	75[a]	$204,750
Steam temperature	75	$204,750
De-superheater spray water flow	50	$136,500
Coal spillage	25	$68,250
Unburned carbon in flyash	25[a]	$68,250
Unburned carbon in bottom ash	25	$68,250
Slagging and fouling	25[a]	$68,250
Cycle losses	25	$68,250
All others, including soot blowing and auxiliary power factors	25	$68,250
Total	**750**	**$2,047,500**

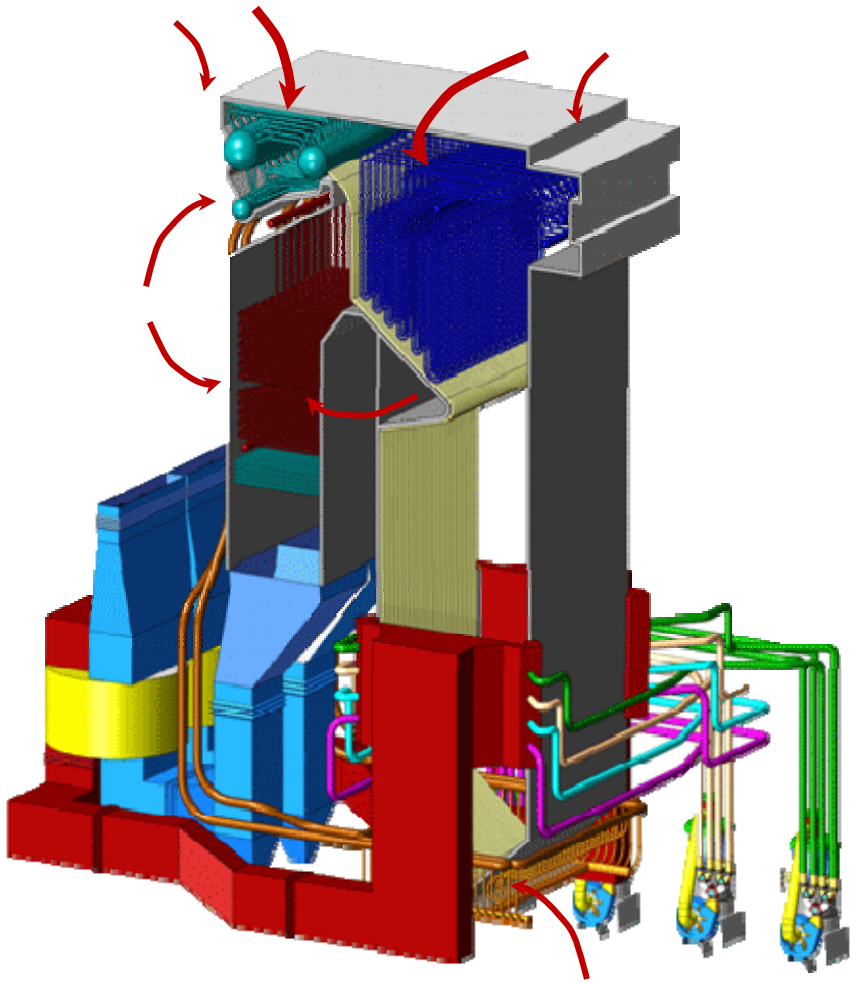
Note: a. Interactions between variables will impact meeting this estimate.

Example Heat Rate Curve of What Can Be Accomplished By Applying The Basics

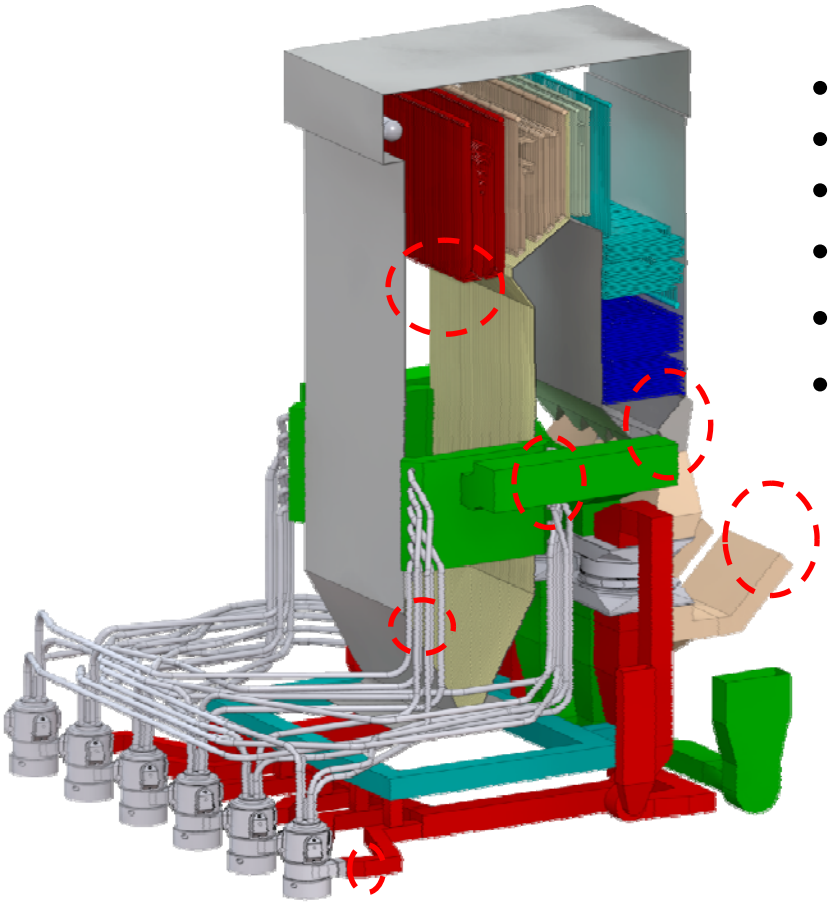


Air In-Leakage

- Penalties due to air in-leakage (up to 300 Btu's/kWh
- PTC-4.1 does not take into account. Thus, we call them "Stealth Losses"
- In addition to the thermal penalty, artificially high oxygen readings can have serious performance impacts on good combustion
- The air that leaks into the boiler setting, between penthouse and air heater inlet is useless for combustion, it is simply "tramp air"
- Bottom ash hopper seals are another source of Air Heater Bypass air
- Traditional Concerns of Air heater leakage and the penalties of high Air Heater Leakage



Comprehensive Evaluation and Application of the Basics

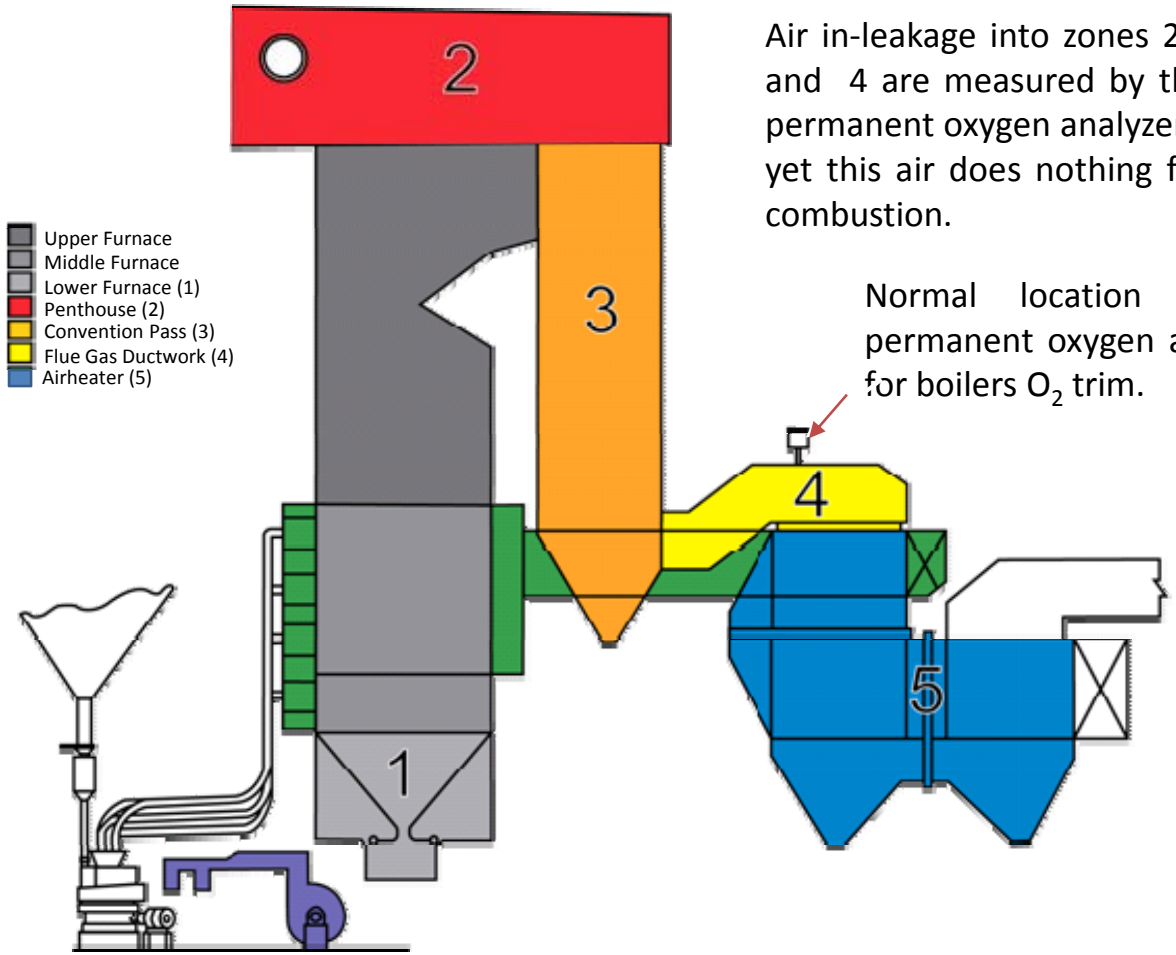


- Fuel Line Performance Measurements & Mill Optimization
- Mill Inlet Primary Airflow Calibrations
- Total Secondary Airflow Measurement & Calibration
- Furnace Exit Gas Temperature & Flue Gas Constituents
- Economizer Outlet Flue Gas Measurements
- ID Fan Discharge / Stack Inlet Flue Gas Measurements
- “Stealth Loss” Evaluation, Optimization & Preservation






Typical Locations of Air In-Leakage



Air in-leakage into zones 2,3 and 4 are measured by the permanent oxygen analyzers, yet this air does nothing for combustion.

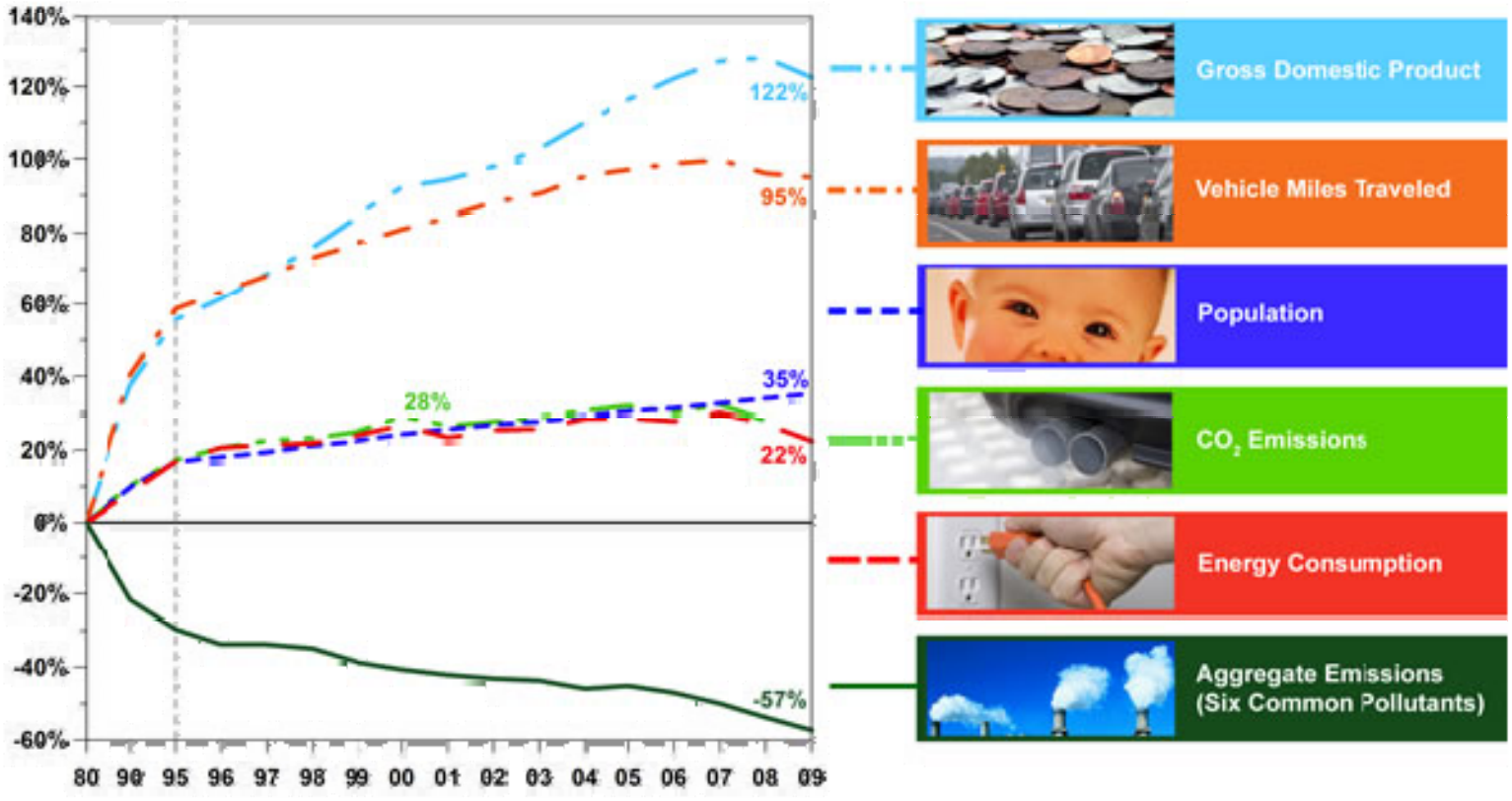
Normal location of the permanent oxygen analyzers for boilers O_2 trim.

Operations at the Best Possible Efficiency is the Right Thing to do for Two Reasons: Environment Awareness and Cost of Generation

• Boiler air in-leakage	200 Btu/kWhr
• Airflow measurement optimization	50 Btu/kWhr
• Pulverizer performance optimization & fuel line balancing	100 Btu/kWhr
• Reducing pulverizer coal rejects	40 Btu/kWhr
• Reduced carbon in ash	50 Btu/kWhr
• Reduced desuperheating spray flows	50 Btu/kWhr

- Extra 50 MW @ $20/MWh translates to $2 million net power revenues
- 500 MW coal plant operating @ 80% capacity will reduce fuel consumption by 10,000 tons/yr.
- Payback on $5 million investment will take only 2 yrs

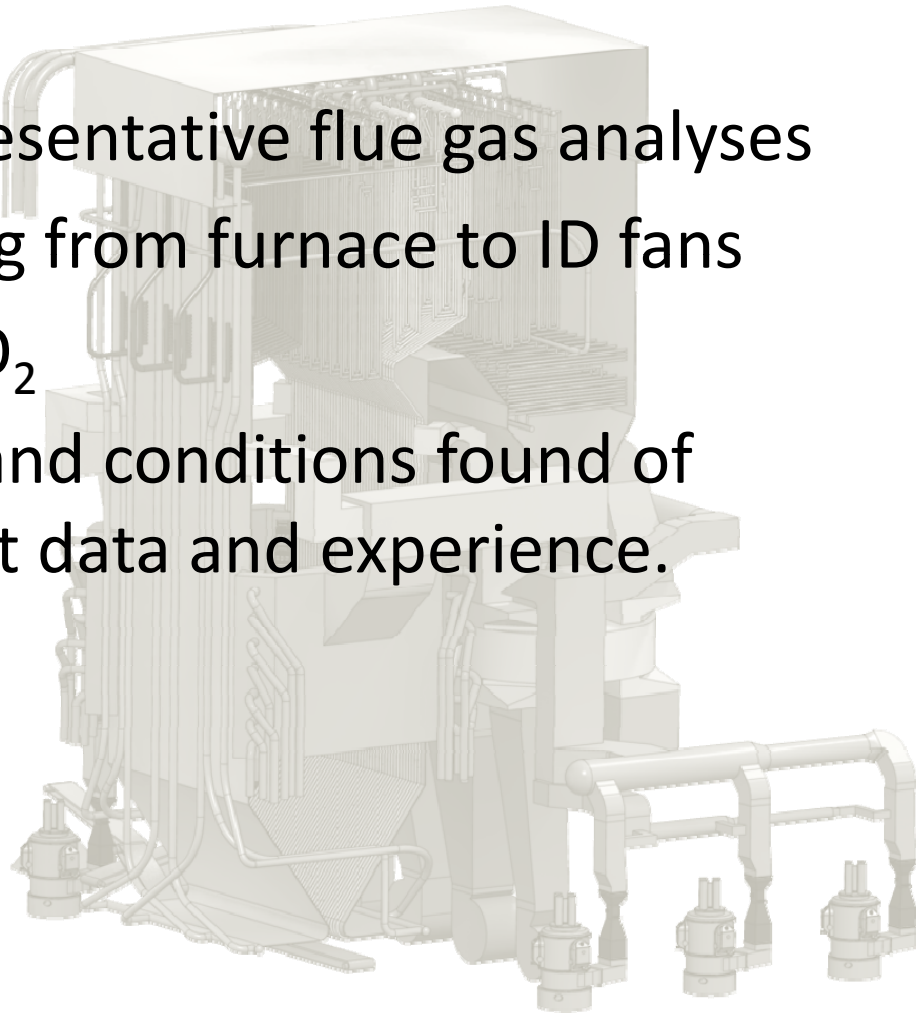
Comparison of Growth Areas and Emissions, 1980-2009



Stack emissions since 1970 have been reduced over 77% for the six major pollutants

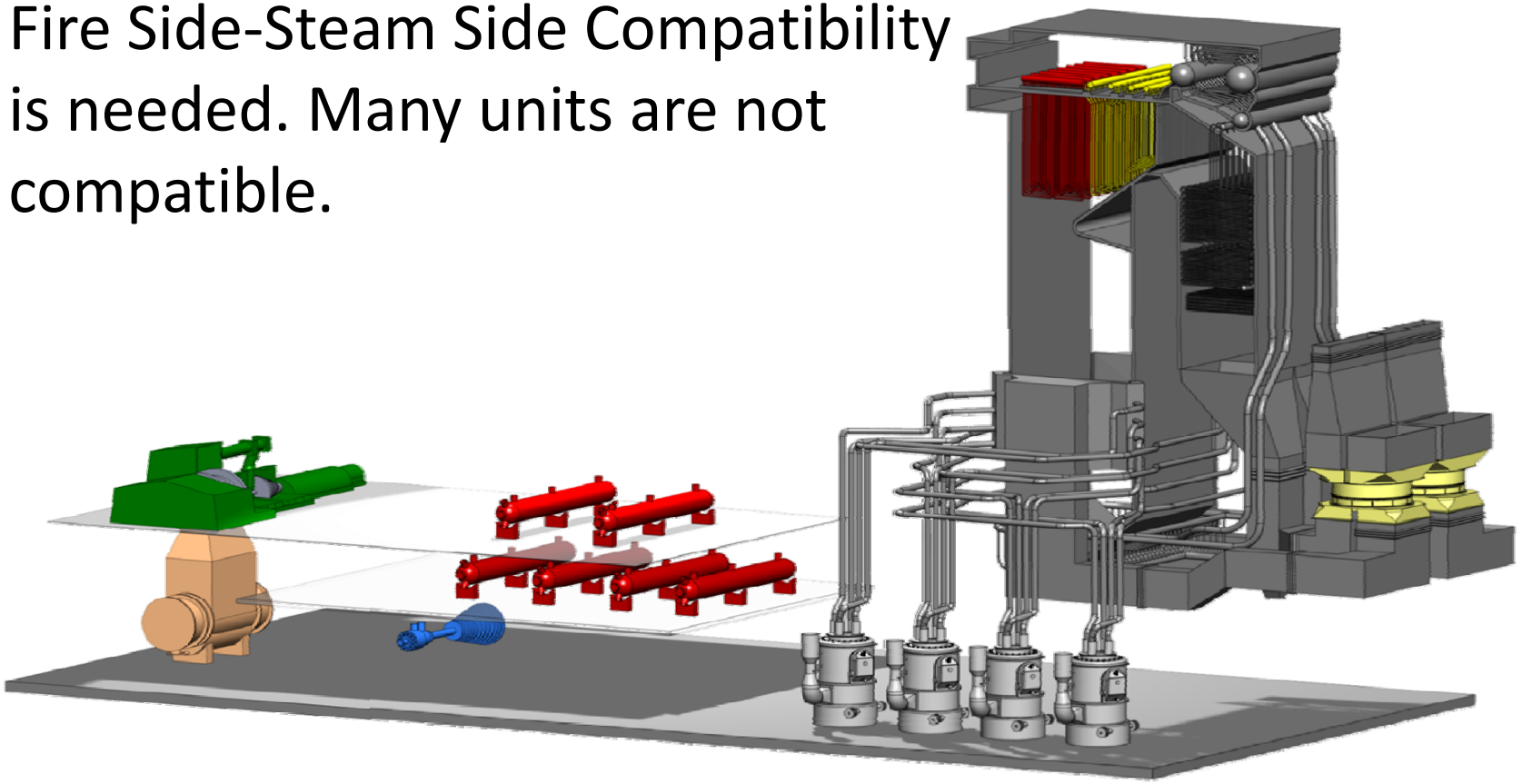
How Can You Identify Air In-Leakage

- Obtain good reliable, representative flue gas analyses
- Perform oxygen rise testing from furnace to ID fans
- Monitor the stack CO_2 or O_2
- Combine the intelligence and conditions found of boiler inspections with test data and experience.



How About NSR? Here Is An Examples:

- Fire Side-Steam Side Compatibility is needed. Many units are not compatible.



The

FUTURE

The Reality of Energy and Economic Prosperity is -

Coal is sure to play a continuing and vital role in meeting the world's future electricity needs. However, increasing global political pressure to reduce carbon emissions may severely diminish coal's favored status going forward to an unfair penalty to America.

America

Needs to Use More Coal – Not LESS

Energy = Quality of Life

Why Coal is Important for America

References

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- Storm Technologies, Inc. - www.stormeng.com

These slides and graphics were prepared by Nhia Ly and Ryan Hall with assistance of all of the Storm Technologies, Inc. staff.

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Thank You

Please go forth and spread the truth on why coal is important. Together we can be part of America's solution to restore our economic strength.

There are about 310 million citizens in the USA. There are about 122,000 ASME members. Engineers in my opinion have two duties to uphold:

1. Our professional responsibility to use energy wisely and to educate the misguided public and politicians who vastly outnumber energy savvy engineers.

2. We have a patriotic duty to keep America strong so that America can improve freedom, liberty and the advancement of humankind around the world. America did this in the 20 year period between 1948-1968 by exporting technologies and products made in the USA to improve living conditions of people all over the world.

Dick Storm