CO_2 reduction through Energy Efficiency in Coal Fired Boilers

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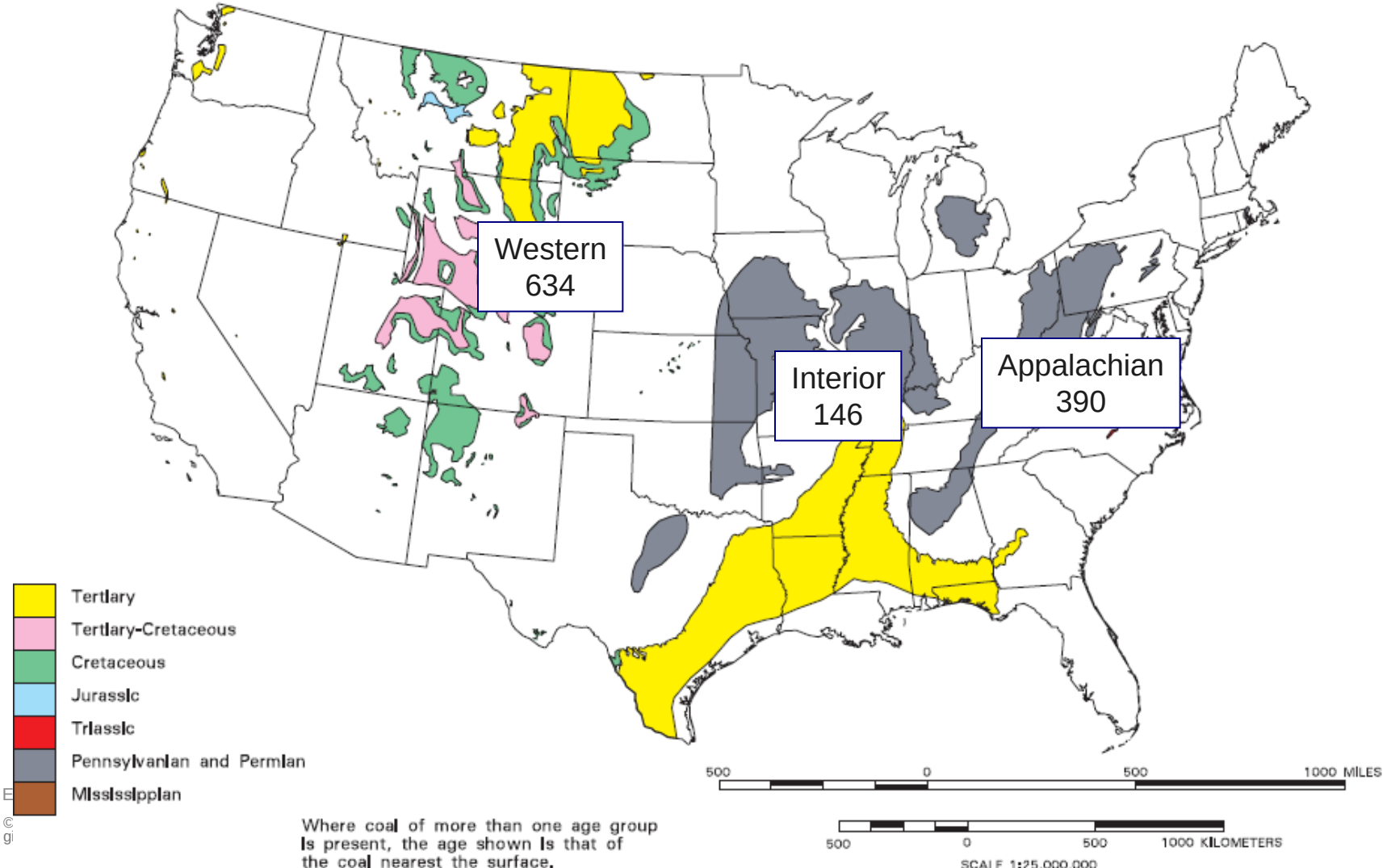
POWER | ALSTOM

US Boiler CO_2 production intrinsically related to coal mining

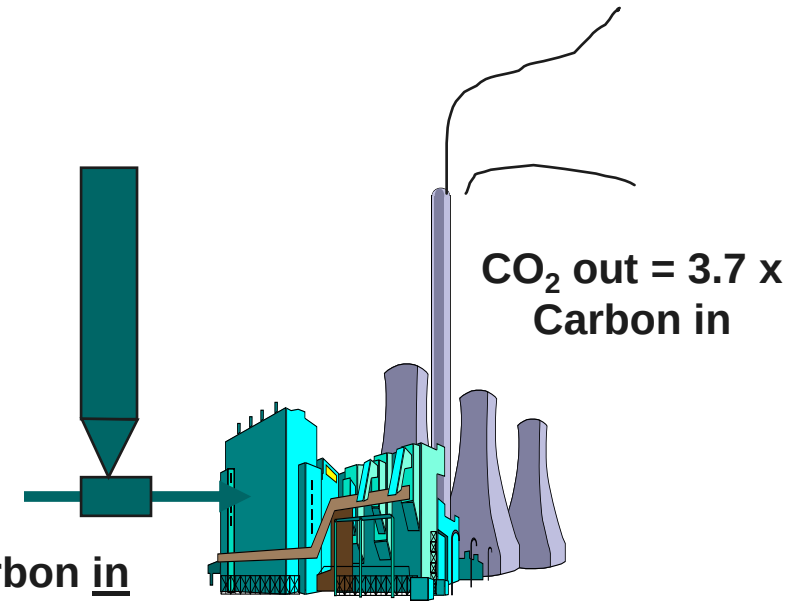
US coal 2008 production = **1.171.809** million Short Tons



US Coal Plants 2008 CO2 Data
Weighting typical ultimate values

Coal Source	Fixed Carbon (%)	Higher Heating Value (Btu/lb)	Coal Fired in Utility Boilers (Million Tons)	Carbon Fired (Million Tons)	CO2 produced (Million Tons)	Heat Produced (Million Btu's)
Western	47%	8000	565.5	263.0	964.2	9.0E+09
Appalachian	77%	13650	347.9	266.5	977.0	9.5E+09
Interior	62%	11200	130.2	80.2	294.1	2.9E+09
Total			1043.6	609.6	2235.3	2.1E+10

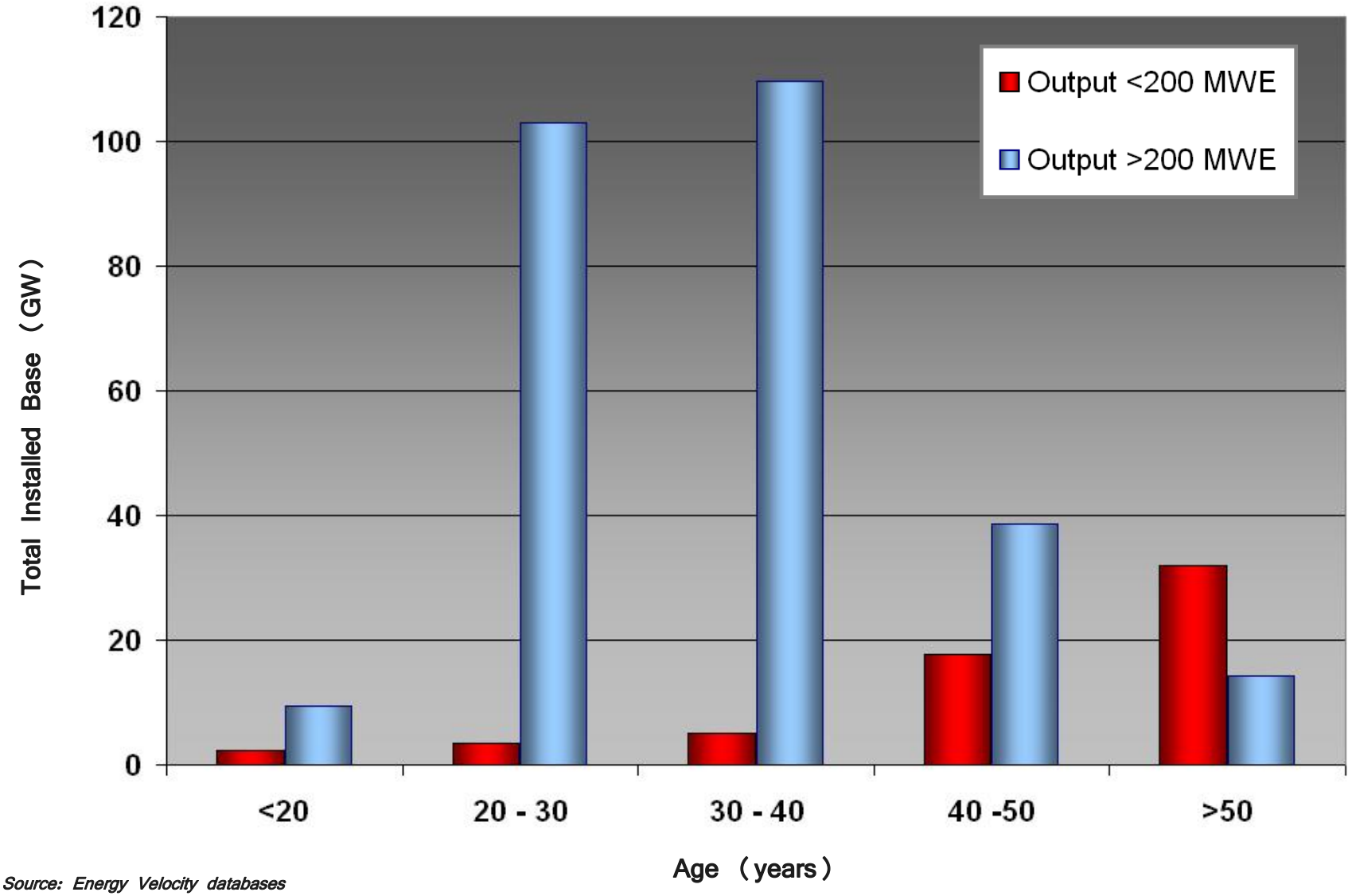
US Electricity Production	2.0E+12	KW-hr
US CO2 Production	2.1E+09	Tons
US Coal Thermal Energy	2.1E+16	BTU
Net Plant Heat Rate	10,761	BTU/kw-hr
Overall Efficiency	31.71	%
CO2 Conversion Rate	0.10	Ton CO2/MMBTU
CO2 Efficiency	2.15	lbs/kwhr



Source: US EIA and Alstom Fuel databases.

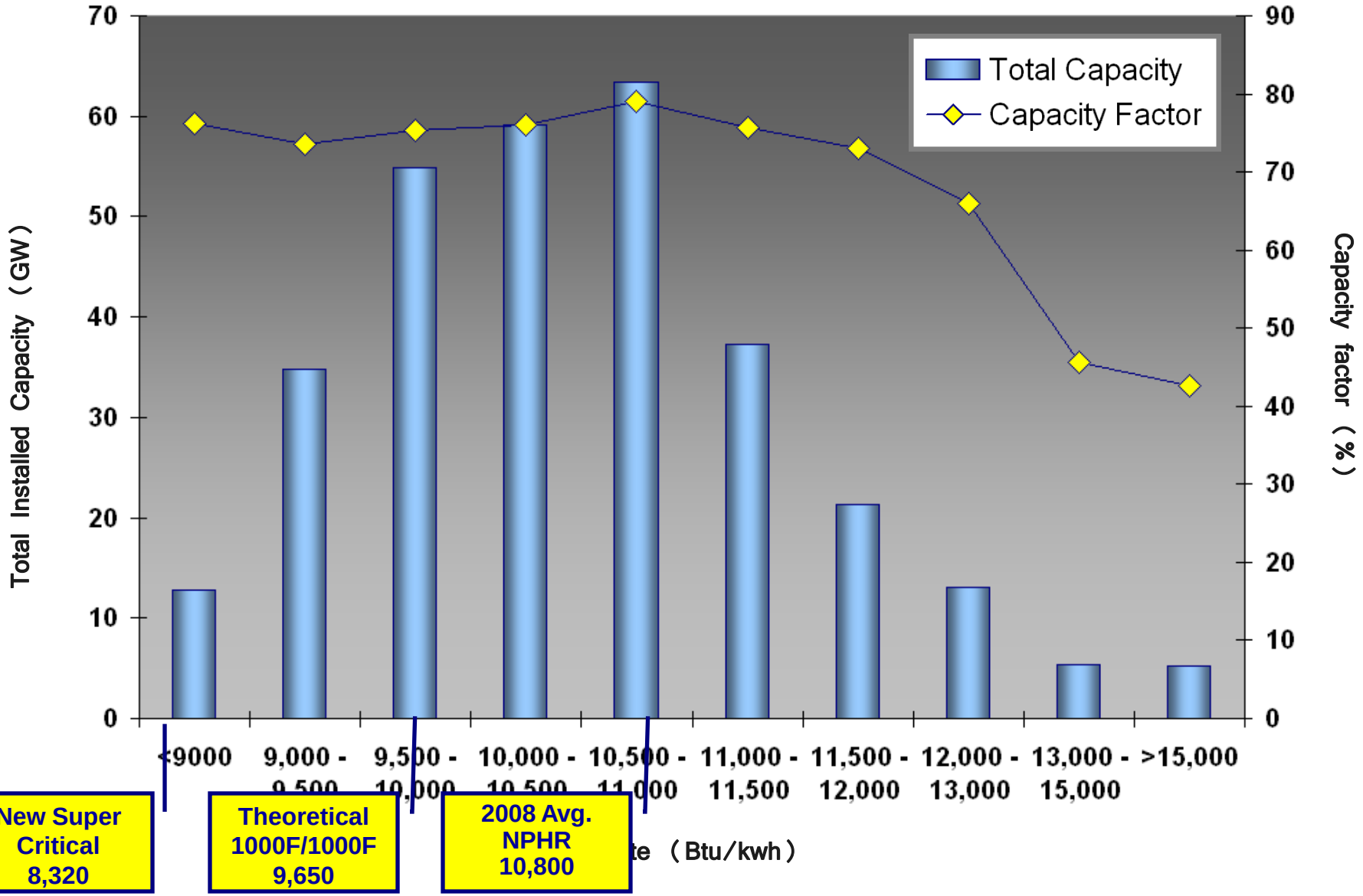
CO2 in top table from fuell analysis CO2 in lower table from eia

US Coal Power Plants
Installed Base (GW) vs Age (years)



Source: Energy Velocity databases

Coal Power Plant
Installed GW and Capacity Factor vs Heat Rate

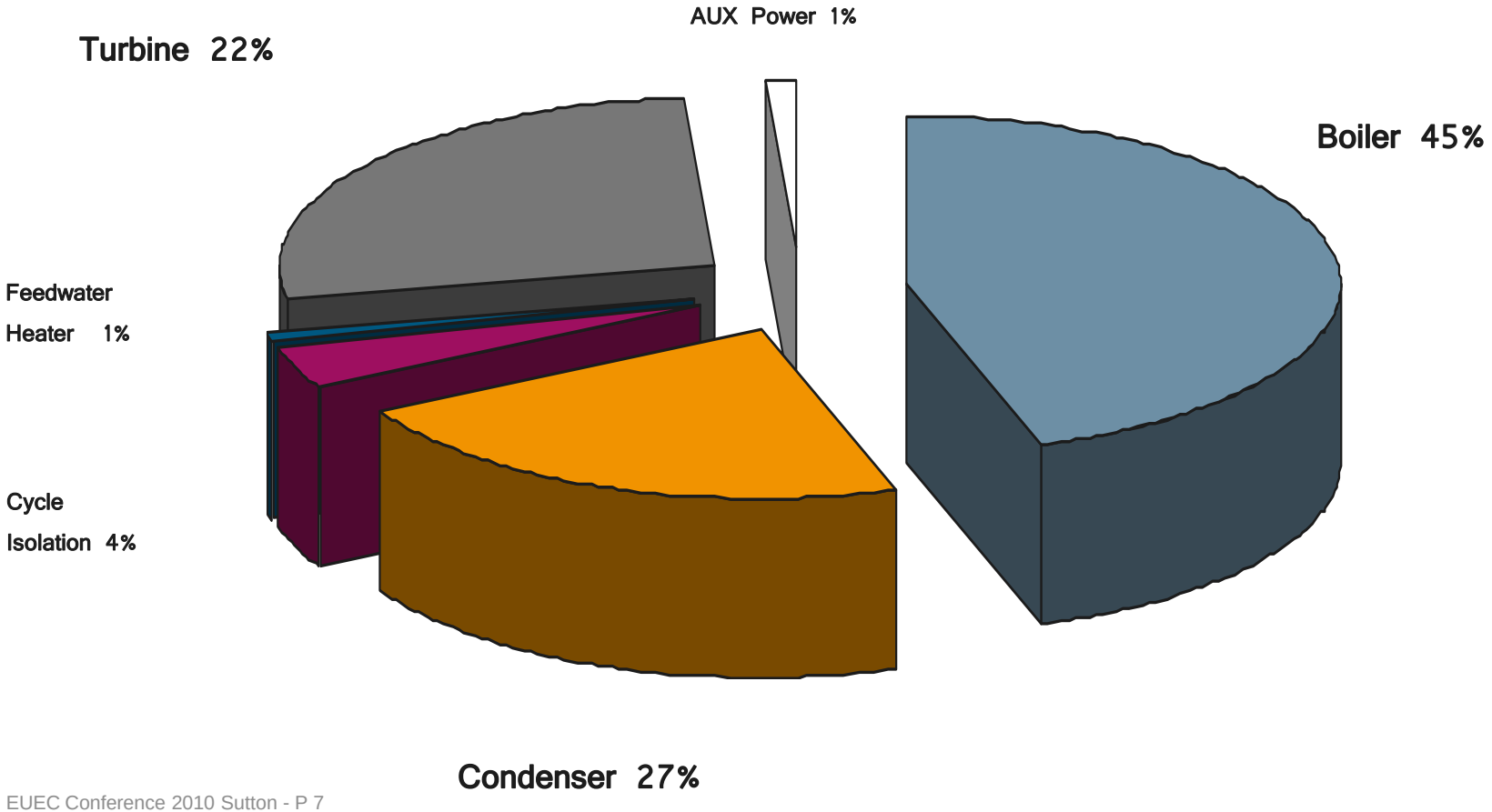


Case Studies to Improve Efficiency

- Larger Projects
  - 760 Megawatt US Utility boiler desires to optimize performance in light of new SO_2 emissions controls and current plant operations
  - 3 x 144 Megawatt US Industrial Boiler desires to improve efficiency and boost output to offset increased parasitic power from SO_2 system
- Smaller Projects
  - 2 x 500 Megawatt Canadian Utility Boiler desires improvement in heat rate by Combustion Optimization
  - 4 x 130 Megawatt Plant requires increased particulate collection while reducing auxiliary power
  - 630 Megawatt Boiler requires zero water discharge and reduced costs

Case Study: 760 MW Midwest Coal Boiler
Analysis of Energy losses

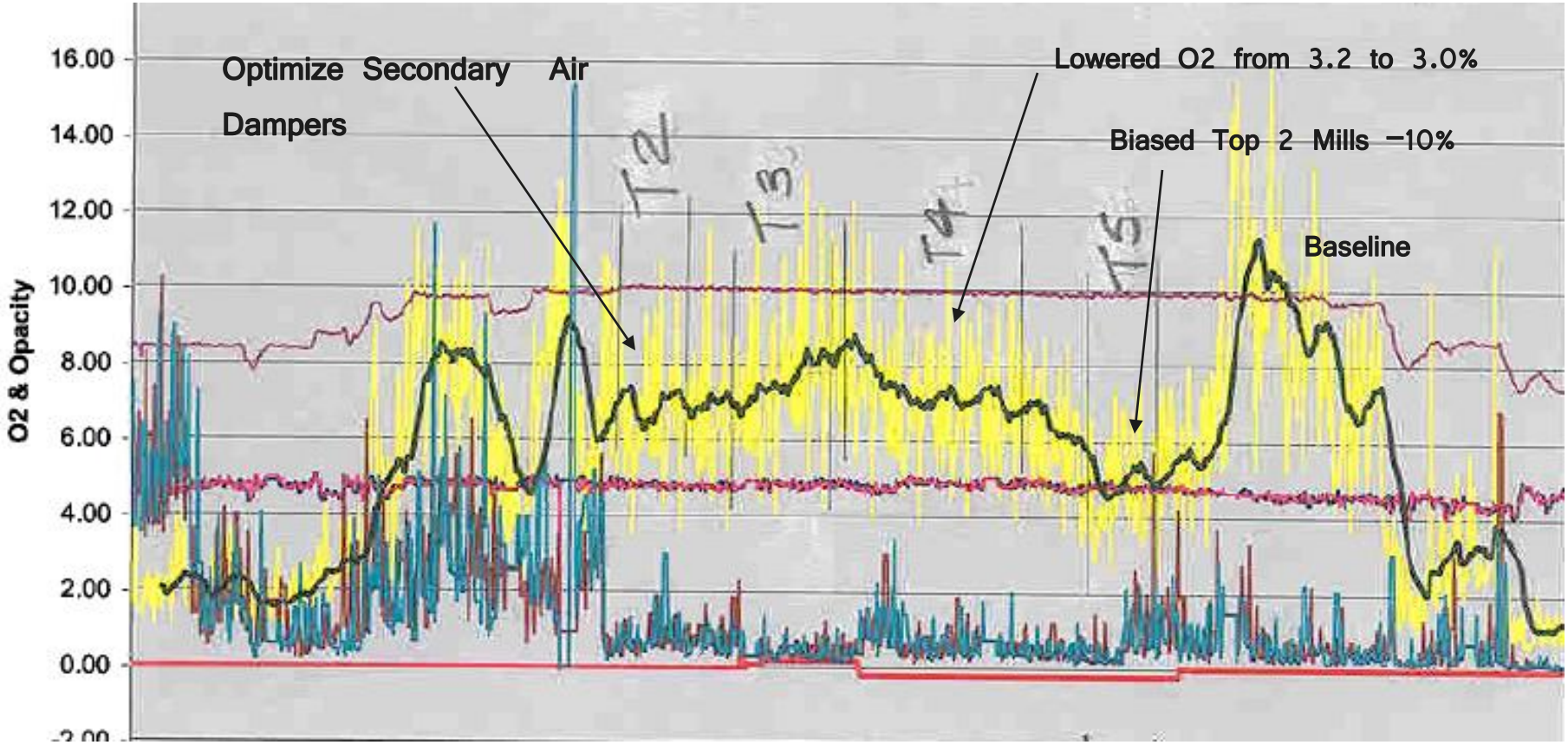
Design Heat Rate	8960 BTU/kWhr
As found Heat Rate	9602 BTU/kWhr



Case Study: 2 x 500 MW Boiler Combustion Optimization Tuning

- Reduce overall excess air levels with optimum adjustment of air introduction (7% reduction)
- Decrease cold air to Pulverizers (5% reduction)
- Increase Pulverized Coal Fineness (Before – 69% thru 200, After – 78% thru 200 mesh)
- Eliminate Leaks in Ductwork and Casing
- Alstom believes that optimizing existing equipment lowers CO_2 production by up to 0.5%

Case Study: 2 x 500 MW Boiler
Impact of Combustion Air Settings



Final Settings resulted in reduced unburned carbon by 2%, lower excess O2 by 7%, reduction in opacity by 5%.

Summary

- US electric power production from coal results in more than 2,100 million Short Tons on CO_2
- Improvements in coal power plant efficiency result in a decrease in CO_2 emissions and improved power plant economics
- A 5% reduction in CO2 / KW-hr produced appears to be feasible
- Case studies showing results for both larger projects and smaller efficiency improvements confirm the concept.

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