

Examination of uncertainty in heat rate determinations

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Purpose of Study

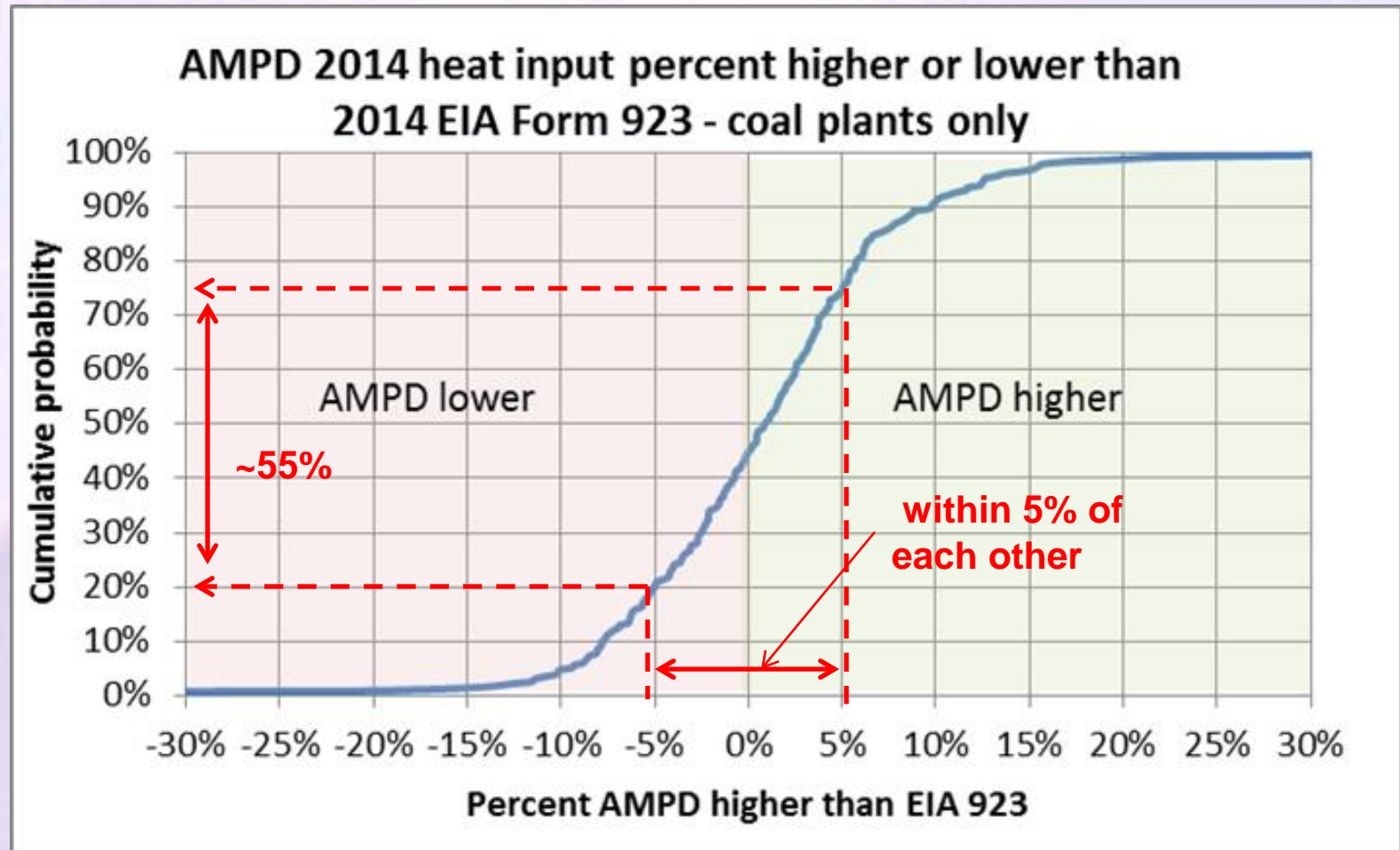
- Compare heat input data from EIA and EPA's AMPD for coal plants and determine degree of consistency/inconsistency
- Examine the stability of the F factor relationship (flow versus heat input) with different coals and the potential impact on “apparent” potential improvement in heat rate when performing heat rate variability analysis

EIA versus AMPD comparison

- Compared annual 2014 AMPD emissions data and EIA Form 923 data for electric utility boilers
 - AMPD is from CEMS
 - EIA Form 923 from reported fuel use
- Compared total annual heat input for 232 plants that only have boilers with coal as primary fuel (no CTs or combined cycle on site)
- Also examined data for units with lowest CO₂ emission rate based upon AMPD and compared against EIA

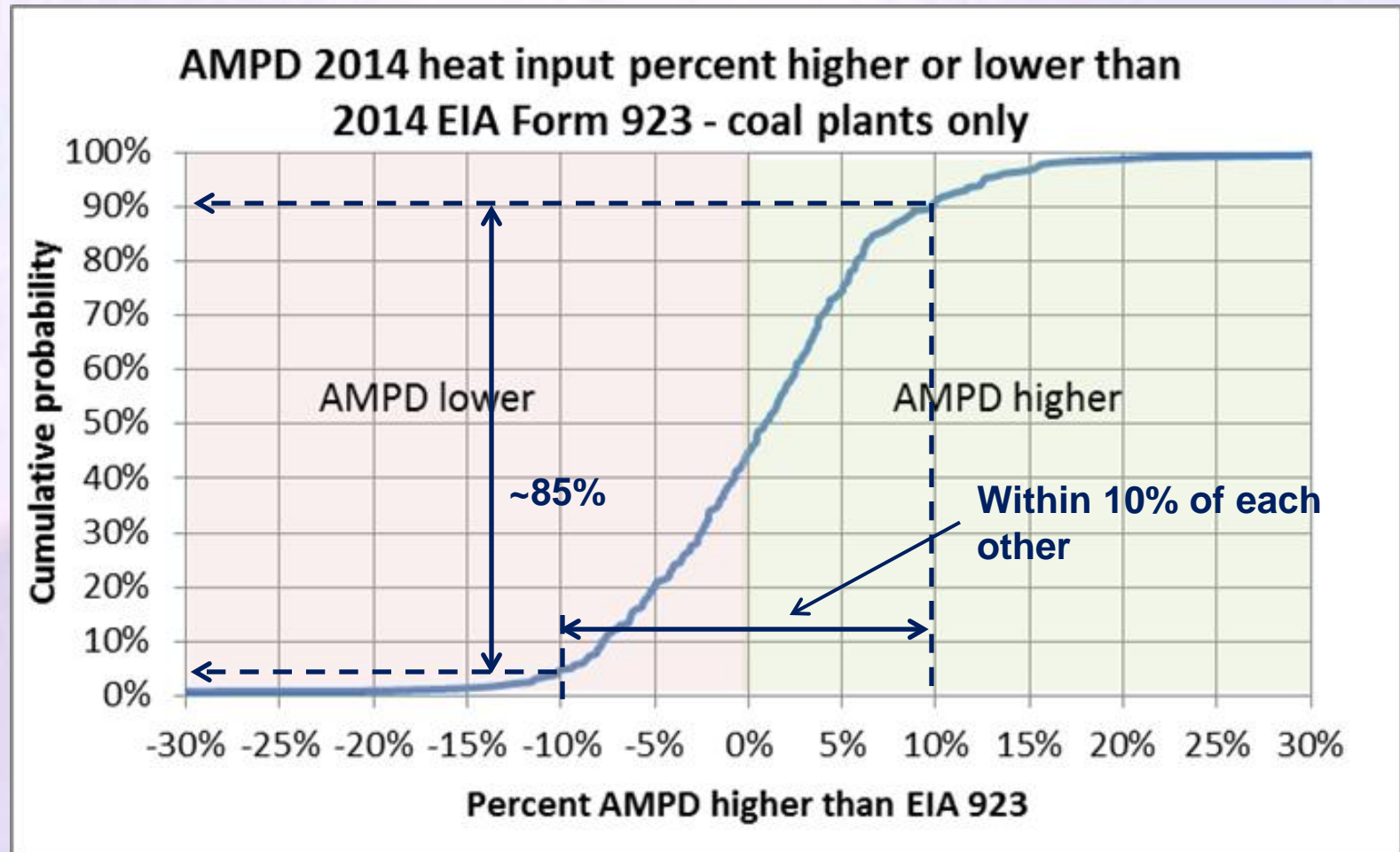
Comparison of heat input – AMPD versus EIA Form 923

Form 923



Comparison of heat input – AMPD versus EIA Form 923

Form 923



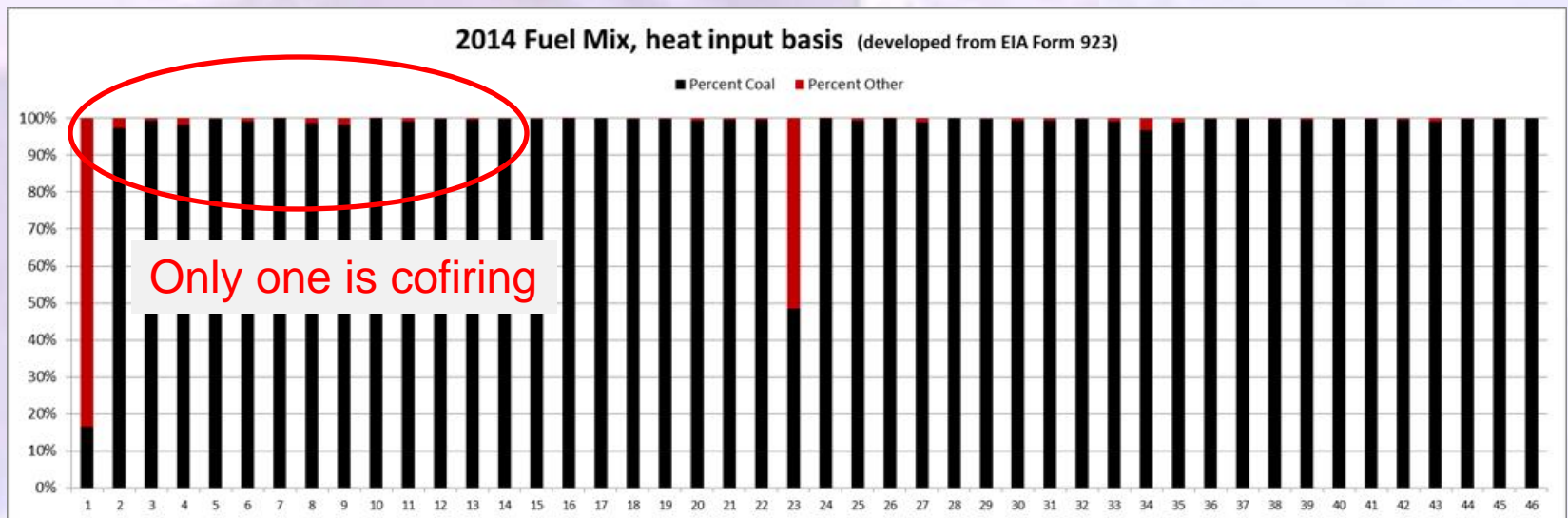
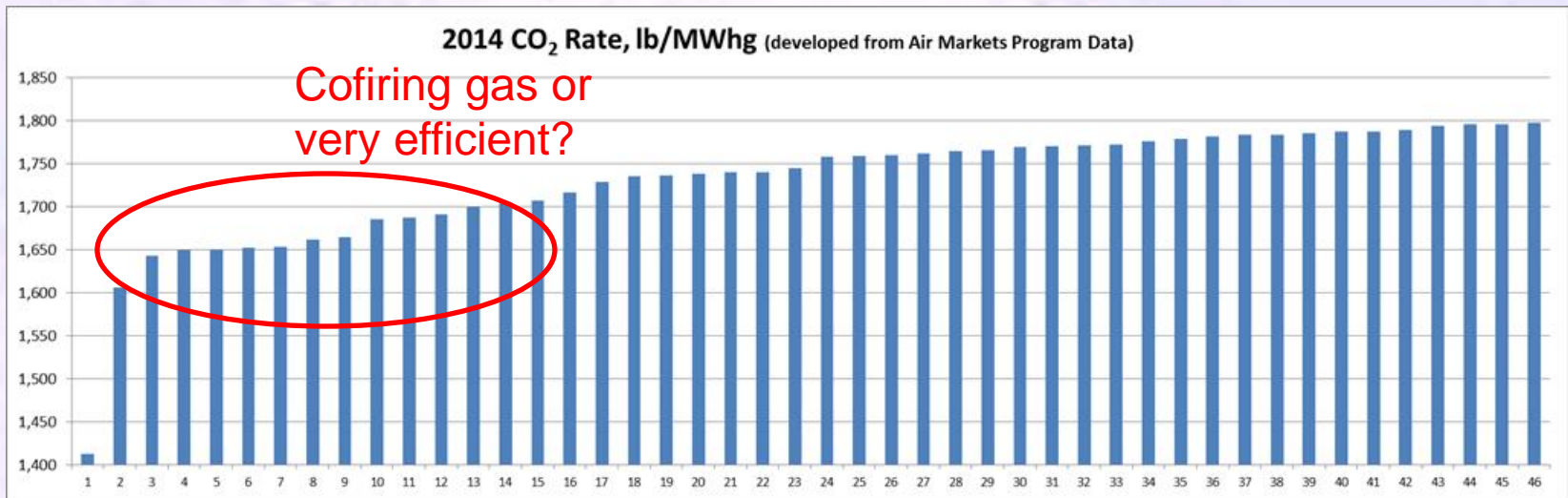
Comparison of 2014 AMPD to EIA Form 923 Plant Heat Input

- AMPD heat input and heat input estimated from EIA Form 923 fuel use data are within 5% in only about 55% of the plants
- AMPD heat input and heat input estimated from EIA Form 923 fuel use data are within 10% in only about 85% of the plants
- The maximum amount that AMPD was lower than that determined by Form 923 was 100%.
- The maximum amount that AMPD was greater than that determined by EIA Form 923 was 34.3%

Examination of specific units

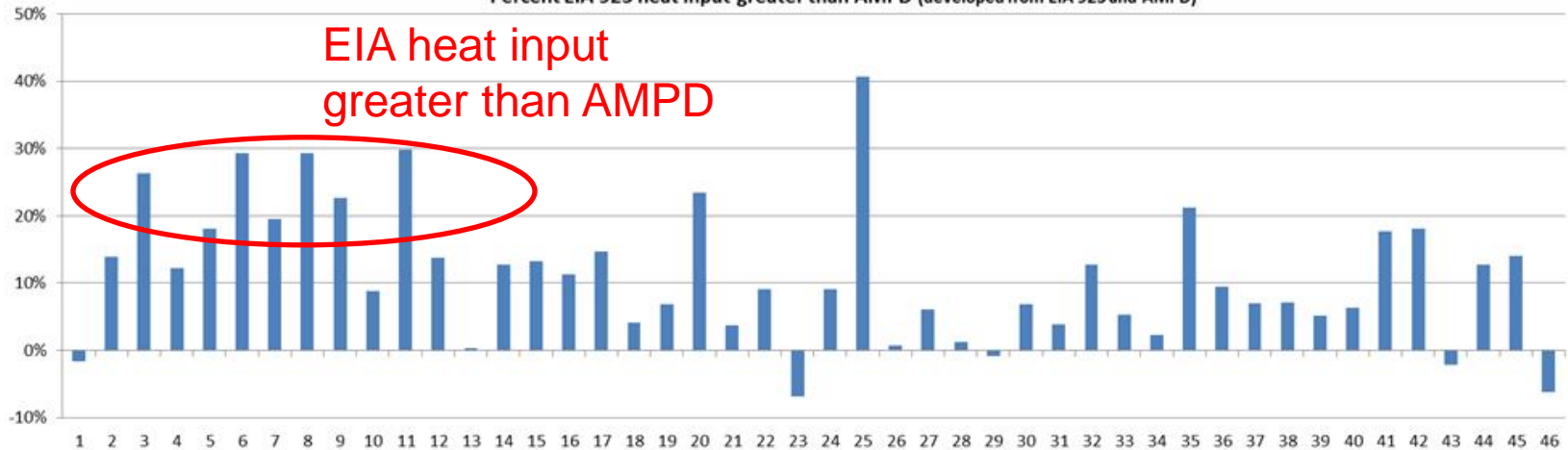
- Examined units that appeared to have low CO₂ emission rates (lb/MWhr) based upon AMPD
- Compared to EIA Form 923 heat input from fuel use

CO₂ Rate and Fuel for lowest emitting units

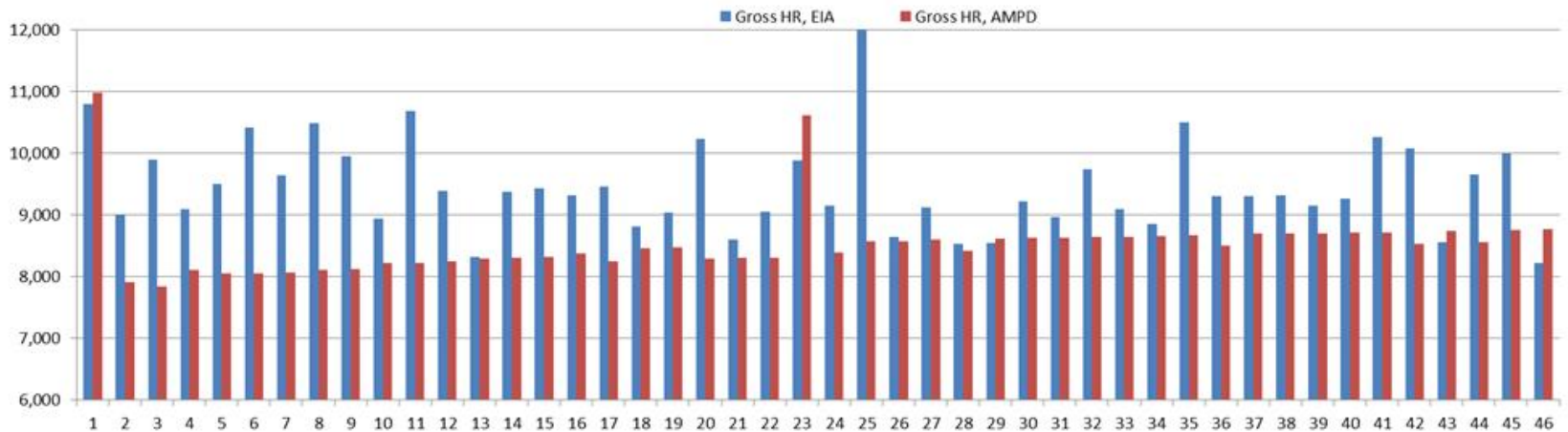


EIA Form 923 versus AMPD Heat Input

Percent EIA 923 heat input greater than AMPD (developed from EIA 923 and AMPD)



2014 Gross Heat Rate, EIA versus AMPD heat input (developed from EIA 923 and AMPD)



Conclusions – AMPD versus EIA

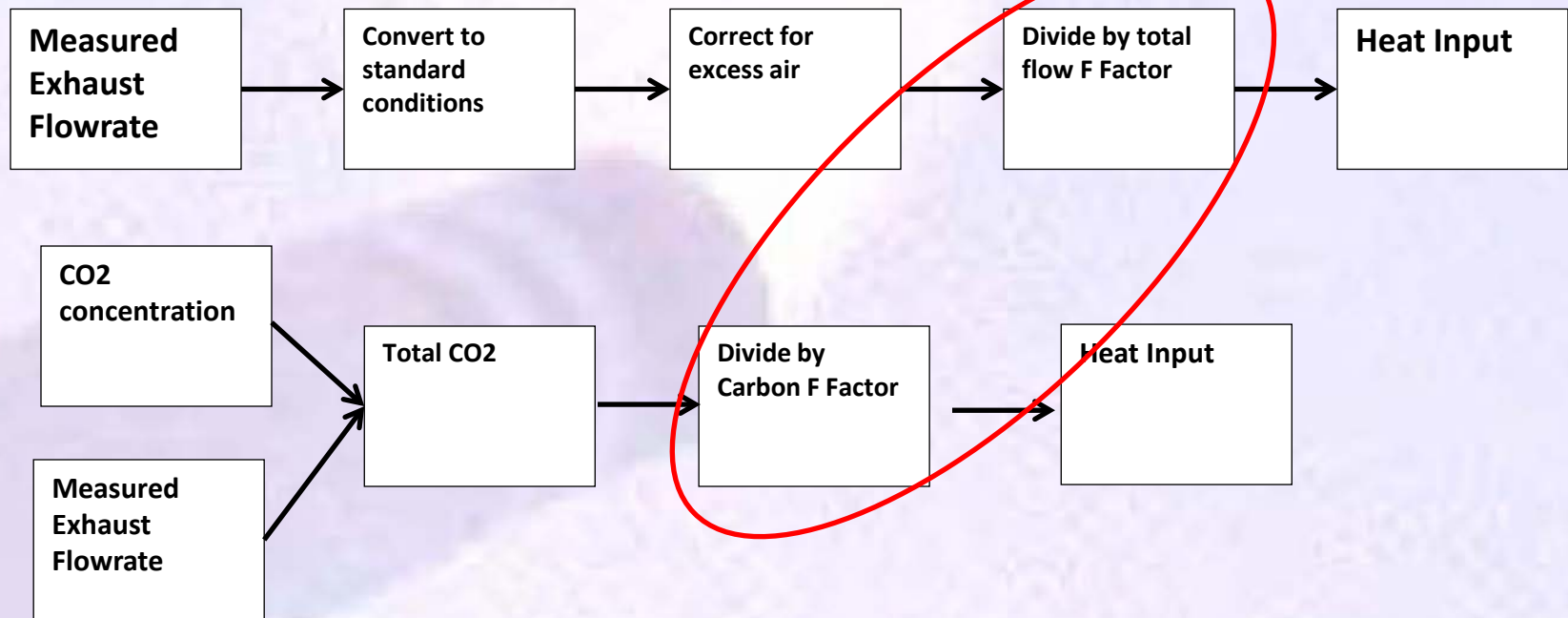
- Significant differences between heat input from AMPD data and EIA Form 923 fuel data
- Sampling of lowest apparent CO₂ emitters found individual discrepancies
 - In these cases the EIA data seemed more believable

Examination of the stability in F factor relationship for different coals

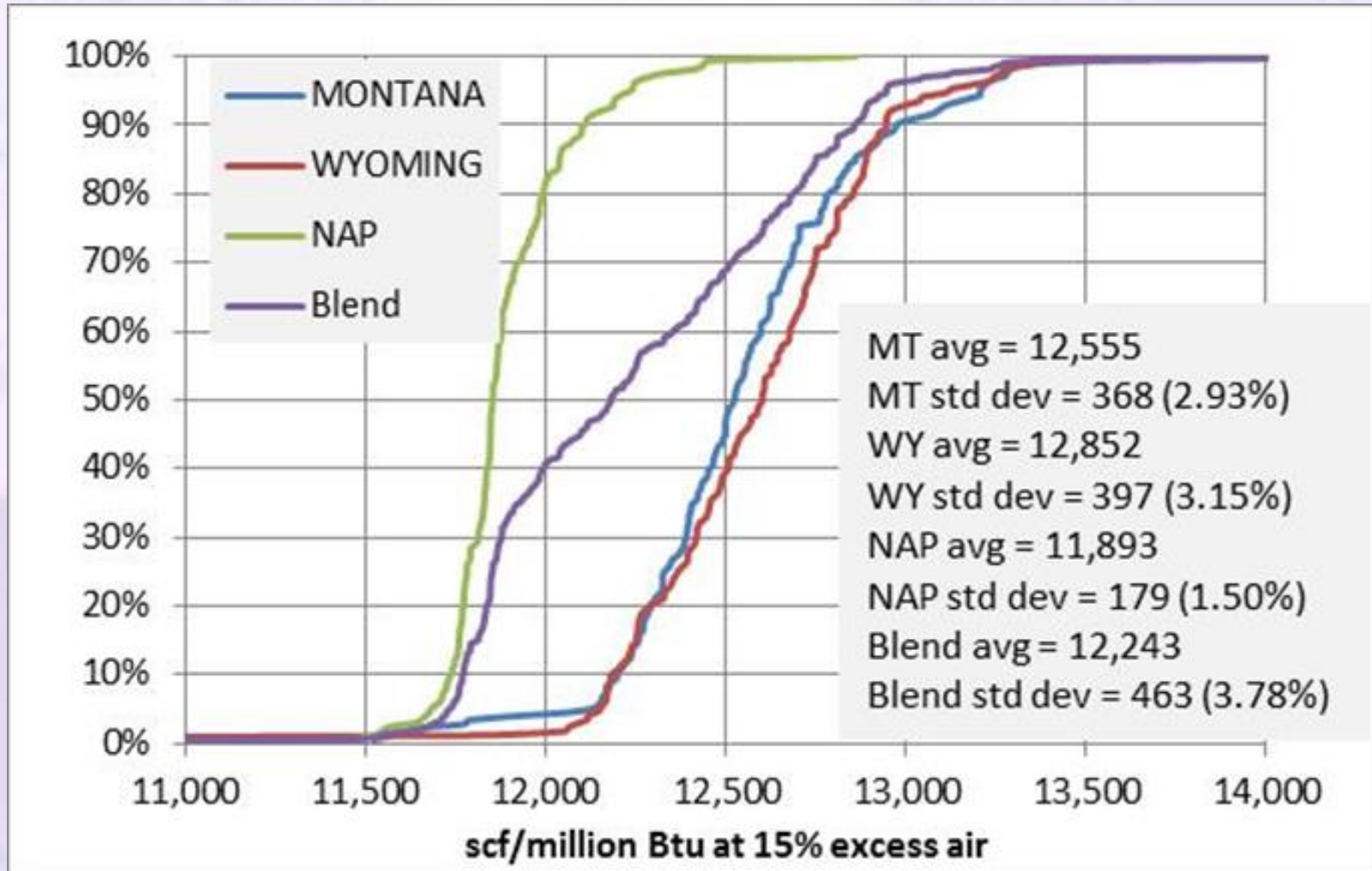
- F factor used in CEMS determined from EPA Method 19
- The actual relationship between flowrate and heat input is a function of coal characteristics.
- Used fuel data from USGS Coal Quality database
- For different coals performed calculations to determine exhaust flowrate per million Btu and lbmol CO₂ per million Btu
- Examined variability in relationship and potential impact on heat rate variability analysis
- Assume “perfect” flow measurement

AMPD Inference of Heat Input from Measured Flowrate

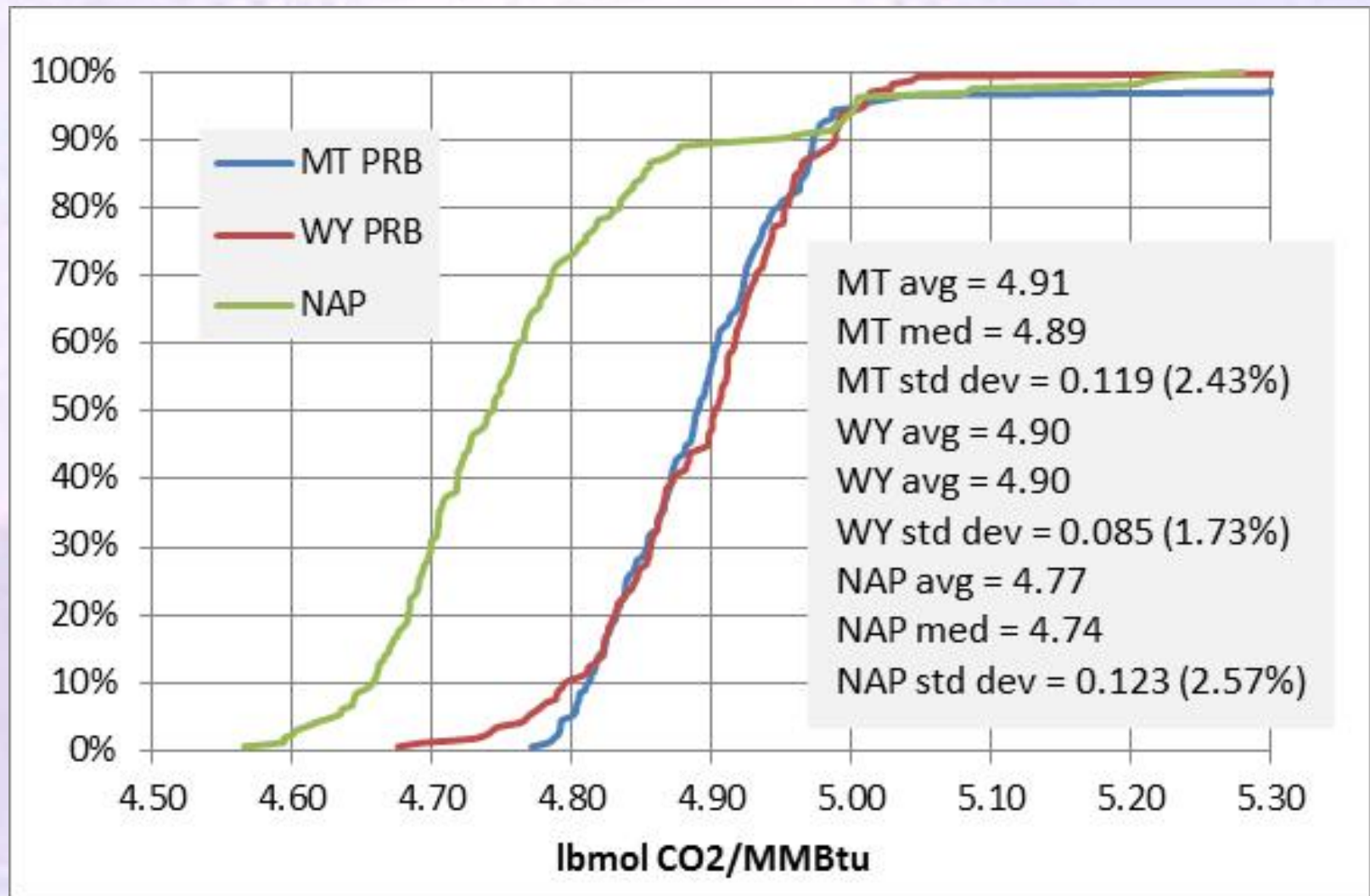
How stable is this relationship?



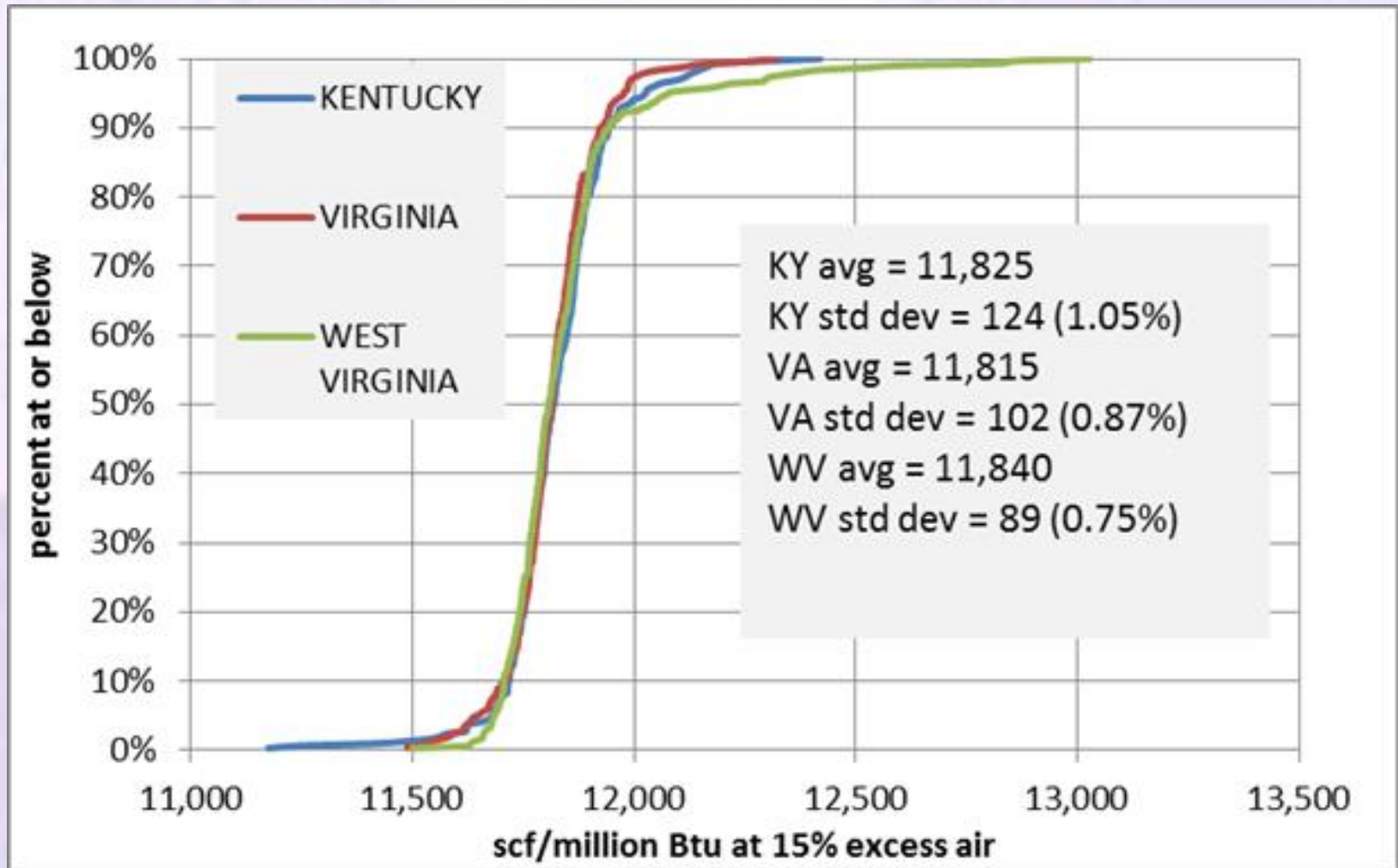
Cumulative probability of exhaust flow to heat input at 15% excess air for Montana PRB, Wyoming PRB, Northern Appalachian (NAP) coals and 50/50 blend of WY PRB and NAP



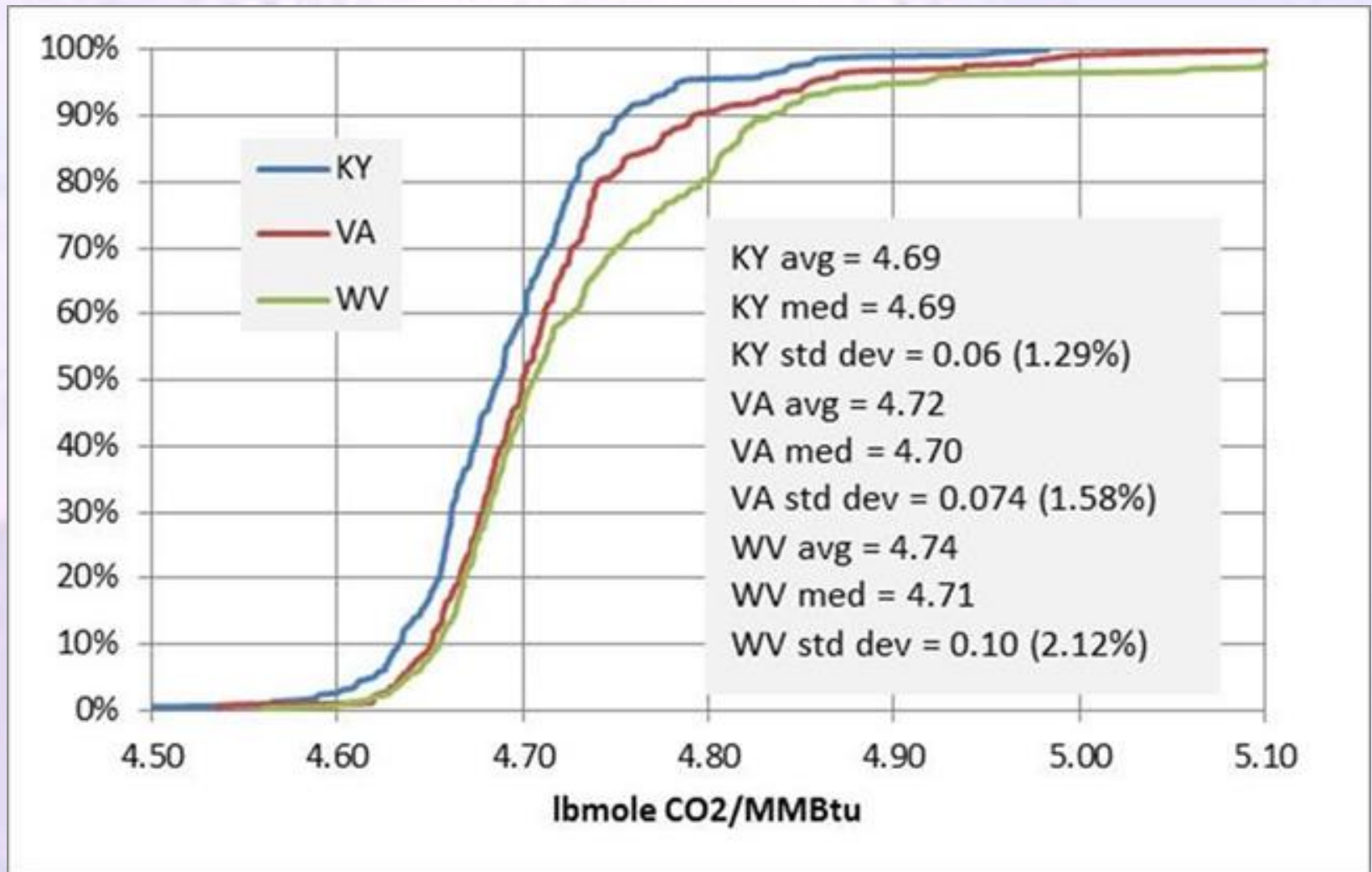
Cumulative probability of lbmol CO₂ to heat input for Montana PRB and Wyoming PRB



Cumulative probability of exhaust flow to heat input at 15% excess air for Kentucky, Virginia and West Virginia Central Appalachian coals



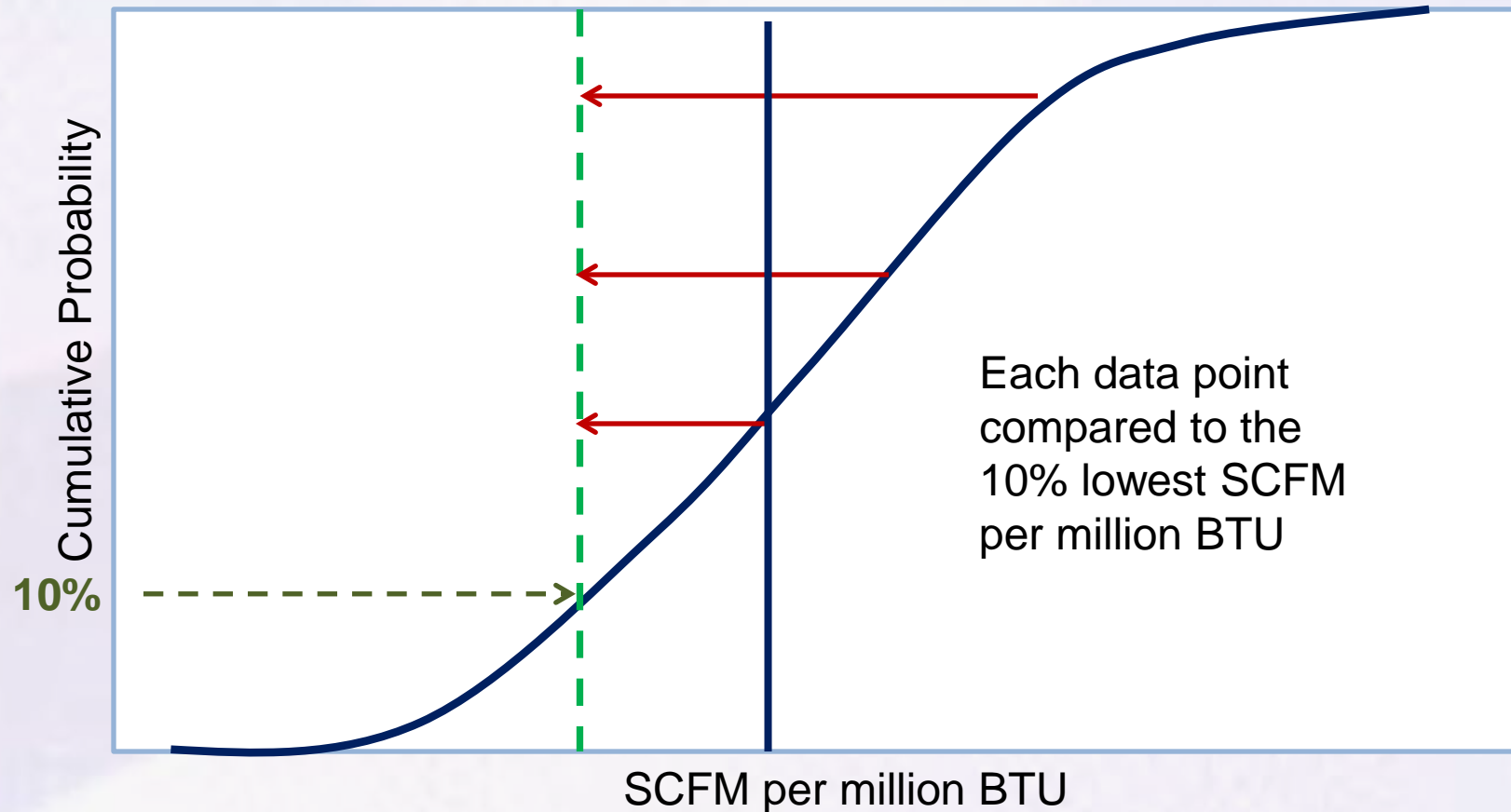
Cumulative probability of lbmol CO₂ to heat input for Central Appalachian coal



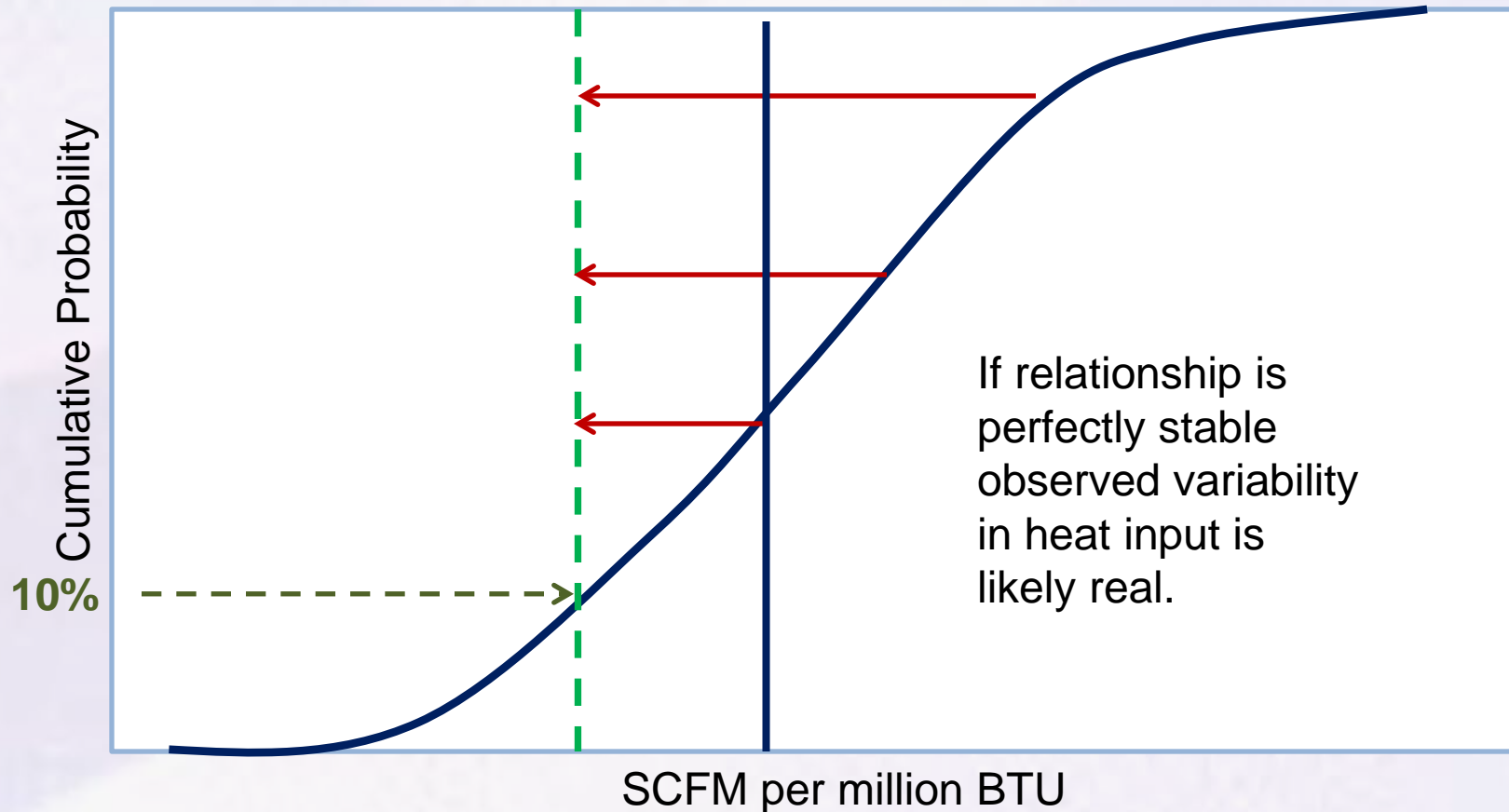
Apparent heat rate improvement opportunities

- If hourly heat rate calculated from AMPD appears to vary under a given condition that *may* indicate an opportunity to improve heat rate.
- What if the observed variability of inferred heat rate at a given condition is, in fact, due in part to F factor instability rather than actual change in heat rate?
- If so, how significant is this effect?

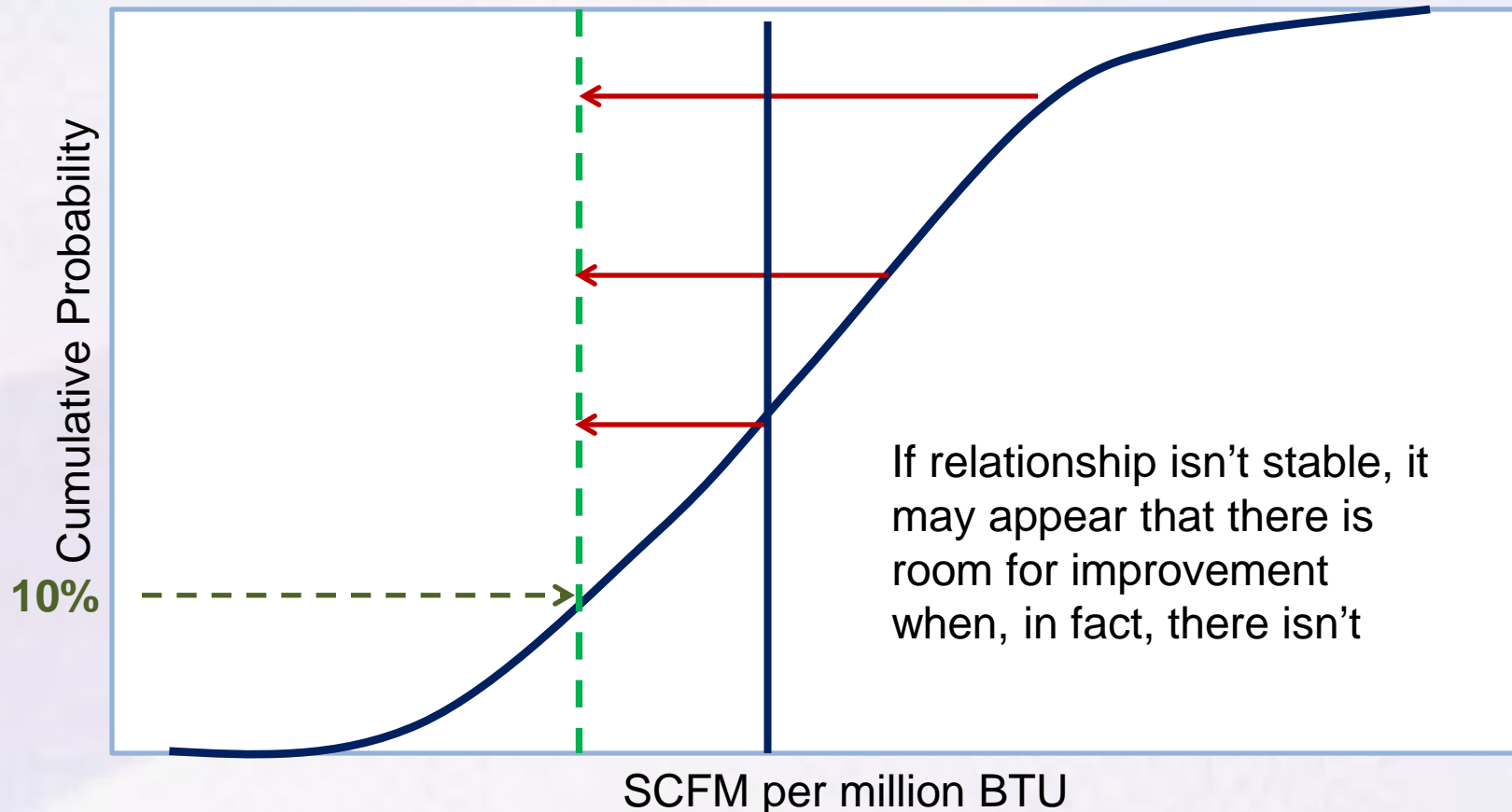
“Apparent” improvement opportunity in heat input



“Apparent” improvement opportunity in heat input



“Apparent” improvement opportunity in heat input



“Apparent” improvement in heat rate resulting from instability in the relationship between flowrate and heat input.

MT PRB	WY PRB	NAP	WY PRB- NAP Blend	KY CAP	VA CAP	WV CAP
3.53%	3.95%	1.56%	4.43%	1.09%	1.11%	1.28%

Conclusions – F factor stability

- F factor used to determine heat input in AMPD does not appear to be stable
- May have significant impact on “apparent” heat rate improvement when performing variability analysis

Recommendations

- Need to better understand differences in the AMPD heat input and the EIA fuel use data
 - Hopefully make data more consistent
- Need to examine the issue of instability in F factor and impact on apparent variability in heat rate
 - Examine more plant coal data
 - Include the impacts of flow monitor performance variability

- For Questions or Comments
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