

# Fan Efficiency Regulation Update for ASHRAE TC 5.1

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Greenheck Fan

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# Department of Energy (DOE)

## Commercial & Industrial Fans & Blower (CIFB)

### Rule Making Update



# DOE CIFB Status / Timing



- **Term Sheet – September 2015**
  - “Letter of Intent” for Rule
- **Proposed Rule (NOPR) – Q1 2016\***
  - Test Standard NOPR
  - Regulatory NOPR
- **Final Rule – January 2017\***
  - 1<sup>st</sup> Potential for Compliance
  - Estimate Products on the Market by 2018
- **Mandatory Compliance – January 2022\***
  - 5 Years after Final Rule\*

*\*Anticipated Date*

# DOE CIFB Term Sheet



- 32 Recommendations
  - Submitted to Appliance Standards & Rulemaking Federal Advisory Committee (ASRAC)
- DOE ASRAC 25 WG Members
  - 1 DOE
  - 7 AMCA
  - 8 AHRI
  - 4 Energy Advocates
  - 3 AMCA/AHRI
  - 1 Consultant
  - 1 Motor/Drive Supplier
- Term Sheet “Consensus” (*after 16 Meetings*)
  - 23 “For” / 2 “Against”
    - Consensus on 28 of 32 Recommendations





# DOE CIFB Term Sheet



- Fan Categories “In” & “Out”
- Scope
- Metric
- Test
- Certification/Labeling

- ❖ **KEY Items NOT covered:**
- Efficiency Levels
  - Replacement Fans<sub>(rec. #28)</sub>

# CIFB Fan Term Sheet

## Categories/Equipment Classes “In”

- “Stand Alone Fans”:
  - Axial Cylindrical Housed
  - Panel
  - Centrifugal Housed & Unhoused (excluding inline & radial)
  - Inline & Mixed Flow
  - Radial Housed (shrouded impeller)
  - Power Roof Ventilators



Ref. Recommendation #1, 30

# CIFB Fan Term Sheet

## Categories “In”

- “Embedded” Fans in:
  - Equipment not Regulated by the DOE
  - Equipment Regulated by the DOE where the regulation does not capture the fan energy.
    - » Fan will be tested outside of equipment (stand alone)
    - » Fan will be tested as a defined “testable configuration”.

*Ref. Recommendation #4 & 8*

# CIFB Fan Term Sheet

## Categories “Out”

- Radial Housed Unshrouded
  - Diameter < 30” / Blade Width < 3”
- Safety
- Circulating
- Induced Flow
- Jet
- Cross Flow



*Ref. Recommendation #2*



# CIFB Fan Term Sheet

## Categories “Out”

- Supply & Condenser Fans in DOE Regulated Equipment where the Regulation captures the energy of these fans
- Fans “Embedded” in:
  - DOE Regulated Central AC & Heat Pumps
  - DOE Regulated Commercial AC & Heat Pumps
  - DOE Regulated Consumer Furnaces
  - Transport Refrigeration
  - Vacuums
  - Heat Rejection Equipment (per Cooling Tower Institute)
  - Air Curtains



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*Ref. Recommendation #2 & 3*

# CIFB Fan Term Sheet

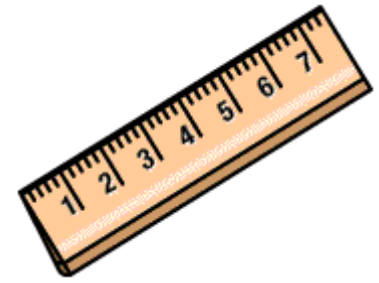
## “Scope”

- Fans offered for sale at Operating Points where:
  - Fan shaft power is greater than or equal to 1 BHP
  - Fan air power is less than or equal to 150 HP (approx. 200 shaft BHP)

*Ref. Recommendation #5*

# CIFB Fan Term Sheet

## “Metric”

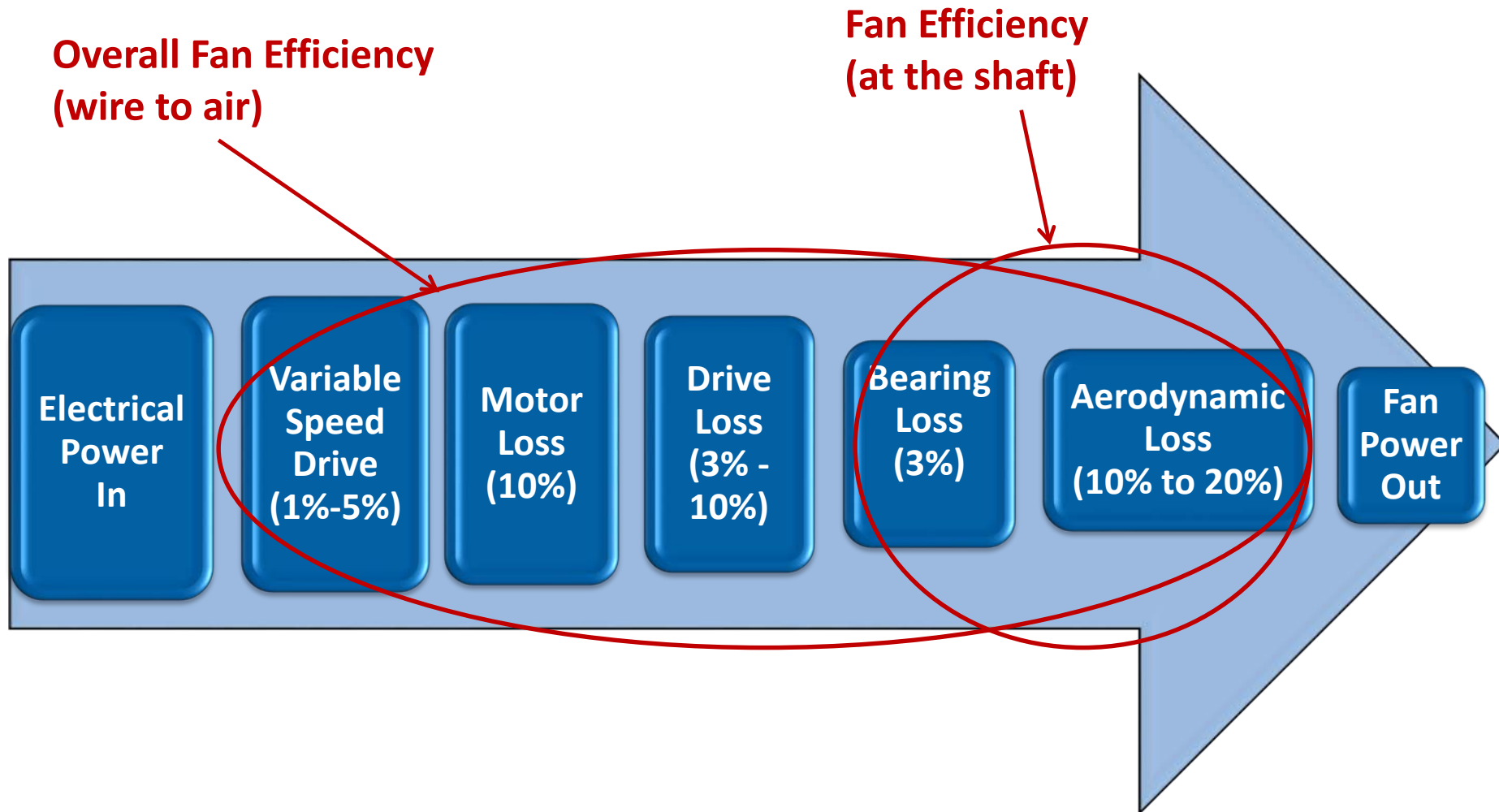


- Fan Electrical (input) Power (FEP)
  - Wire-to-Air (including motor & VSD when supplied by manufacturer)
  - Specific to Operating Point
  - Airflow and Pressure define Maximum Allowable Power –  $FEP_{(std)}$
  - Results in a Range of Airflow and Pressure that can be offered for sale
- Fan Efficiency Index (FEI)
  - $FEP_{(std)} / FEP_{(actual)}$
  - $FEI \geq 1$
  - $(FEI - 1) = \% \text{ savings relative to DOE minimum requirement}$

*Ref. Recommendation #6, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21*

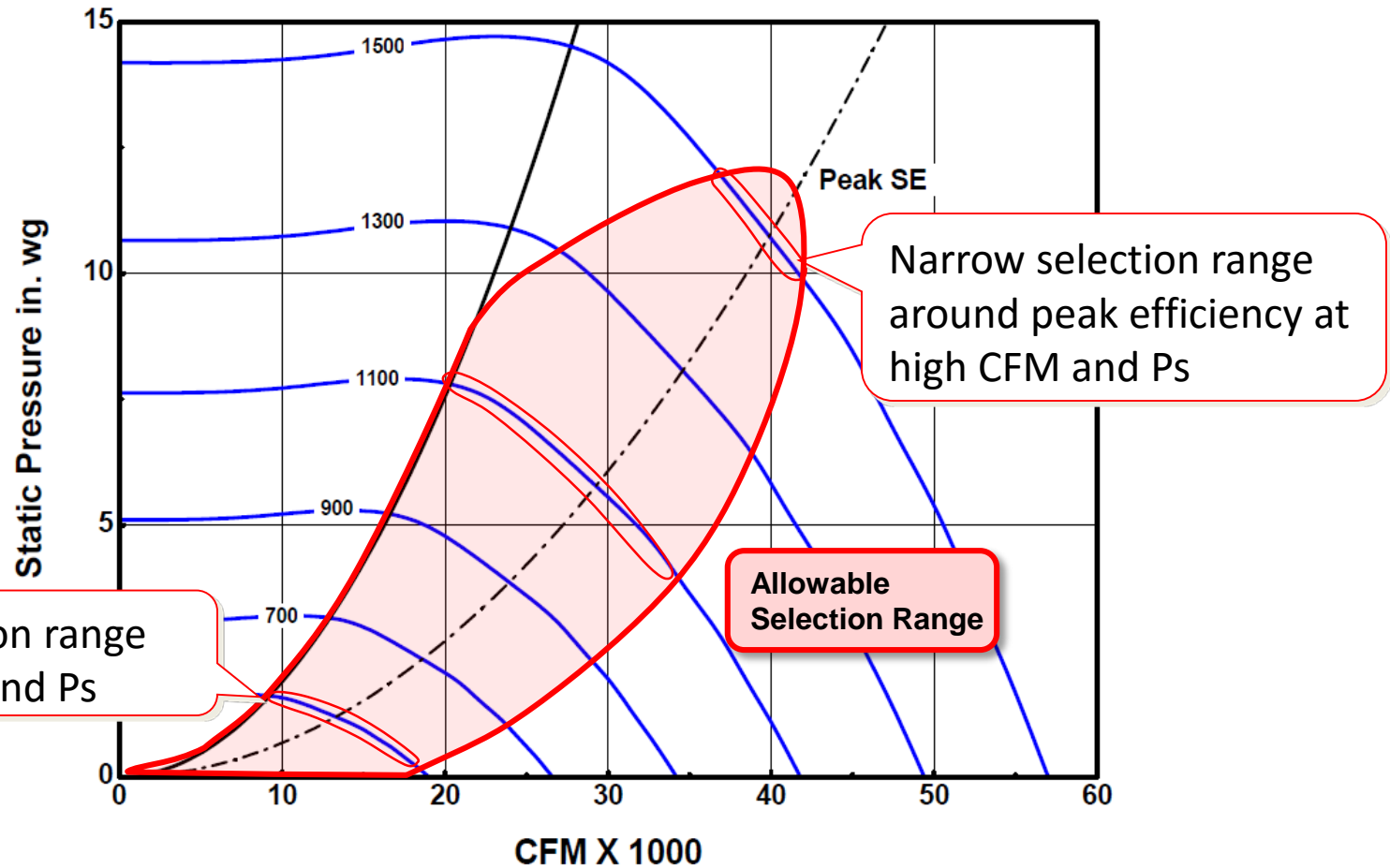


# “Elements” of Fan Efficiency



# Compliant Fan Selections

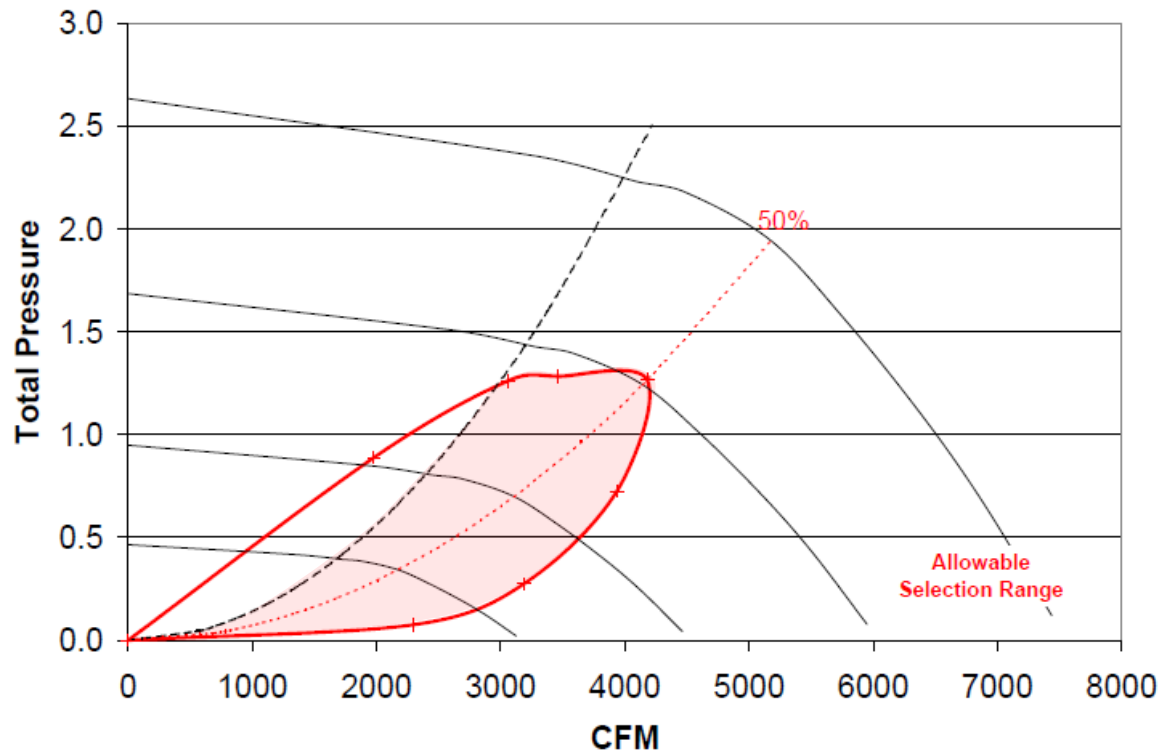
## FEI “Bubble”





# Allowable Fan Selections

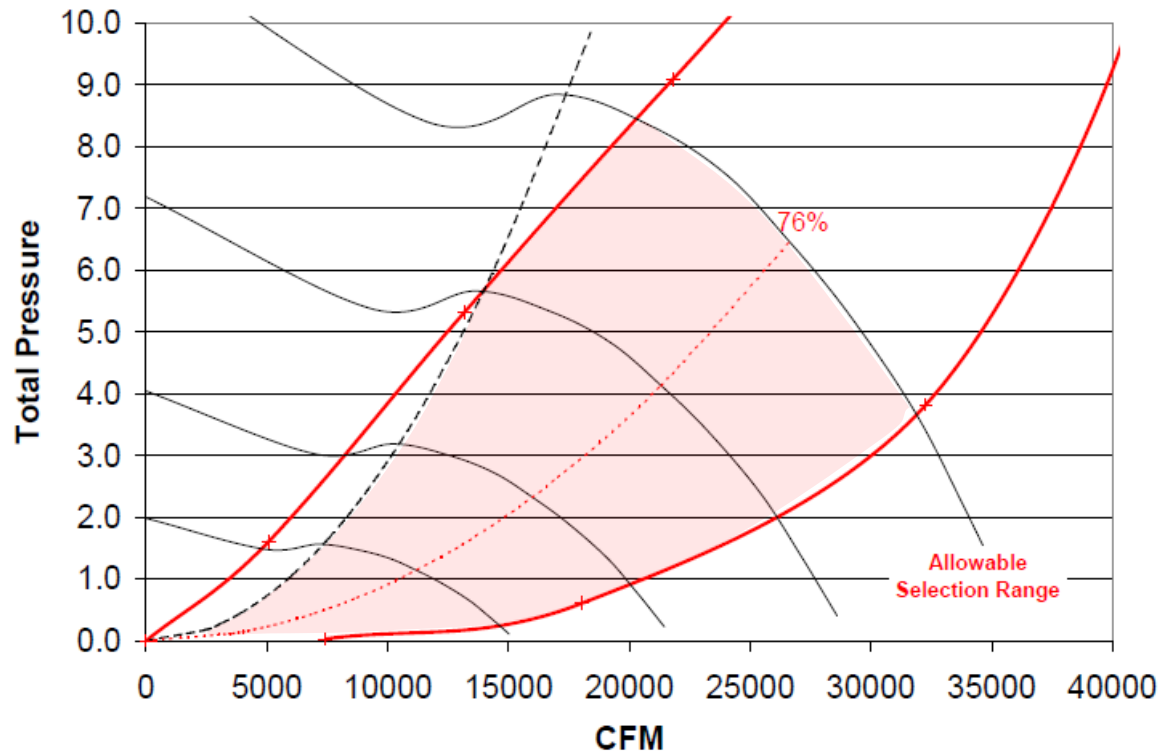
## Example: Inefficient Fan



**Square  
Inline Fan**

# Allowable Fan Selections

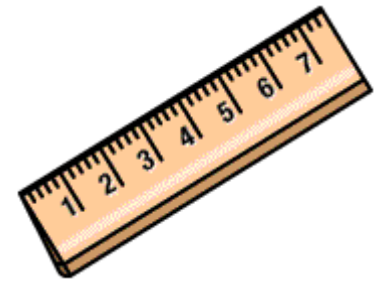
## Example: Efficient Fan



**Mixed Flow  
Inline Fan**

# CIFB Term Sheet

## “Metric”



**Compliance Metric: Fan Electrical Power at Design Point  $\leq FEP_{STD}$**

$$FEP_{STD,i} = \frac{(Q_i + Q_0)(P_i + P_0)}{6346 * \eta_{target}}$$

$FEP_{STD,i}$  = maximum fan input power at operating point i

$Q_i$  = flow (cfm) at operating point i

$P_i$  = total pressure for ducted fans, static pressure for non-ducted fans (in. wg.) at operating point i

$Q_0$  = flow constant of 250 cfm

$P_0$  = pressure constant of 0.4 inches water gauge

$\eta_{target}$  = target static and total efficiency levels to be set by DOE

*Ref. Recommendation #18, 19, 20, 21*



# CIFB Fan Term Sheet

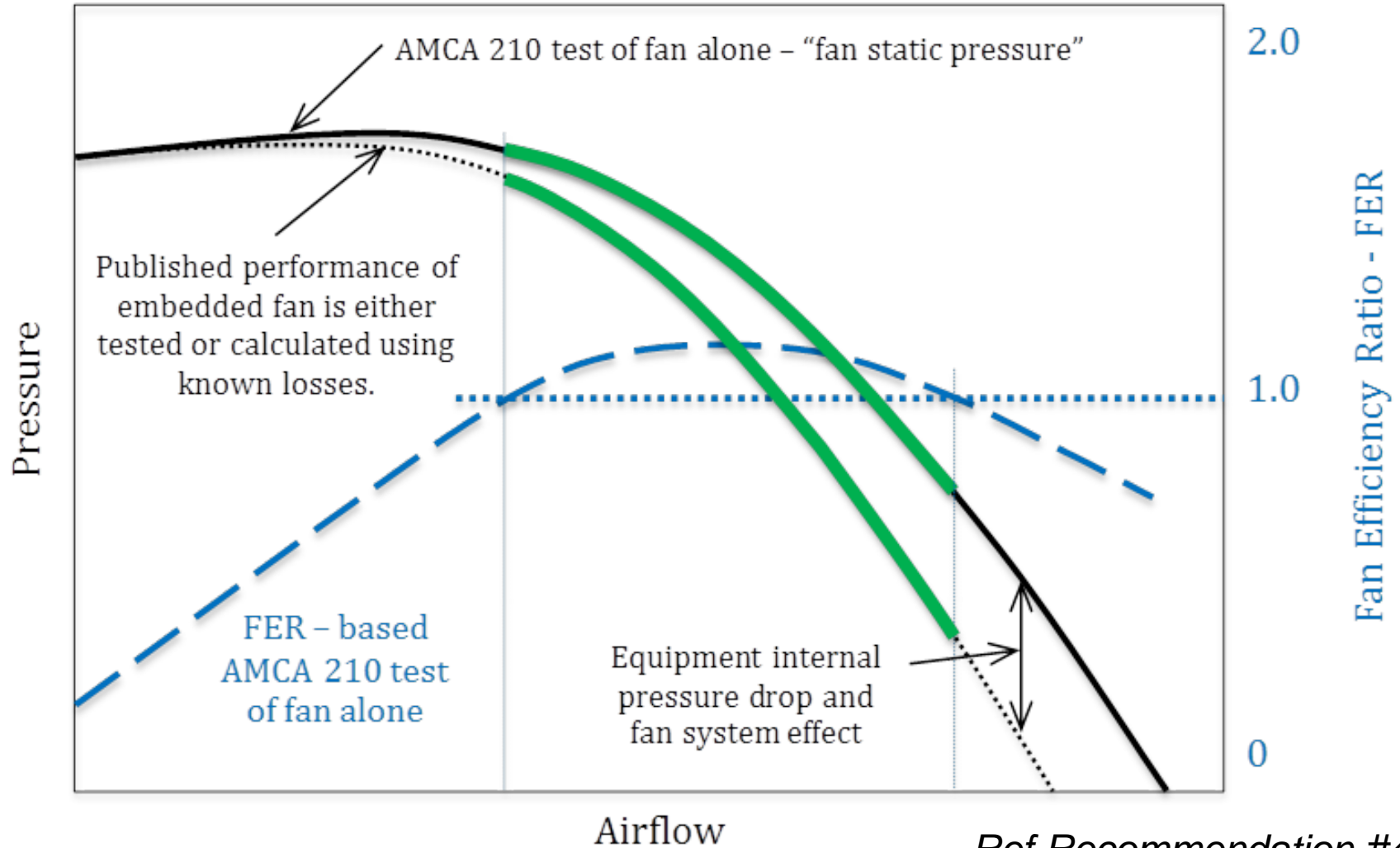
## “Test”



- DOE Regulation based on:
  - AMCA Standard 210 (stand alone / non-embedded fans)
- Includes “default” losses for:
  - Drives, Motors, VSDs
- Allows Alternative Efficiency Determination Method
  - AEDM

*Ref. Recommendation #7, 8, 9, 17, 22, 23, 24, 25, 29*

# Embedded Fan Testing



*Ref Recommendation #4, 8*



# CIFB Fan Term Sheet

## “Certification/Labeling\*”

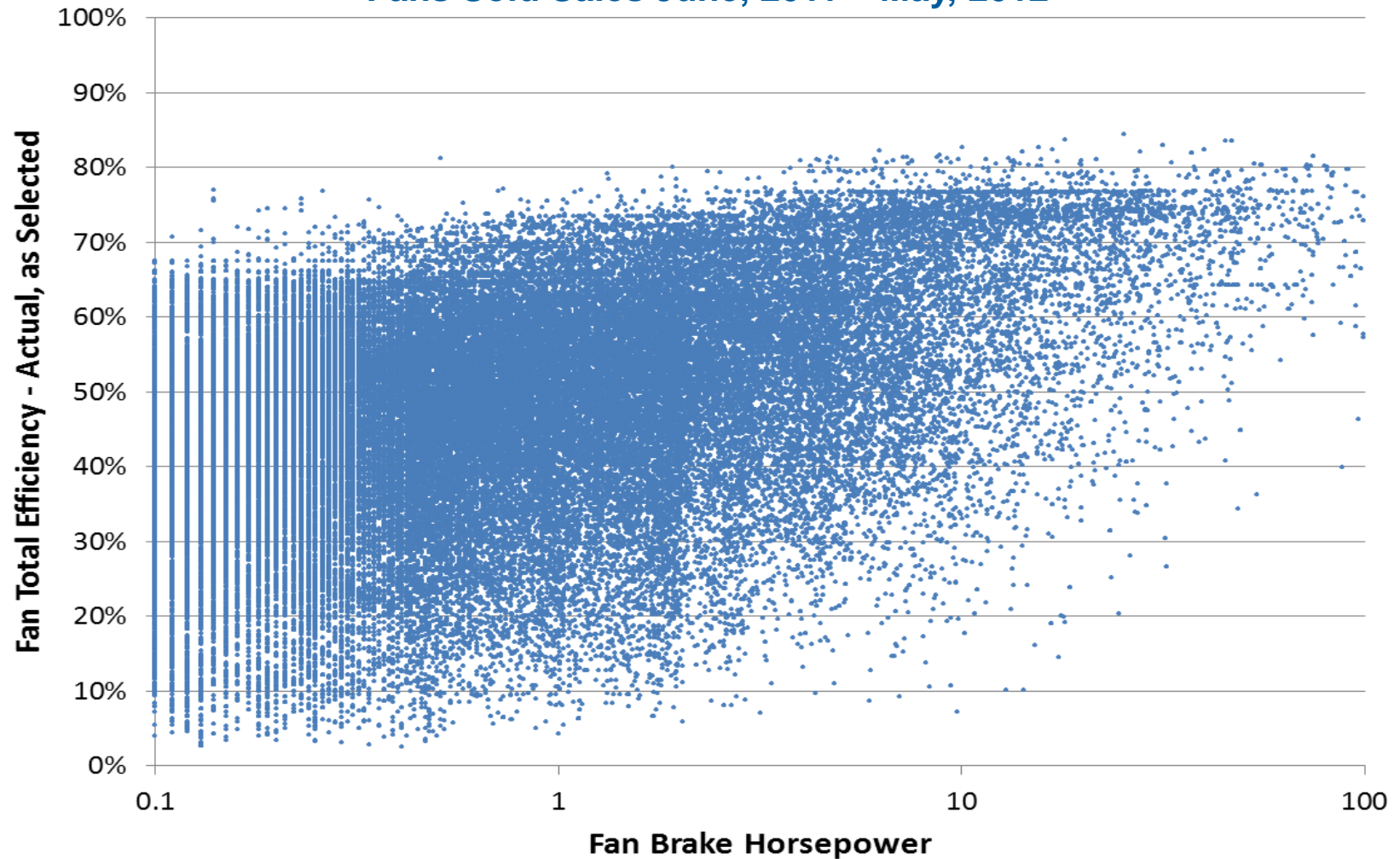
- Certification:
  - Submit Selection Software (like AMCA eCAT)
  - Submit Operating Range (equation or tabular)
  - Submit Literature
  - Info will be in “Public Domain”
  - Working to utilize AMCA CRP
- Labeling (design point dependent)
  - Model
  - Serial #, Date
  - Design Airflow, Pressure, FEI
  - Max RPM
  - Link to DOE website



*\*Likely to Change  
Ref. Recommendation #26, 27, 31, 32*

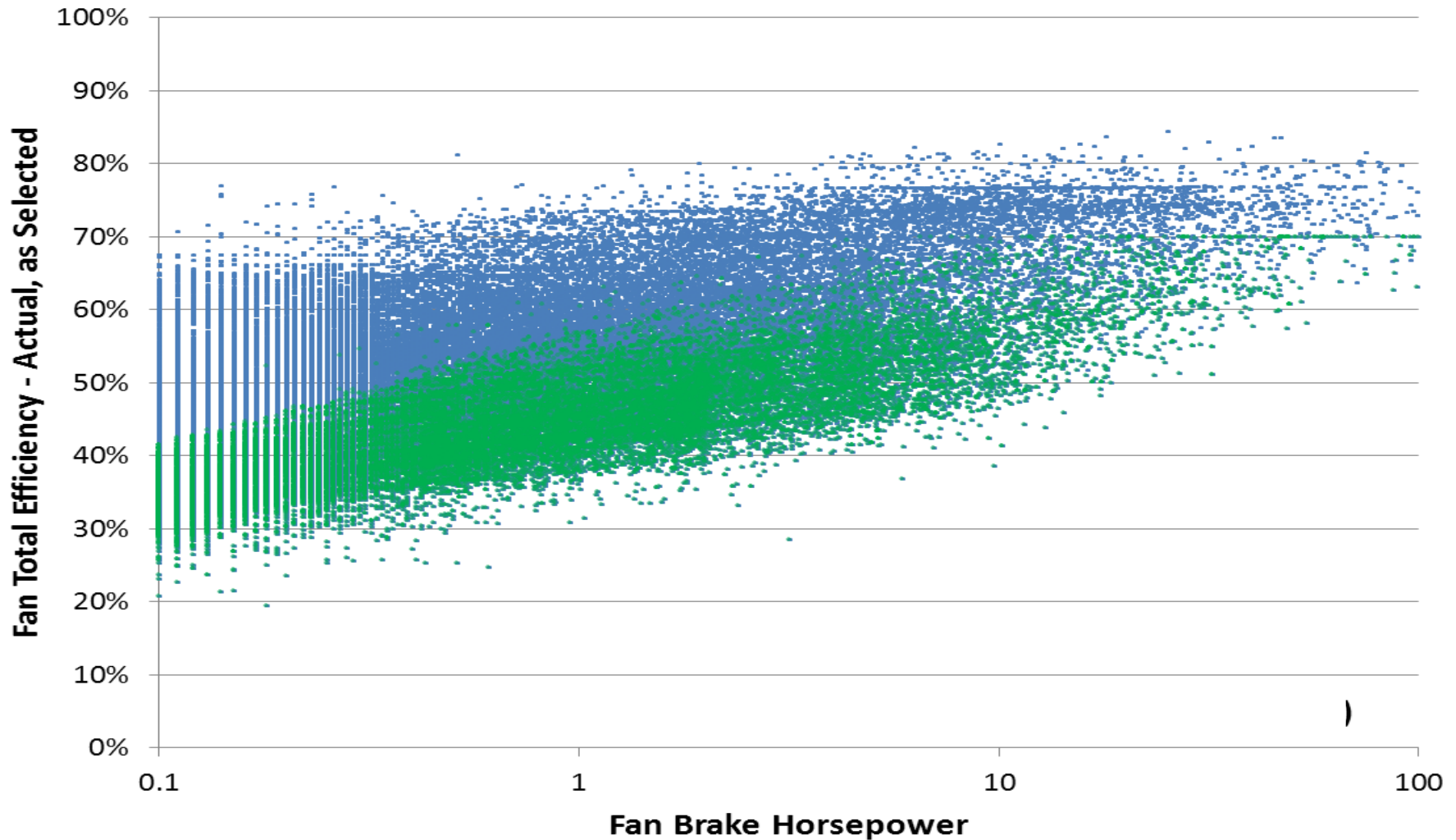
# Total Annual Sales

Fans Sold Sales June, 2011 – May, 2012



# Impact of Selection-Based Efficiency Limits

Fans Sold June, 2011 – May, 2012



# Future

- ASHRAE 90.1
  - $FEI \geq 1.0$  at design airflow and pressure
- ASHRAE 189.1
  - $FEI \geq 1.1$  at design airflow and pressure
- Utility Rebates
  - $FEI \geq 1.2$  triggers \$X per motor hp rebates

# Questions / Comments

## DOE CIFB Rule

