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| **Filer:** | Alex Galdamez |
| **Organization:** | California Energy Commission |
| **Submitter Role:** | Commission Staff |
| **Submission Date:** | 7/10/2018 3:24:21 PM |
| **Docketed Date:** | 7/10/2018 |

# Commercial and Industrial Fans and Blowers

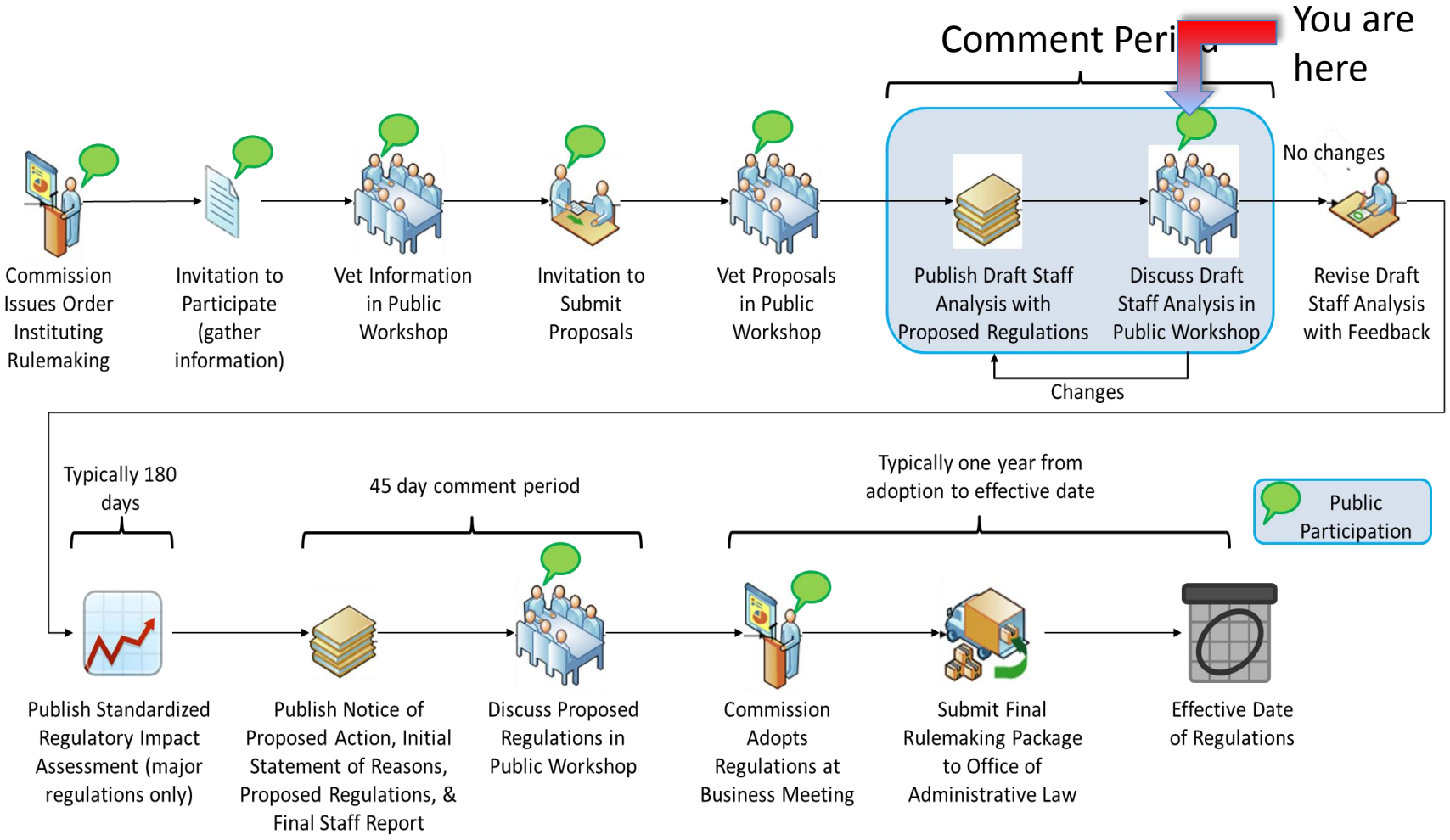
## Proposed Standard Draft Staff Report

**Alejandro Galdamez**
**July 10, 2018**
**California Energy Commission**

# Presentation Agenda

- Rulemaking Process
- Background
- Staff Proposal
- Technical Feasibility
- Savings Methodology
- Cost Effectiveness
- Statewide Energy Savings
- Conclusions
- Scheduled Presentations
- Public Comments

# Rulemaking Process



# Background

- The U.S. Department of Energy started the process to regulate commercial and industrial fans and blowers
- Issued the Notices of Data Availability and used data provided by industry for the analysis
- DOE assumptions were used in analyzing embedded fan shipments

# Staff Proposal

- Staff proposal focuses on stand-alone fans and embedded fans in non-regulated equipment

Stand-alone axial inline fan

Axial panel embedded fans

# Staff Proposal

- The draft staff report contains proposal details
  - https://efiling.energy.ca.gov/GetDocument.aspx?tn=223774
- Staff seeks comments and supporting data for the proposed standard

# Staff Proposal

- Stand-alone and embedded fans in non-regulated equipment:
  - Break horsepower greater or equal to 1 horsepower or 1 kilowatt
  - Air horsepower less than or equal to 150
- Covered fans: Axial inline fans, axial panel fans, centrifugal housed and unhoused fans, centrifugal inline fans, inline mixed flow fans, power roof/wall ventilators

# Staff Proposal

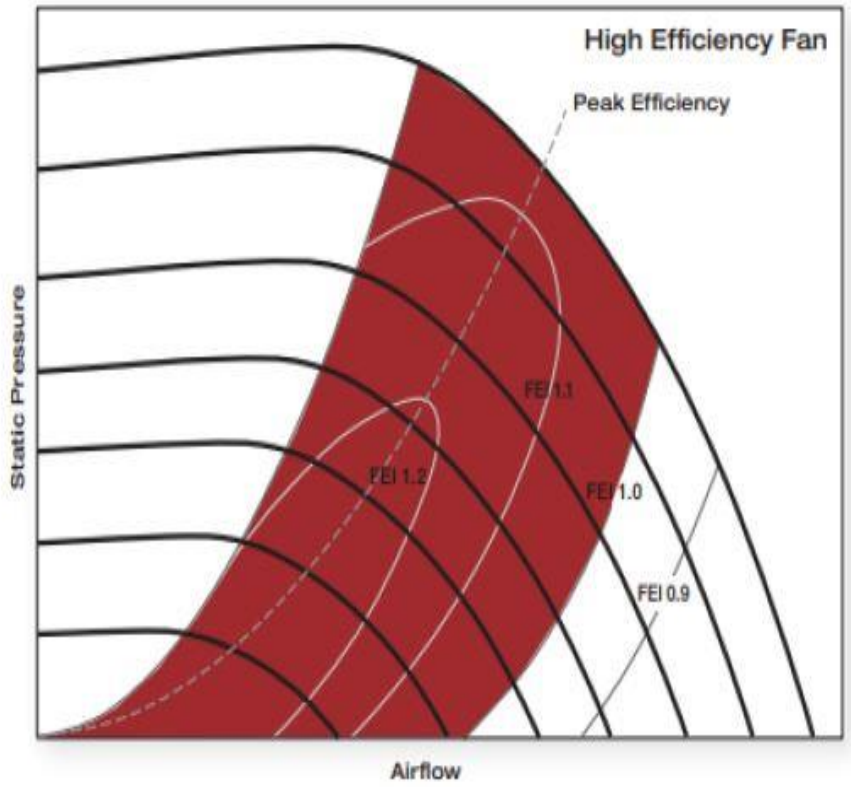
- CEC staff is proposing the Fan Energy Index (FEI) of 1 as the metric for the fans covered under this proposal
- FEI is equal to the Reference Fan Electrical input power ($FEP_{ref}$) compared to the actual fan electrical input power ($FEP_{act}$)

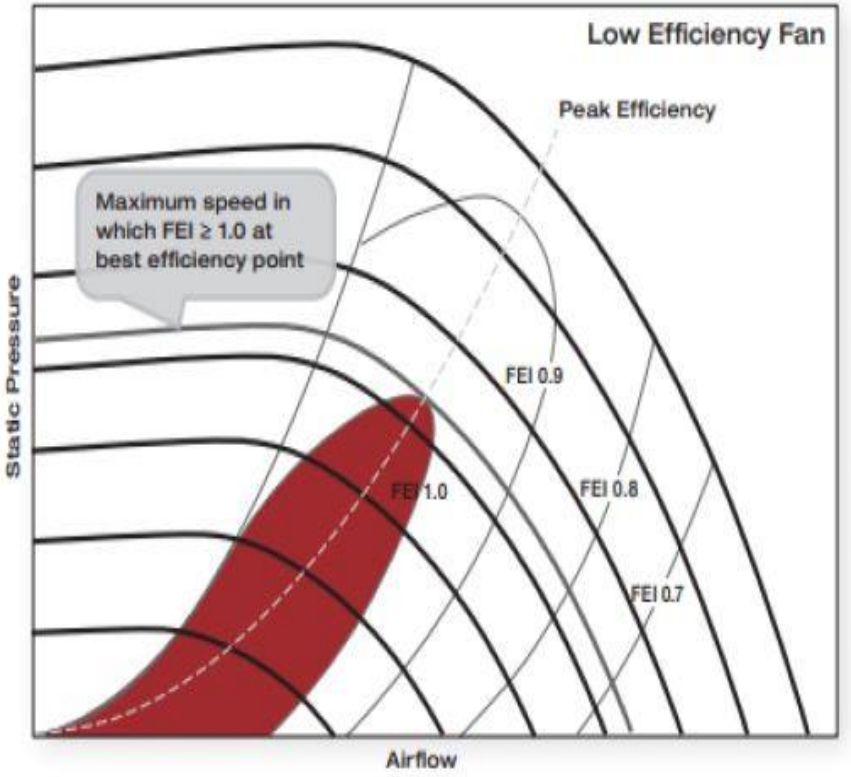
$$FEI = FEP_{ref} / FEP_{act}$$

# Staff Proposal

- ANSI/AMCA 208-18 Calculation of the Fan Energy Index
  - AMCA 208-18 requires ANSI/AMCA Standards 210 and ANSI/AMCA 207
  - Both AMCA 210 and AMCA 207 are necessary for the calculations of AMCA 208

# Technical Feasibility



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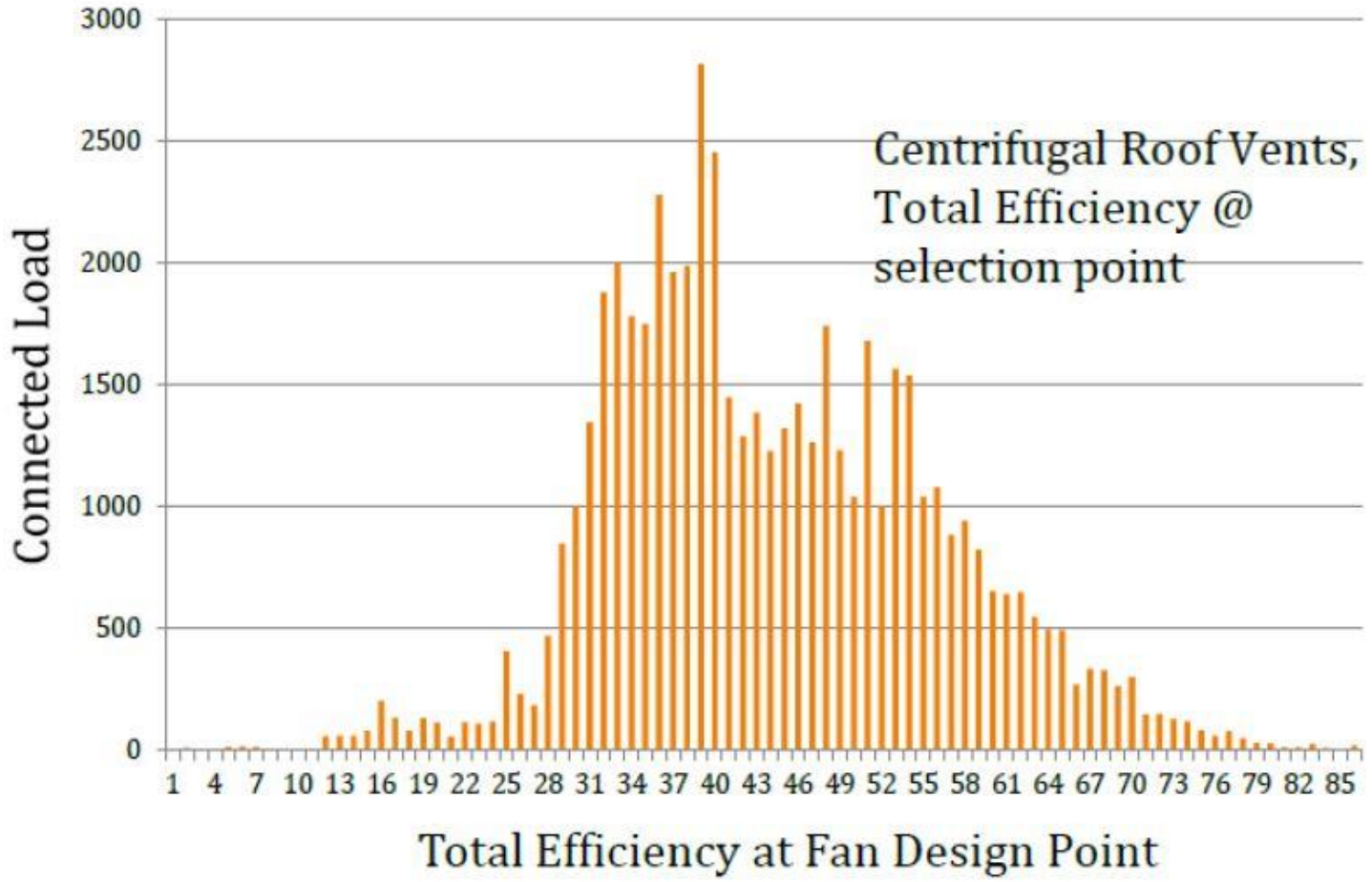
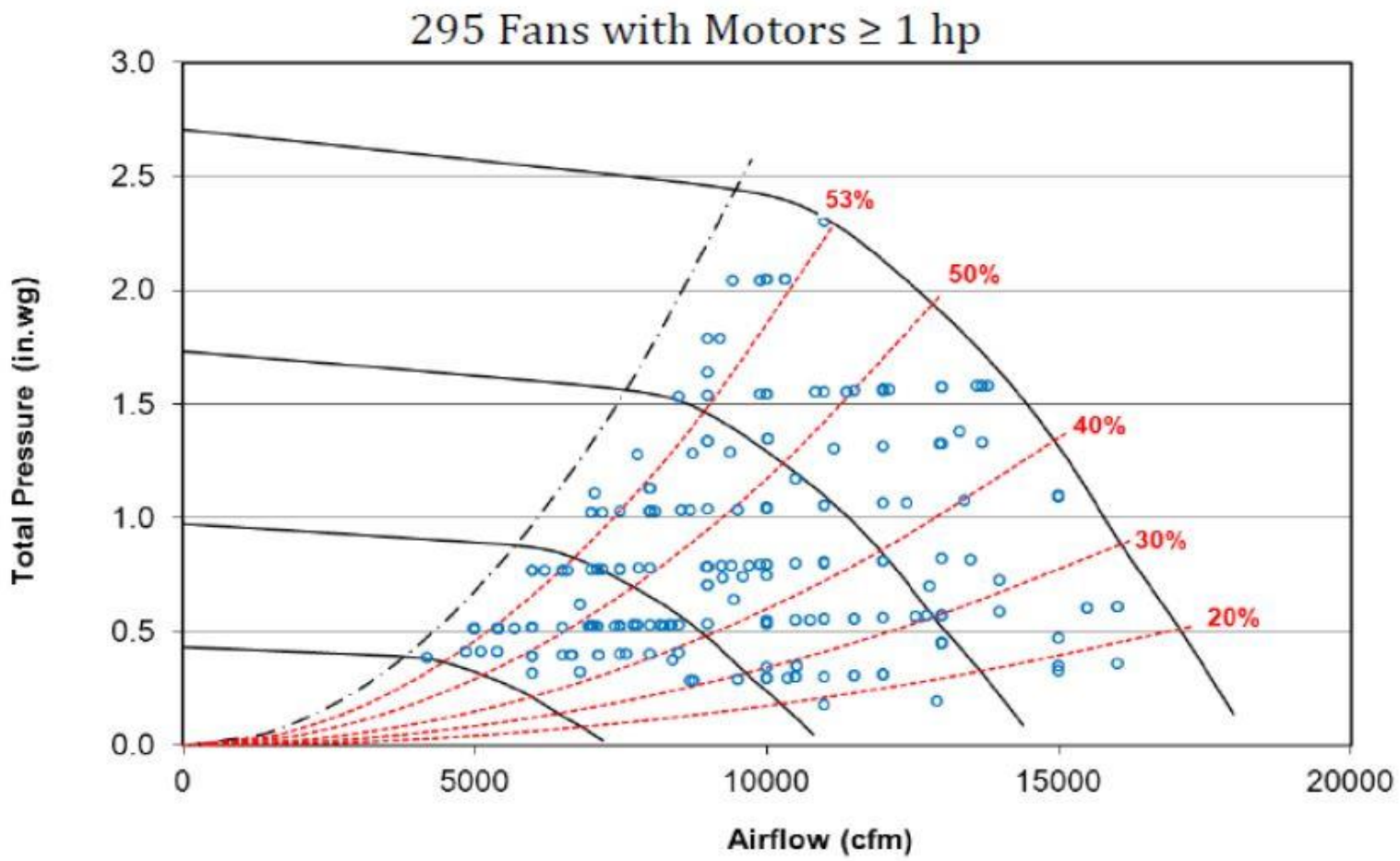


# Technical Feasibility



# Technical Feasibility

| Fan Model | Design BHP | FEI | Operation Cost ($/yr) | Weight (lbs) | Housing Width | Budget Cost |
|---|---|---|---|---|---|---|
| Sq Inline 30 “ | 5.33 | 0.62 | $1,363 | 571 | 46” | $3,300 |
| Sq Inline 42” | 2.92 | 1.12 | $758 | 735 | 58” | $4,050 |
| Mixed Flow 27” | 2.77 | 1.18 | $719 | 611 | 41” | $6,700 |
| ★ EQB-27 | 2.83 | 1.16 | $734 | 451 | 41” | $3,900 |

30” Sq Inline

42” Sq Inline

27” Mixed Flow

EQB-27

# Technical Feasibility

- The figures on slides 11 and 12 represent two different centrifugal stand-alone fans
- The same technical feasibility is applicable to stand-alone fans and embedded fans since:
  - When tested outside of the embedded unit, it will perform exactly the same as a stand-alone fan
  - Current design practices for some embedded fans is driven by space available and not efficiency
  - For some embedded fans, the system is built around the fan (i.e. air chillers)

# Technical Feasibility

- We received additional information on the FEI compliance on Unitary Rooftop units

Fan Example in a Unitary Rooftop

| TSP | FEI (EL1) | | | FEI (EL2) | | | FEI (EL3) | | | FEI (EL4) | | | FEI (EL5) | | | FEI (EL6) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.8 | 1.3 | 1.4 | 1.4 | 1.2 | 1.3 | 1.3 | 1.1 | 1.2 | 1.2 | 1.1 | 1.2 | 1.2 | 1.0 | 1.1 | 1.1 | 0.9 | 0.9 | 1.0 |
| 5.0 | 1.4 | 1.4 | 1.4 | 1.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 | 0.9 |
| 1.3 | 1.5 | 1.3 | 1.2 | 1.4 | 1.2 | 1.1 | 1.3 | 1.1 | 1.0 | 1.3 | 1.1 | 1.0 | 1.2 | 1.0 | 0.9 | 1.0 | 0.9 | 0.8 |
| CFM | 29000 | 43500 | 58000 | 29000 | 43500 | 58000 | 29000 | 43500 | 58000 | 29000 | 43500 | 58000 | 29000 | 43500 | 58000 | 29000 | 43500 | 58000 |
| %Fail | 0% | | | 0% | | | 0% | | | 11% | | | 11% | | | 89% | | |

# Savings Methodology

- California Energy Commission staff used operating costs for different fans at the different efficiency levels as calculated in DOE's third NODA
- The calculation is based on the difference in operational cost between a non compliant fan and one operating at efficiency level 3

# Cost Effectiveness Stand-alone Fans

| Fan Type | Per Unit Electricity Savings (kWh/yr) | Per Unit Incremental Cost ($) | Average Lifetime (yr) | Per Unit Average Annual Savings ($/yr) | Life Cycle Net benefit ($/unit) |
|---|---|---|---|---|---|
| **Axial Cylindrical Housed** | 1,155 | 399 | 29 | 169 | 2,839 |
| **Panel** | 500 | 53 | 28 | 85 | 1,542 |
| **Centrifugal Housed** | 408 | 33 | 27 | 69 | 1,236 |
| **Centrifugal Unhoused** | 130 | 39 | 27 | 22 | 365 |
| **Inline Mixed Flow** | 1,131 | 689 | 27 | 192 | 2,830 |
| **Radial** | 2,211 | 221 | 30 | 323 | 6,111 |
| **Power Roof Ventilators** | 927 | 595 | 30 | 157 | 2,489 |

# Cost Effectiveness Embedded Fans

| Fan Type | Per Unit Electricity Savings (kWh/yr) | Per Unit Incremental Cost ($) | Average Lifetime (Yr) | Per Unit Average Annual Savings ($/yr) | Life Cycle Net Benefit ($/unit) |
|---|---|---|---|---|---|
| Axial Cylindrical Housed | 362 | 187 | 18 | 61 | 657 |
| Panel | 102 | 56 | 21 | 17 | 211 |
| Centrifugal Housed | 380 | 178 | 18 | 65 | 709 |
| Centrifugal Unhoused | 130 | 47 | 17 | 22 | 243 |

# Statewide Energy Savings

- Stand-alone fans:
  - First year: 50 GWh
  - After full stock turnover: 1,400 GWh/year
- Embedded fans:
  - First year: 24 GWh
  - After full stock turnover: 430 GWh/year

# Conclusions

- Cost-effective
  - Calculated savings include a discount rate of 3%
- Technically feasible to achieve
- First year energy savings (~74 GWh)
- Energy savings after full stock turnover (~1800 GWh/year
  - Compare:
    - Battery chargers: 2,200 GWh/year
    - State-regulated LEDs: 859 GWh/year
    - Portable electric spas: 218 GWh/year

# Conclusions

- First Year Savings
  - ~$183 million
- Savings after stock turnover:
  - ~$529 million per year

  or
  - ~$4.8 billion cumulative savings for California consumers

# Stand-alone Fans Discussion

- Definition
  - All covered stand-alone definitions
- Exemptions
  - Circulating fans
  - Energy Commission staff did not include emergency fans due to concerns on how they are identified

# Stand-alone Fans Discussion

- Test procedure
  - Basic model testing
  - Energy Commission is seeking more information, examples, and data on the implementation of fan laws for testing and/or reporting

# Embedded Fans Discussion

- Embedded fans definition
  - Comments on the definition for embedded fans
  - Energy Commission is seeking definitions for embedded fans that would prevent loopholes in regulations

# Embedded Fans Discussion

- Scope
  - Energy Commission is accepting substantiated comments to define the scope of embedded fans

# Embedded Fans Discussion

- Test Procedure
  - Energy Commission staff is seeking engineering data and information supporting whether or not the test procedure is representative for embedded fans

# Embedded Fans Discussion

- Energy Savings
  - Preliminary calculations received show significant energy savings for California
  - Energy Commission staff is accepting data and analysis supporting a different conclusion for embedded fans

# Embedded Fans Discussion

- Cost effectiveness
  - Energy Commission staff has received comments on additional costs associated with embedded fans
  - Energy Commissions is requesting data and itemized information on cost increases

# Comments

- Comments due by 5:00 p.m. on July 31, 2018
- To submit electronically:
  - Go to http://www.energy.ca.gov/appliances/2017-AAER-06-13/17-AAER-06.html
  - Click on “Submit eComment”
- To send a hard copy:

  California Energy Commission
  Dockets Office, MS-4
  Re: Docket No. 17-AAER-06
  1516 Ninth Street
  Sacramento, CA 95814-5512
- To send a digital copy: docket@energy.ca.gov include docket number 17-AAER-06 and indicate Commercial and Industrial Fans and Blowers in the subject line

# Thank you!

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