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Response to California's proposed appliance efficiency regulations for CIFBs

Additional submitted attachment is included below.

Daikin Applied Comments: Commercial and Industrial Fans and Blowers (CIFB)

Subject: Docket # 17 AAER-06

These comments are submitted by Daikin Applied in response to California's proposed appliance efficiency regulations for CIFBs. Daikin Applied is headquartered in Plymouth, Minnesota, manufactures commercial HVAC equipment, employs over 9,000 people, and is a division of Daikin Industries.

The Draft Staff Report, docketed 6-11-2018, needs significant corrections before good decisions can be made regarding proposed embedded fan regulation. The following corrections are quantifiable and documented. Energy savings will still be overstated, even after these corrections, due to subjective corrections covered in separate comments.

- The estimated quantity of housed and unhoused, embedded centrifugal fans in Table A3 is overstated by about 500% due to the DOE AH and EAF/RAF annual shipment errors mentioned in AHRI comments. Corrections are shaded yellow.
- The annual energy savings in the 21st year in Table A9 is overstated by 67% because it assumes the entire population of California fans will improve due to regulations. Actually only about 33% will improve at DOE's EL3 level. Corrections are shaded green.
- The imbedded panel fan P01 bin [1-1.8 HP] in DOE's LCC Tab of Life Cycle Cost Analysis is incorrectly shown to include 0% of the fan population. Many if not most condenser fans fall into this power bin. This can be confirmed in published catalogs. This essentially doubles the correct average panel fan size and energy consumption as shown in gray shading.
- Corrected Table A9 energy savings are in bold font.
- Documentation begins on page 2.

Table A2	Table A3	Table A5		Table A7	**Table A9**			
		Shipments			$ Savings		**Gwh Savings**	
	US 2012	US 2019	Ca 2019	Ca Stock	1st Year	Turn Year	**1st Year**	**21st year**
Panel	125,786	158,243	18,989	398,769	208,881	4,386,459	1.9	40.6
Housed	266,066	336,528	40,383	726,894	1,655,718	29,802,654	15.3	276.0
Unhoused	319,064	409,666	49,160	835,720	688,239	11,700,080	6.4	108.3
	Corrected Table A3 and A5 and			Table A7	**Corrected Table A9**			
Panel	125,786	158,243	18,989	398,769	69,626	1,462,153	**0.3**	**6.8**
Housed	60,830	76,939	9,233	166,189	126,180	2,271,248	**1.2**	**21.0**
Unhoused	50,248	64,517	7,742	131,614	36,129	614,200	**0.3**	**5.7**

Revised 2012 Air Handlers =	60,000
AH [RAF+EAF] / SAF =	15%

EL3 = 33% of total

2 x average size

Revised 2012 Rooftop EAF/RAFs					
MBH	65-135	135-240	240-760	Over 760	Total
Units	165,628	63,370	20,793	1,397	
Fan / Unit	1.1	1.2	1.5	1.75	
RAF+EAF	16,563	12,674	10,397	1,048	42,078

We request California consider the potential consumer impact [Staff Report Table A12] if DOE estimated conversion costs [blue shading] are passed on to customers as extra cost [orange shading.] Corrected consumer benefit ratios are unfavorable as shown in bold font. Note that DOE estimated, extra cost and redesign conversion costs are vastly understated as explained in separate comments.

Table A 12

	Extra Cost	Annual Energy Savings	Lifetime Years	Lifetime Energy Savings		Benefit / Cost Ratio
				Non Discounted	Discounted	
Panel	$ 56	$ 17.31	21	$ 364	$ 211	3.8
Housed	$ 178	$ 64.52	18	$ 1,161	$ 709	4.0
Unhoused	$ 47	$ 22.03	17	$ 375	$ 243	5.2

	Table A12 Corrected To Include DOE Redesign Cost				2 x average size	
Panel	$ 147	$ 8.66	21	$ 182	$ 106	**0.72**
Housed	$ 1,498	$ 64.52	18	$ 1,161	$ 709	**0.47**
Unhoused	$ 355	$ 22.03	17	$ 375	$ 243	**0.68**

Redesign Cost

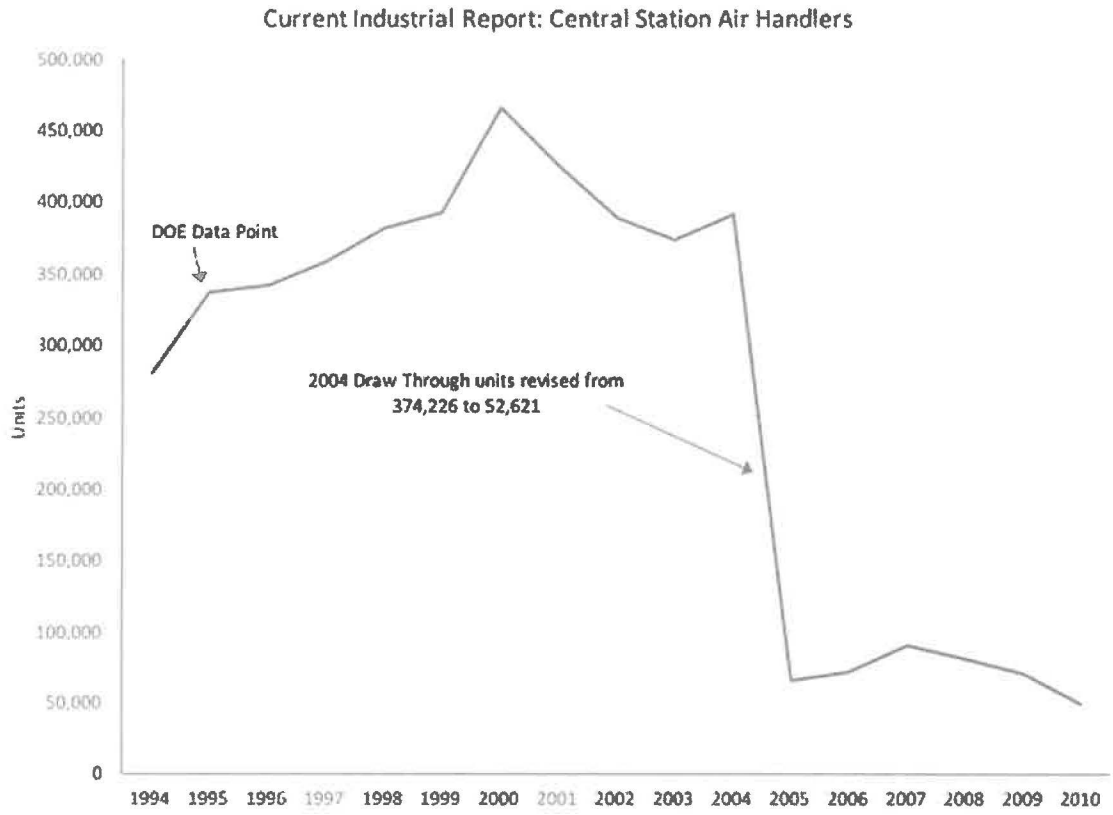
	EL3 Redesign Costs [$m] in DOE Engineering Spreadsheet, OEM Equip Conv Cost Tab	33% of Ca, 17-21 Year Shipments	Redesign Cost/Fan
Panel	$ 36.1	398,769	$ 91
Housed	$ 215.9	163,517	$ 1,320
Unhoused	$ 40.2	130,517	$ 308

Documentation – The DOE Impact Spreadsheet, 2012 Shipment Tab overstates the market.

- DOE estimated the air handler market to be 330,402. We suspect that came from a pre-2005, erroneous Commerce Report that was later corrected as shown by AHRI. The correct 2012 air handler market size is about 60,000 and not 330,000.
- DOE erroneously estimated that about 165,000 or 50% of all air handlers have dual fans or integral RAFs/EAFs. The correct estimate is about 15% or 9,000. This can only be confirmed by factory visits but is strongly supported by market experience.
    - Indoor, floor by floor units rarely need RAFs/EAFs.
    - Blower coils are not available with EAFs or RAFs.
    - Most indoor air handler, SAF and RAF/EAF sections ship separately and are often considered 2 air handlers.
- DOE estimated that 50% of packaged rooftops have EAFs/RAFs. This % is fairly accurate on larger equipment but 90% of the market is smaller equipment with 10-20% EAFs as documented by AHRI. This can only be further confirmed by factory visits but is generally confirmed by market knowledge. Smaller rooftops generally are installed on 1 story, single zone applications and building pressure control doesn't require EAFs as explained in our separately submitted, power point presentation.
- Page 3-6 = Air handler report error, unitary RAF / EAF error, condenser fan size error, and redesign cost estimates

Centrifugal Fans

DOE Relied on Incorrect Data from Current Industrial Report



Source: US Department of Commerce, Current Industrial Report MA35M and MA333M

DOE Shipments 2012 Tab **with errors**

HVACR Equipment and Fans	*Commercial Packaged Air-Conditioning*				*Air Handlers*	*A/C Chillers*
	Air-Cooled	*Air-Cooled*	*Air-Cooled*	*All*		
Capacity - MBH	65-135	135-240	240-760	Over 760	all	all
Unit Equipment	165,628	63,370	20,793	1,397	330,402	12,579
Fans per unit	0.5	0.5	1.5	1.5	1.5	14.0
% with in scope SAF	0%	0%	0%	0%	100%	0%
% with in scope cond fan	0%	0%	0%	0%	0%	100%
% with RAF	50%	50%	50%	50%	25%	0%
% with EAF	0%	0%	100%	100%	25%	0%
HVACR Fans	**82,814**	**31,685**	**31,189**	**2,095**	**495,604**	**176,106**
In scope supply fans	-	-	-		330,402	-
In scope condenser fans	-	-	-	-	-	176,106
Return fans	82,814	31,685	10,396	698	82,601	-
Exhaust fans	-	-	20,793	1,397	82,601	-

Corrected DOE Shipments 2012 Tab

HVACR Equipment and Fans	*Commercial Packaged Air-Conditioning*				*Air Handlers*	*A/C Chillers*
	Air-Cooled	*Air-Cooled*	*Air-Cooled*	*All*		
Capacity - MBH	65-135	135-240	240-760	Over 760	all	all
Unit Equipment	165,628	63,370	20,793	1,397	60,000	12,579
Fans per unit	1.1	1.2	1.5	1.75	1.15	14.0
% with in scope SAF	0%	0%	0%	0%	100%	0%
% with in scope cond fan	0%	0%	0%	0%	0%	100%
% with RAF	0%	0%	20%	50%	7.5%	0%
% with EAF	10%	20%	30%	25%	7.5%	0%
HVACR Fans	**16,563**	**12,674**	**10,396**	**2,444**	**69,000**	**176,106**
In scope supply fans	-	-	-	1,397	60,000	-
In scope condenser fans	-	-	-	-	-	176,106
Return fans	-	-	4,159	698	4,500	-
Exhaust fans	16,563	12,674	6,238	349	4,500	-

Total CAC RAF + EAF + SAF > 760 = 42,077

EMBEDDED FANS -- Distribution by Sector (OEM)				
		Panel	Housed	Unhoused
Power Bin #	Bin ranges (HP)	Commercial	Commercial	Commercial
P01	1.00 - 1.80	0%	100%	100%
P02	1.80 - 3.25	100%	100%	100%
P03	3.25 - 5.85	100%	100%	100%
P04	5.85 - 10.54	100%	100%	100%
P05	10.54 - 18.98	0%	100%	100%
P06	18.98 - 34.20	0%	100%	100%
P07	34.20 - 61.62	0%	100%	0%
P08	61.62 - 111.01	0%	0%	0%
P09	111.01 - 200.0	0%	0%	0%

Distribution by Application			
	Panel	Housed	Unhoused
Commercial Sector	Embedded	Embedded	Embedded
Clean Air Ventilation	0.0%	0.0%	0.0%
Exhaust	0.0%	15.8%	16.7%
Supply	0.0%	33.2%	66.7%
Return	0.0%	50.9%	16.7%
Condenser	100.0%	0.0%	0.0%
Total	100%	100%	100%

LOAD PROFILES - ALL FANS				
Load profile: Applied to 20 % of fan selections in the Commercial sector				
Percentage of Design Flow	25%	50%	75%	100%
Percentage of Annual Operating hours	5%	35%	55%	5%
Load profile: Applied to 60 % of fan selections in the Commercial sector				
Percentage of Design Flow	25%	50%	75%	100%
Percentage of Annual Operating hours	0%	50%	50%	0%

life cycle cost spreadsheet
~~selections~~ sectors + applications tab

EMBEDDED- Annual Operating Hours Commercial Sector		
1. Exhaust / Return		
Minimum	Maximum	Percentage
1	1,752	29%
1,752	2,628	7%
2,628	3,504	64%
3,504	4,380	0%
4,380	5,256	0%
5,256	6,132	0%
6,132	7,008	0%
7,008	7,884	0%
7,884	8,759	0%
8,760	8,760	0%
Average		2,501

2. Supply		
Minimum	Maximum	Percentage
1	1,752	0%
1,752	2,628	0%
2,628	3,504	100%
3,504	4,380	0%
4,380	5,256	0%
5,256	6,132	0%
6,132	7,008	0%
7,008	7,884	0%
7,884	8,759	0%
8,760	8,760	0%
Average		3,066

4. Condenser		
Minimum	Maximum	Percentage
1	1,752	33%
1,752	2,628	67%
2,628	3,504	0%
3,504	4,380	0%
4,380	5,256	0%
5,256	6,132	0%
6,132	7,008	0%
Average		1,883

Total Industry OEM Equipment Conversion Cost					
EL1	EL2	EL3	EL4	EL5	EL6
$161,745,467	$187,403,943	$215,929,848	$254,928,573	$303,832,681	$407,893,892
$16,311,869	$25,513,155	$40,216,177	$63,499,254	$98,595,383	$327,960,335
$12,450,000	$15,600,000	$18,900,000	$20,850,000	$24,600,000	$31,500,000
$3,150,000	$4,050,000	$5,700,000	$7,950,000	$9,750,000	$20,550,000
$17,250,000	$22,350,000	$26,100,000	$30,750,000	$35,100,000	$47,850,000
$14,170,398	$16,289,391	$22,607,436	$28,955,677	$38,110,726	$65,936,870
$18,190,417	$25,940,597	$36,139,266	$48,576,825	$57,659,261	$85,380,865
$243,268,151	*$297,147,086*	*$365,592,727*	*$455,510,329*	*$567,648,051*	*$987,071,962*

Fan Class	Industry Redesign Counts for Equipment with Fans Incorporated in OEM Equipment					
	EL1	EL2	EL3	EL4	EL5	EL6
Centrifugal Housed	1078	1249	1440	1700	2026	2719
Centrifugal Unhoused	109	170	268	423	657	2186
Inline and Mixed Flow	83	104	126	139	164	210
Radial	21	27	38	53	65	137
Power Roof Ventilator	115	149	174	205	234	319
Axial Cylindrical Housed	94	109	151	193	254	440
Panel	121	173	241	324	384	569
Sum	*1621*	*1981*	*2438*	*3037*	*3784*	*6580*

engineering spreadsheet
oem equip ~~Fans~~ ~~#~~ ment conversion cost tab