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U.S. DEPARTMENT OF ENERGY

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OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

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PUBLIC MEETING: ENERGY CONSERVATION STANDARDS FOR
COMMERCIAL WARM AIR FURNACES

+ + + + +

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MONDAY, MARCH 2, 2015

The above-referenced working group met in
Room 8E-809, 1000 Independence Avenue SW,
Washington, D.C., 20585 at 9:00 a.m., Doug
Brookman, facilitating.

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1 P R O C E E D I N G S

2 MR. BROOKMAN: Okay, let's begin. Good
3 morning, everyone. Welcome. This is the Notice
4 of Proposed Rulemaking Public Meeting on Energy
5 Conservation Standards for Commercial Warm Air
6 Furnaces, here at the U.S. Department of Energy at
7 the Forrestal Building in Washington, D.C. Today
8 is March 2nd. Glad to see you here this morning.
9 We're going to start with welcoming remarks from
10 John Cymbalsky.

11 MR. CYMBALSKY: Thanks, Doug. Thanks to
12 all of you who braved the two-hour delay here and
13 we're going to start pretty much on time. So I
14 appreciate everyone's effort in making it. I know
15 a few of us who wish to be here are on the webinar
16 instead due to travel issues. So please
17 participate through the webinar as if you were in
18 the room because we really want this to be a good
19 dialogue today. Thank you.

20 MR. BROOKMAN: Thank you. And we'll
21 talk more about the webinar in a moment. I'm
22 going to start with introductions, as I typically

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1 do. I'll start to my immediate left, and Harvey,
2 if you'd say your name and organizational
3 affiliation, we can get used to turning these
4 microphones on and off.

5 MR. SACHS: Hi. I'm Harvey Sachs,
6 American Council for an Energy Efficient Economy,
7 otherwise known as ACEEE.

8 MR. BROOKMAN: Thank you.

9 MS. HOOTMAN: Jill Hootman, Trane.

10 MR. RAY: Mike Ray, Lennox.

11 MR. VON WENTZEL: Constantin von
12 Wentzel, Navigant Consulting.

13 MR. DARLINGTON: Adam Darlington,
14 Navigant Consulting.

15 MR. STAS: Eric Stas, DOE General
16 Counsel Office.

17 MR. LAU: Chris Lau, Navigant.

18 MR. FRANCO: Victor Franco, Lawrence
19 Berkeley National Laboratory.

20 MR. LEKOV: Alex Lekov, Lawrence
21 Berkeley National Laboratory.

22 MR. MCCLIVE: Sam McClive, Navigant

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1 Consulting.

2 MR. RIVEST: Mike Rivest, Navigant

3 Consulting.

4 MR. MCCABE: Michael McCabe,

5 representing myself.

6 MR. CASE: Dave Case, U.S. Department of

7 Energy.

8 MR. BROOKMAN: Thanks again to all of

9 you for braving the cold and ice this morning to

10 get here. All of you received a packet of

11 information I hope. I'm going to do a very brief

12 agenda review. Immediately following this agenda

13 review, there's an opportunity for anybody that

14 wishes to, to make opening remarks, brief summary

15 remarks here at the outset about issues that

16 matter to you.

17 Following that, we're going to hear the

18 purpose of the public meeting and regulatory

19 authority and rulemaking overview. We'll move

20 from there directly into market and technology

21 assessment and screening analysis. We'll take a

22 break midmorning around about 10:15 or so. Then,

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1 engineering analysis followed by markups, energy
2 use characterization, lifecycle cost and payback
3 period analysis.

4 We'll take lunch around about noon or
5 so, describe any details surrounding that as
6 necessary when we get there. Returning from
7 lunch, lifecycle cost and payback period analysis
8 and then national impact analysis, shipments and
9 regulatory impact analysis. We intend to take a
10 break around about 2:15 or so and then - or
11 whenever we get there - manufacturer impact
12 analysis, environmental impacts and indirect
13 employment impacts.

14 And then, at the end of the day, yet
15 another opportunity for closing remarks, any
16 issues that anybody wishes to raise that they
17 don't think have been covered sufficiently during
18 the course of the day. As the agenda reflects, we
19 expect we'll be adjourning today no later than 4
20 o'clock.

21 I'd ask for your consideration. Please
22 speak one at a time. If you would, say your name

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1 for the record each time you speak; you've already
2 gotten used to turning the microphones on and off.
3 There'll be a complete transcript of this meeting
4 made available. If you could, be concise and
5 share the airtime. If you haven't done so
6 already, please turn your cellphone on silent mode
7 and if you can limit the sidebar conversations,
8 that'd be helpful.

9 Webinar participants, we welcome you.
10 The Department of Energy is trying very hard to
11 make these meetings totally accessible.
12 Especially it's useful on a day like this when the
13 federal government opens late and travel is
14 perilous. Please turn your phones on mute if you
15 would and raise your hands in the software
16 provided to be recognized to speak. It's been
17 working pretty well here recently. So if you wish
18 to speak, we'll unmute you and you can speak and
19 we ought to be able to hear you in the room. So
20 you can participate in this conversation, you can
21 follow the slides on your computer.

22 And I would also just encourage everyone

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1 including everyone joining us via the Web to
2 please submit written comments following today's
3 meeting. The department benefits by having
4 detailed written comments on all these matters,
5 and timely if at all possible; so we appreciate
6 you doing that. And then we'll go to the purpose
7 of the public meeting; John Cymbalsky?

8 MR. CYMBALSKY: Thanks, Doug. This is
9 John Cymbalsky, from DOE. Okay, our purpose of
10 the public meeting. As I look around the room, we
11 have attendees here who are used to this by now,
12 so I'm not sure I'm going to read through all
13 this. But in a nutshell, we're going to present
14 our results from our proposal for commercial warm
15 air furnaces and, again, we can't say this enough.
16 Let's get a good dialogue going with lots of
17 comments as we go through our analysis here.

18 Okay, so we're going to just open it up
19 now for opening remarks. Those who wish to say a
20 few words about the proposal for commercial warm
21 air furnaces, now's your chance.

22 MR. BROOKMAN: Comments here at the

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1 outset? No? None at the time. Okay, then --

2 MR. CYMBALSKY: Any on the webinar?

3 MR. BROOKMAN: Then I think we'll

4 proceed with the content, moving to regulatory

5 authority.

6 MR. CYMBALSKY: Okay. Thanks, Doug.

7 Still John Cymbalsky at DOE. Okay, so as we

8 probably all know by now, DOE's regulatory

9 authority for most appliances traces back to the

10 Energy Policy and Conservation Act of 1975. There

11 were also updates throughout the years including

12 EPCA 1992, which is what added commercial warm air

13 furnaces as a type of covered equipment.

14 The statute at this time also set

15 initial standards for commercial warm air

16 furnaces. EPCA also directs DOE to consider

17 amending existing federal energy conservation

18 standards for commercial warm air furnaces

19 whenever ASHRAE amends the levels in 90.1. So,

20 further into the timeline on updates to EPCA, EISA

21 2007 and the American Energy Manufacturing

22 Technical Corrections Act amended EPCA to require

1 that every six years the secretary publish either
2 a Notice of Determination that standards do not
3 need to be amended for, in this case, commercial
4 warm air furnaces, or a Notice of Proposed
5 Rulemaking that includes new standards. And so,
6 that's what we have here today.

7 AEMTCA also required that DOE consider
8 amended energy conservation standards for
9 equipment for which more than six years had lapsed
10 since the most recent energy conservation standard
11 for this product. And so, that's the authority
12 under which we're acting here today.

13 Definitions: So, EPCA defines a warm air
14 furnace as a "self-contained oil or gas-fired
15 furnace designed to supply heated air through
16 ducts to spaces that require it and includes
17 combination warm air furnace/electric air
18 conditioning units but does not include unit
19 heaters and duct furnaces", and you can see the
20 citation to the Code.

21 DOE further defines a commercial warm
22 air furnace as "a warm air furnace that is

1 industrial equipment and that has a capacity as
2 rated by maximum input of 225,000 Btu per hour or
3 more", and you can see the citation in the Code of
4 Federal Regulations.

5 And then, for the scope, this rulemaking
6 covers self-contained gas-fired and oil-fired warm
7 air furnaces that supply heated air through ducts
8 with input ratings above 225,000 Btu per hour. It
9 includes commercial warm air furnaces that are
10 designed for makeup air heating and it also
11 includes combination warm air furnace/electric air
12 conditioning units, but does not include unit
13 heaters or duct furnaces.

14 Regulatory history: Equipment classes
15 were established by EPACT in 1992. It divided the
16 products into two classes; gas and oil-fired
17 units. The current minimum standards were
18 established by EPACT with an effective date of
19 January 1, 1994 and the thermal efficiencies are
20 listed below: 80 percent for gas-fired commercial
21 warm air furnaces, and 81 for oil.

22 Test procedure and efficiency metric,

1 the test procedure is in the CFR, and it's a
2 uniform test method for the measurement of energy
3 efficiency of commercial warm air furnaces. It
4 incorporates ANSI standard Z21.47-2006, also the
5 UL standard 727-2006, and ASHRAE standard 103-
6 1993. The efficiency metric for commercial warm
7 air furnaces is thermal efficiency, which equals
8 100 percent minus the percent flue loss determined
9 using the testing procedure prescribed under 10
10 CFR 413.76.

11 Okay, as we probably all know by now, in
12 evaluating whether or not new standards are
13 justified, DOE has its seven EPCA factors that it
14 considers. They are listed here and we will go
15 through all these analyses over the course of the
16 day. And here we are at the proposal stage, or
17 the NOPR stage, and you can see the chevrons
18 indicating the analysis that went into the
19 proposal here today and we will go through each
20 and every one of these as we go through the day.
21 Okay, with that, if there are no questions, we're
22 going to move on to Adam Darlington to present the

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1 market and technology assessment and screening
2 analysis.

3 MR. HARVEY: Have you been trained up on
4 that?

5 MR. DARLINGTON: I have not. I'm trying
6 to figure out how to work this.

7 MR. CYMBALSKY: Oh, just to the right.

8 MR. DARLINGTON: To the right?

9 MR. CYMBALSKY: Yeah.

10 MR. DARLINGTON: And then, is this is a
11 -- do we have like a little pointer.

12 MR. CYMBALSKY: Yeah.

13 MR. DARLINGTON: It's not pointing. All
14 right, well -- yeah, it's not going on the screen
15 though. I guess I'll do without. All right, well
16 anyways, good morning, everyone. Adam Darlington
17 with Navigant. So I'll be taking us through the
18 market and technology assessment and the screening
19 analysis and the engineering analysis.

20 So the market and technology assessment,
21 here we have the purpose and methodology for this
22 particular portion of the analysis. So the market

1 and technology assessment -- the market assessment
2 develops a quantitative and qualitative
3 characterization of the commercial furnace
4 industry, basically looking at manufacturers,
5 market shares, regulatory and non-regulatory
6 programs, historical market information; that type
7 of information.

8 The technology assessment develops a
9 list of potential technologies for improving the
10 energy efficiency of commercial furnaces and the
11 sources for these are all outlined in the TSD
12 chapter three. It's based on a variety of
13 publicly available information sources.

14 Okay, and so this slide is basically a
15 quick overview of the type of products we're
16 talking about here. So the majority of the market
17 for commercial furnaces are gas-fired commercial
18 furnaces. And typically these units are packaged
19 with the commercial air conditioning system
20 generally installed on rooftops. And so, as you
21 can see on the slide, it says "primarily installed
22 outdoors, supplies heated air to commercial

1 buildings via ducts." Most are manufactured in a
2 single package as I just said, and they are
3 weatherized, meaning they are designed to be
4 installed outdoors.

5 Oil-fired commercial furnaces are a much
6 smaller portion of the market. They are generally
7 not packaged -- actually I think always the models
8 that we identified were never packaged with a
9 central AC -- an air conditioning component. And
10 they're generally intended for indoor
11 installation. So they're non- weatherized.

12 And so, as the slide says, DOE
13 identified four major manufacturers and nine
14 manufacturers with relatively smaller market
15 shares.

16
17 This slide is sort of a snapshot of the
18 models distribution. So DOE developed a database
19 based on the AHRI directory; and also for non-AHRI
20 members, DOE looked at product listings on
21 manufacturer websites. And DOE basically
22 maintained the existing equipment class breakdown

1 into gas-fired and oil-fired. And so, on this
2 slide we're showing -- you can see the first two
3 columns, we're looking at 95 percent of the models
4 being gas-fired compared to 5 percent being oil-
5 fired. And then we also, just for informational
6 purposes, are looking at non-weatherized versus
7 weatherized. As you can see there, about tenfold
8 weatherized models to non-weatherized for the gas-
9 fired and then for the oil-fired they were all
10 non-weatherized. And keep in mind this is just
11 distribution of models. So actual unit sales or
12 shipments might be even more skewed in one of
13 these directions.

14 So the big -- one of the big things that
15 comes out of the market assessment is this, you
16 know, we look at the efficiencies of models on the
17 market. It kind of gives us a starting point, what
18 levels we're going to look at in the engineering
19 analysis. So, as you can see on this slide we're
20 looking at, the current federal minimum standard
21 is 80 percent. There are a lot of models at the
22 baseline. Still a good number at 81 as well, and

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1 then a few are at 82, and then just a handful
2 there at the condensing levels about 90 percent
3 and then nothing between 82 and 90 which, as you
4 all probably know, is the near- condensing range.

5 MR. RAY: Question.

6 MR. BROOKMAN: Please, Mike?

7 MR. RAY: Mike Ray, with Lennox. The 90
8 and 92 percent, do they fall into the above
9 225,000 Btu range?

10 MR. DARLINGTON: They are above the
11 225,000, yes. And so, I don't know if you caught
12 it in the scope section, but this rulemaking
13 includes makeup air units. And so, these are
14 actually smaller manufacturers of makeup air
15 units, yeah. So they're not what you would think
16 of as a conventional --

17 MR. RAY: What'd you call them again?

18 MR. DARLINGTON: Makeup air, yeah.

19 MR. RAY: Okay.

20 MS. HOOTMAN: [Off mic] -- outside air
21 units.

22 MR. DARLINGTON: Yeah, and then so this

1 slide shows the oil-fired efficiency distribution.
2 And again, so the baseline is 81 percent and
3 that's the current federal standard. Most of the
4 models, you know, are at 82 percent with a couple
5 down there at 92 as well. And again, you know,
6 obviously a much smaller market and fewer models
7 than we saw for the gas.

8 And so, the other big part of the market
9 and technology assessment is the technology
10 assessment, and again as I stated earlier, the
11 goal is to develop a preliminary list of
12 technologies to improve the efficiency of
13 commercial furnaces. So DOE looked at a variety
14 of sources, reviewed manufacturer literature,
15 manufacturer brochures, spec sheets, took the
16 comments and inputs from stakeholders, discussions
17 during manufacturer interviews, and also
18 information gained during tear-down analysis and
19 we looked at all of these things to identify the
20 technologies that could be incorporated or are
21 currently incorporated to improve the efficiency
22 of commercial furnaces.

1 And this brings us to the list shown on
2 this slide, where a number of technologies were
3 identified, and all of these are defined and
4 described in chapter three of the TSD. But
5 basically I would just say that this is sort of
6 the initial entire list. So just because
7 something's on this list doesn't mean that it's
8 necessarily driving any of the analysis. We'll
9 talk about it in the screening analysis and the
10 engineering analysis which of these technologies
11 were actually implemented and which were screened
12 out and which were not considered for other
13 reasons.

14 And so, here we're coming to our first
15 request for comment. Basically we are seeking
16 comment on the proposed equipment classes. We
17 note here in particular there's a question of
18 whether there's a need for separate classes for
19 non-weatherized and weatherized commercial
20 furnaces. And I guess just a little bit of
21 background on that point. So the question kind of
22 relates to whether there are any reasons to have

1 separate product classes for them and I know that,
2 you know, we look at certain technology options
3 that may be more proven in non-weatherized, the
4 obvious example being condensing. But it's such a
5 small portion of the market, it's really unclear
6 if there would be too much benefit, so we're
7 seeking comment on that.

8 Also seeking comment on the technologies
9 identified, primarily whether DOE missed any
10 technologies, whether technologies are out there
11 that weren't included that possibly should have
12 been included and then also just generally on any
13 part of the market and technology assessment we're
14 seeking comment. So with that, do you want to
15 take it away, Doug?

16 MR. BROOKMAN: Thank you. Comments
17 here? You see the comment boxes, the request for
18 comment. Harvey Sachs?

19 MR. SACHS: This is Harvey Sachs with a
20 question. Are the hundred percent makeup air
21 units differentiated enough to warrant
22 consideration of a separate product class for them

1 or would that just lead to people doing some
2 submarining by adapting conventional units to
3 provide that function?

4 MR. DARLINGTON: Yeah, I mean, I guess
5 that's a question for maybe the manufacturers,
6 whether you're aware of any significant
7 differences. I mean, we did tear-down analysis.
8 We looked at outdoor air units. We looked at
9 conventional packaged units. You know, overall
10 the functionality I think is very similar,
11 obviously the big difference being that the
12 outdoor air, the makeup air units bring more than
13 just return air. They bring in outdoor air. So
14 as far as, you know, big design changes, you know,
15 I guess I'm not aware of anything that would maybe
16 drive it. But maybe the manufacturers could maybe
17 speak to some of the concerns if there are any.

18 MR. SACHS: Presumably the makeup --
19 hundred percent makeup air units or outdoor air
20 units would be missing a damper and a duct stub
21 for the return air.

22 MR. DARLINGTON: Well, sure. But I mean

1 --

2 MR. SACHS: So the question -- I think
3 it's appropriate for the manufacturers --

4 MR. BROOKMAN: Louder, Harvey.

5 MR. SACHS: I think it's an appropriate
6 question for the manufacturers whether these might
7 warrant a separate class.

8 MR. DARLINGTON: Yeah, certainly if
9 there's going to be any difference in how the
10 efficiency can be improved as compared to other
11 types of commercial furnaces.

12 MR. BROOKMAN: Thank you, Adam. Jill?

13 MS. HOOTMAN: Jill Hootman, Trane. So a
14 gas furnace in a makeup air unit versus a
15 conventional package air conditioning system that
16 has a heating -- gas heating system, for all
17 intents and purposes really that gas furnace in
18 that makeup air unit can be tested the same as far
19 as the furnace. It certainly can be tested in the
20 same standard, Harvey. So I think that as far as
21 the test for its efficiency it's the same.

22 Now, whether you design those units in

1 their application the same is another whole
2 question. They're certainly not designed the same.
3 The fan systems are different. Cabinet strength
4 and durability is different. Cabinet sizing is
5 different. So you don't design them because one is
6 for comfort conditioning and one is literally for
7 just ventilation and taking that outside air and
8 making it more comfortable for an air conditioning
9 system sometimes to condition on top of that. So
10 they're definitely two different utilities for how
11 they're used.

12 MR. BROOKMAN: Thank you. Mike, do you
13 have a comment? No?

14 MR. RAY: Mike Ray, with Lennox. The
15 hundred percent outside air unit; it traditionally
16 is a significantly larger cabinet and that's one
17 of the differences. The mainstream gas electric,
18 if you will, are significantly smaller and don't
19 take into account all the various things that are
20 necessary as you design a hundred percent outside
21 air unit. So there are significant differences
22 between just a regular HVAC gas electric unit and

1 a hundred percent outside air unit.

2 From a cooling standpoint, your coils
3 are significantly bigger, et cetera. But overall,
4 the gas heating component is just -- you know, I
5 mean, getting to 90 percent, I understand now the
6 -- who had 90 percent and where it was applied.
7 In general you don't see that in a commercial
8 arena.

9 MR. BROOKMAN: I don't think we've
10 received any comment yet about whether separate
11 equipment classes are needed. Jill?

12 MS. HOOTMAN: Jill Hootman, Trane. I
13 think what might be good here is what does the
14 department feel defines a product class? I mean,
15 in our eyes, these are different applications.
16 They're designed differently when we design them.
17 So we approach them totally differently. But that
18 doesn't mean that that's the definition by which
19 the department defines a product class. So maybe
20 an explanation of product class might be
21 appropriate.

22 MR. BROOKMAN: Uh-huh, or Adam, maybe

1 you can start with the actual illustration here.

2 MR. DARLINGTON: Well, so the -- sorry,
3 the illustration?

4 MR. BROOKMAN: Go ahead. Keep going.

5 MR. DARLINGTON: Well, I was going to
6 say that there are statutory criteria for
7 establishing product classes, which is what I
8 think Eric is looking into right now. So you
9 know, I know it's capacity.

10 Do you have the -- so according to the
11 statute, we have the secretary can establish
12 separate equipment classes if the secretary
13 determines that the covered products within such
14 group, A) consume a different kind of energy from
15 that consumed by other covered products within
16 such type, B) have capacity or other performance-
17 related feature which other products within such
18 type (or class) do not have and such feature
19 justifies higher or lower standard from that which
20 applies (or will apply) to other products within
21 such type (or class). And I believe that's it.
22 Yeah, that's all.

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1 MR. SACHS: The term -- this is Harvey.
2 The term utility does not find itself in the
3 definition, different utility.

4 MR. DARLINGTON: A performance
5 characteristic I think was the term.

6 MR. CYMBALSKY: This is John, from DOE.
7 So I mean, to me the consumer is demanding warm
8 air and both are delivering the warm air. So I
9 don't know if a consumer would get any additional
10 utility from the warm air from a makeup unit
11 versus the more conventional one, my personal
12 opinion.

13 MR. BROOKMAN: Mike Rivest?

14 MR. RIVEST: So just from a practical
15 application from product classes and other
16 rulemakings, the thing that's guided DOE in the
17 past has been, you know, can this product achieve
18 the same AFUE values without risking that standard
19 set for one class would render that product non-
20 available. So for example -- so if the standard -
21 - if the standard were set for a regular
22 commercial furnace and at an AFUE that would

1 result in non-availability of gas packs, like a
2 bare unit, for example, that would definitely, you
3 know, create automatically a trigger for a
4 separate product class.

5 MR. SACHS: So Mike --

6 MR. RIVEST: Now, in this case, you
7 know, it's -- you know, is there something
8 inherently different about the gas product itself
9 and the AFUE.

10 MR. SACHS: Yes.

11 MR. BROOKMAN: Harvey Sachs, go
12 ahead.

13 MR. SACHS: This is Harvey and what
14 caught my attention is several things. First of
15 all, an existence proof that we do have condensing
16 makeup air units available in the market. So
17 they're clearly to some degree --

18 MR. RIVEST: That only proves that --
19 you'd say, you know, those units consume a lot of
20 energy, right? So there's an economic argument.
21 But you know, the product class is not an economic
22 argument.

1 MR. SACHS: Let me continue my mental
2 meandering please.

3 MR. RIVEST: Okay.

4 MR. SACHS: This is Harvey. We do have
5 an existence proof. It is a type of equipment
6 that gets special designs, as Mike and Jill have
7 told us, larger coils, for example. It is a
8 definite purpose class of equipment and I would be
9 the first to admit that the general body of
10 commercial gas furnaces incorporated in RTUs is
11 not yet ready for a condensing furnace. But given
12 the large amount of energy each of these large
13 units consumes or transforms and the existence of
14 products that comply with condensing on the
15 market, my question was simply should it be
16 considered for a separate class. Thank you.

17 Excuse me, one more thing. My memory is
18 short and I forgot about John's comment. I don't
19 see the RTU with return air and the dedicated
20 outdoor air makeup unit as being -- as providing
21 the same immunity to some extent there's an
22 application difference that the hundred percent

1 unit is more likely to be applied in a different
2 system, a dedicated outdoor air system than a
3 mixed air chiller-based or unitary -- large
4 unitary equipment.

5 So the one is providing an essentially
6 ventilation-targeted service and bringing the
7 temperature and sometimes the humidity of the
8 makeup air into a range that can be handled by the
9 terminal units in a DOAS system whereas the other
10 is doing a hundred percent of the work all in one
11 box. That is the conventional RTU with gas pack.
12 So there is conceptually to me a significant
13 difference in the applications. They're not both
14 just providing warm air. In particular, the
15 hundred percent makeup might be providing so-
16 called neutral air.

17 MS. HOOTMAN: Exactly.

18 MR. BROOKMAN: So are you advocating
19 a separate product equipment class?

20 MR. SACHS: I am -- this is Harvey. I
21 am strongly advocated -- advocating that we look
22 at that question because of the differences in

1 utility.

2 MR. BROOKMAN: Okay.

3 MR. SACHS: I don't have an answer. I
4 don't have enough data. Thank you.

5 MR. BROOKMAN: I didn't think I'd
6 heard it yet.

7 [Laughter.]

8 MR. BROOKMAN: Jill, do you have an
9 additional comment here?

10 MS. HOOTMAN: Well, yeah. I would just
11 -- Jill Hootman, Trane. I would support what
12 Harvey has said. It definitely has a different --
13 it definitely has a different use in the building.
14 It doesn't always. In my mind, I would say a
15 makeup air unit is not necessarily a comfort
16 conditioning. It is not providing the comfort
17 conditioning. It's providing room-neutral and
18 then another system is taking care of the actual
19 comfort conditioning.

20 So yes, there are applications. I would
21 agree, Mike. There are applications that have an
22 exorbitant temperature difference it has to

1 overcome and with a hundred percent outside air.
2 So yes, it is burning quite a bit of gas in some
3 applications. I'm sure that northern Minnesota
4 and parts of this country are, you know --

5 MR. RIVEST: Yeah. I'm not making a
6 case for or against. I was just saying if you
7 could not reach it, the same AFUE, then definitely
8 it would warrant a separate product.

9 MS. HOOTMAN: Yeah. So when I look at
10 those -- when I look at energy --

11 MR. BROOKMAN: So that was Mike
12 Rivest. Now back to Jill. Go ahead.

13 MS. HOOTMAN: Yeah, sorry. When I agree
14 when I look at energy and capacity, I mean, the
15 designing of that heat exchanger is pretty much
16 similar I would say and it can be tested to the
17 same test conditions for sure. So I'm not so
18 sure. I'm sitting here on the fence really saying
19 that there is a different product class or not.

20 MR. RIVEST: So what's the product
21 definition?

22 MR. BROOKMAN: Mike, say it again

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1 please.

2 MR. RIVEST: What is the product
3 definition?

4 MR. BROOKMAN: Adam?

5 MS. HOOTMAN: It's just a furnace that -
6 -

7 MR. RIVEST: It doesn't get into space
8 conditioning versus --

9 MS. HOOTMAN: No.

10 MR. CYMBALSKY: What is the range of
11 efficiency of these things?

12 MS. HOOTMAN: Eighty to 90.

13 MR. CYMBALSKY: It is the whole range,
14 okay.

15 MS. HOOTMAN: Yeah. Oh, makeup air?

16 MR. CYMBALSKY: yeah, the makeup air.

17 No, no the makeup air, so it will span that whole
18 range.

19 MS. HOOTMAN: yeah. The packaged units
20 do not, okay?

21 MR. CYMBALSKY: Correct.

22 MS. HOOTMAN: The packaged air units do

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1 not.

2 MR. CYMBALSKY: I got that one. It's
3 just the makeup airs.

4 MR. BROOKMAN: Okay, thank you, Jill.
5 Daniel Arnold? We're going to unmute your phone,
6 Daniel. Let's hope we can hear you in the room.

7 MR. ARNOLD: Okay. Can you hear me?

8 MR. BROOKMAN: Yes, you sound good.
9 Keep going.

10 MR. ARNOLD: Okay. I'm with -- well,
11 I'm getting terrible echo on my end, sorry.

12 MR. BROOKMAN: Yeah, thank you.
13 We're getting reverb here in the room.

14 MR. ARNOLD: Yeah, let me try and -- can
15 you hear me now?

16 MR. BROOKMAN: Yeah. Okay, try it.

17 MR. ARNOLD: Hello?

18 MR. BROOKMAN: Yes, you sound good.

19 MR. ARNOLD: Okay. Sorry about that.

20 We had two phones going. Yeah, this is Dan
21 Arnold. I'm with Nortek Global HVAC, formerly
22 Nordyne and we do make makeup air units and I

1 would just advocate to keep them in the same
2 class. I just don't really see the justification
3 for a separate class. I've been listening to the
4 discussion and, you know, as was mentioned,
5 they're essentially following the same test
6 procedure more or less to determine the steady-
7 state efficiency.

8 The heat exchanger, air burners, et
9 cetera, the technologies are similar to, you know,
10 a standard warm air furnace. So to put -- you
11 know, I just don't see the need for a separate
12 class and to go through that extra analysis.

13 MR. BROOKMAN: Okay. Thanks, Dan.
14 And for those of you joining us via the Web, we've
15 confirmed that this Web feature works for those of
16 you who wish to join us and speak. So please feel
17 free to do so. You see the comment box listed
18 here. Any additional comments before we move on?
19 Okay, we're moving on.

20 MR. DARLINGTON: All right. This is
21 Adam Darlington again. So I'll take us through
22 the screening analysis. The purpose of the

1 screening analysis, as I alluded to previously, is
2 to basically remove from consideration designs
3 that are -- I guess they're not yet quite ready to
4 be considered. So here on the slide we show the
5 four criteria for screening and they are
6 technological feasibility; practicability to
7 manufacture, install and service; adverse impacts
8 on equipment, utility or availability to
9 customers; and adverse impacts on health or
10 safety.

11 And then, we also note that DOE would
12 only look at efficiency levels that can be
13 achieved using proprietary designs if there were
14 also non-proprietary technologies capable of
15 achieving the same efficiency although I don't
16 think that really came into play too much here.
17 And then, the last bullet, DOE also removes from
18 consideration any technologies that don't affect
19 the energy consumption or I guess actually the
20 energy efficiency as measured by the Department of
21 Energy test procedure.

22 So chapter four is the TSD chapter that

1 corresponds to the screening analysis and it lays
2 out a lot of the justification for all of these.
3 But here you can see that we screened out several
4 technologies. A number of technologies were
5 removed because they would not affect the
6 efficiency as rated by the DOE test procedure,
7 which rates the thermal efficiency. So it's an
8 active mode test and it's actually very much like
9 a combustion efficiency test where it's actually
10 just 100 percent minus flue losses. So as you can
11 see, there were a number of technologies that
12 wouldn't really have an impact on the thermal
13 efficiency, or would have a very tiny impact. So
14 they weren't really considered further.

15 And then this next slide -- so we also
16 removed condensing -- or, sorry, concentric
17 venting which is generally only applicable in non-
18 weatherized installations because most of these
19 were, you know, as I said earlier, are weatherized
20 and also there's not a great deal of information
21 on the efficiency benefits as far as commercial
22 furnaces. So sort of the key takeaway from this

1 slide is the technologies that were primarily
2 considered in the engineering analysis and they
3 all related to the heat exchanger.

4 So we had the addition of secondary or
5 condensing heat exchanger which would allow you to
6 get, you know, up into the 90-plus range.
7 Increased heat exchanger surface area; that was
8 primarily used, you know, looking at the non-
9 condensing, how to improve the efficiency of
10 those. And then we also took a closer look at the
11 incorporation of the heat exchange surface
12 features such as dimples, also internal features
13 such as baffles and turbulators.

14 And so, that was just kind of a quick
15 run-through of the screening. Here we're
16 inviting comments generally on the screening
17 analysis, you know, whether there are comments
18 about any of the technologies that were in or out.
19 And then, item 2-3, specifically we're asking
20 about the potential for the lessening of product
21 utility or unavailability of product types for any
22 -- you know, any of the commercial furnaces

1 meeting the proposed standards which would be at
2 82 percent, so would there be any issues with the
3 levels and the technologies considered. So with
4 that, I'll let Doug go from there.

5 MR. BROOKMAN: Okay. Harvey Sachs?

6 MR. SACHS: I'm embarrassed not to have
7 done more of my homework. But if you would return
8 to slide 15 for a second, because I think it's
9 germane. That's test procedure and efficiency
10 metric. Oh, this is Harvey Sachs. Does ANSI
11 standard Z21.47-2006 look like the AFUE test or
12 does it look like a steady state?

13 MR. DARLINGTON: It's a steady-state, a
14 steady-state thermal efficiency test.

15 MR. SACHS: A steady-state thermal
16 efficiency.

17 MR. DARLINGTON: Yeah, except again,
18 sorry, it's called a thermal efficiency test.

19 MS. HOOTMAN: Everyone keeps using AFUE
20 and that's not right.

21 MR. DARLINGTON: Yeah. Well, even then,
22 so the thermal efficiency test, I think that we're

1 all familiar with, would include the jacket losses
2 and that's not included.

3 MR. SACHS: Well, then returning from
4 that to slide 28, we see that the department has
5 given great consideration to the move from EER,
6 which is for air conditioners an analog to thermal
7 efficiency, to an IEER following the lead of
8 ASHRAE and I guess I'm disappointed considering
9 the duty cycle of most commercial equipment that
10 we haven't seen a parallel push toward the
11 adoption of an IEER-like rating that would give --
12 de facto give credit to two-stage modulating
13 capacities since we have seen their benefits even
14 in DOE rulemakings on the residential side. I
15 think this is something for which we all bear some
16 responsibility for negligence. We didn't beat you
17 up and you all didn't propose it. But it is a
18 route by which you can get to significant
19 decreases in energy utilization. End of rant.

20 MR. BROOKMAN: Jill?

21 MS. HOOTMAN: So Harvey, I understand
22 what you're saying. I guess I do want to say that

1 the nature of heating in most of this country for
2 comfort conditioning in commercial buildings is
3 one of morning warm-up and then you may never have
4 the heater on again.

5 MR. SACHS: Good point.

6 MS. HOOTMAN: So you know, that -- I am
7 generalizing here. Obviously there are
8 applications for two stages and we make them and
9 modulating burners and we make them. But they are
10 usually a combination of a higher outside air
11 combination. So they're trying to do a dual
12 purpose with the outside -- you know, significant
13 outside air, whether that's a hundred percent or a
14 50 percent rate or whatever it might be, you know,
15 it's a little bit higher. It's compensating for
16 the outside air effect. But you know, in general,
17 even in the northern parts of the country, you are
18 still just morning warm-up and then the internal
19 loads tend to take over in a commercial building.

20 MR. SACHS: Harvey Sachs, again. Point
21 well taken, Jill --

22 FEMALE: Mic, please.

1 MS. HOOTMAN: He thought he hit it.

2 MR. SACHS: I'll be more aggressive with
3 the mic later. Point well taken, Jill. This is
4 Harvey, and I guess that I'm still thinking that
5 on all but the peak days, I may be able to benefit
6 from that more lightly loaded heat exchanger and
7 particularly in these situations -- well,
8 particularly in these situations where I'm doing
9 warm-up of an unoccupied building and not having
10 to deal with massive quantities of outside air.
11 So I think it is something that should be
12 considered by the department and that I didn't
13 push it. Nobody else pushed it. But I think it's
14 -- as we move forward, it certainly ought to be on
15 the bucket list for revising the standard.

16 MR. BROOKMAN: Okay. Michael McCabe?

17 MR. MCCABE: This is Michael McCabe.
18 Question for you, Adam, kind of to go back to the
19 questions on the makeup air and also the screening
20 analysis. Looking at the chart that you had that
21 had the units achieved, the 90 and 92 percent
22 thermal efficiency were makeup air units?

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1 MR. DARLINGTON: That's right, yes.

2 MR. MCCABE: Looking at the design
3 options that come out of the screening analysis,
4 is it possible for the non-makeup air units, that
5 is, the rest of the units, to achieve the 90, 92
6 percent level with those technologies that are
7 being considered by the department?

8 MR. DARLINGTON: Did you want to answer
9 that?

10 MR. VON WENTZEL: I can take it.
11 Constantin von Wentzel. We believe so based on
12 our tear-down analysis and analysis of smaller,
13 residential units that are already on the market
14 that have that technology in them and it would
15 just be a matter of scaling it up to commercial
16 scale. But the technology is fundamentally the
17 same.

18 MR. BROOKMAN: Thank you. Jill?

19 MS. HOOTMAN: Jill Hootman, Trane. So I
20 would agree if that's all you were to look at. We
21 could probably make them in a commercial arena.
22 It will have way more impact on the installation

1 of that unit. And that's where I think we lose
2 utility and that's where I think we lose and have
3 issues with. While it is in some cases possible to
4 take that caustic condensate and bring it back
5 through the building, you will still have a gap in
6 the curb that is outside that would still need to
7 have heat tape or some kind of protection for
8 freeze protection on it that's not conditioned in
9 the curb.

10 So that's a possibility. And yet, even
11 bringing it down into the building, there are
12 definitely building codes that would not allow
13 that and where that caustic, you know, condensate
14 gets dumped into potable water systems, there's
15 codes against that as well. So I think there's a
16 significant barrier in the installation of these
17 systems. But I would not disagree in that we
18 could probably make a condensing furnace that fits
19 in most of these units.

20 Now, when you are getting up to -- this
21 has no upper end of Btus. When you're getting up
22 into the million and the 2 million Btu heat

1 exchangers that are made in packaged units, that's
2 another question. We don't -- I mean, they're
3 going to get so big and the secondary heat
4 exchangers are going to get so big that by the
5 time you design the fan to go across that, that
6 starts to get huge and significantly starts to
7 have an issue with replacement of existing systems
8 because that cabinet will be big. And we're
9 already the largest load that can go down a
10 highway in those units. So I think we start to
11 lose the ability to put that in, in some of those
12 units.

13 MR. BROOKMAN: Mike?

14 MR. RAY: I'd like to reinforce what
15 Jill just said about the size of the equipment.
16 Excuse me. As you add a secondary heat exchanger
17 to the cabinet, that then means you have to do
18 something to grow your cabinet to allow for that
19 secondary heat exchanger. That's one piece of it.
20 Physically, it has to get larger. The second
21 piece that goes along with that is the fan has to
22 increase because it's fighting the air of the

1 secondary heat exchanger, which then impacts the
2 efficiency of the unit itself.

3 Now I've got to put in a larger
4 horsepower motor and now I'm hurting my cooling
5 efficiency which is not being taken into account
6 in the calculation that we've got going. So, and
7 to Jill's point, as I grow into my larger cabinets
8 and we're getting now to the point where it is
9 reaching the point where we're going to have a lot
10 of flatbeds going down the road, you know, being
11 able to ship these units down the road is becoming
12 more and more challenging because we're increasing
13 efficiencies and as the cabinets grow, it makes it
14 more difficult to get them to transport down the
15 road. So there's a lot of challenges associated
16 with a simple thing of going to 92 percent
17 efficiency for gas heating. There's a lot of
18 impacts that aren't being taken into account.

19 MR. BROOKMAN: Okay, thank you.

20 Harvey?

21 MR. SACHS: Just a -- this is Harvey.

22 Just a clarification, Mike. My sense has been

1 that the real growth in the RTU industry has been
2 in what amount to almost -- well, to the very
3 largest capacities, the 60 tons, the 40 tons. We
4 probably don't have much difference in the
5 shipping challenges for 10-ton units. They're
6 bigger. You can't put as many of them on the
7 truck.

8 MR. RAY: Correct.

9 MR. SACHS: But they don't require
10 follow cars.

11 MS. HOOTMAN: Right.

12 MR. SACHS: So good. So it's really the
13 supplementing of built-up systems by packaged RTUs
14 in the largest capacities is where we're seeing
15 the problem.

16 MR. BROOKMAN: Jill?

17 MS. HOOTMAN: Yes. Sorry, yes. Jill
18 Hootman, Trane. But also remember, I mean, almost
19 60 percent of the business is replacement and so
20 if these units have gotten bigger, they no longer
21 replace themselves easily. So when we get to the
22 point, and I know we will talk about the

1 additional cost that that incurs, so you're right.
2 We start to lose, you know, the ability to put as
3 many on a truck. So our freight and then down the
4 road we'll also lose the ability to replace
5 ourselves. So it has the lessening of some of the
6 product utility.

7 MR. BROOKMAN: Robert Whitwell, we
8 would like to hear from you. You should be
9 unmuted now.

10 MR. WHITWELL: Okay, yes. Thank you.
11 This is Bob Whitwell from Carrier. Can you hear
12 me okay?

13 MR. BROOKMAN: You sound good.

14 MR. WHITWELL: Okay. So I just wanted
15 to expand on a point that Mike made earlier when
16 if we were to add the heat exchanger -- secondary
17 heat exchanger for condensing efficiencies in the
18 rooftop, he talked about the impact it would have
19 on the fan power.

20 And we have to keep in mind that we
21 would have that impact all year round. So it
22 would be not only impact the cooling efficiency

1 but we also would have that additional fan watts
2 during ventilation periods and also during the
3 heating periods.

4 MR. BROOKMAN: Okay. Thank you. Do
5 we have additional comments, perhaps final
6 comments on screening analysis, generally or
7 specifically? Nothing additional. Okay, then do
8 you want to take a break now or do you want -- how
9 long is the -- yeah, we'll keep going then.
10 Engineering analysis.

11 MR. DARLINGTON: Okay. This is Adam
12 Darlington with Navigant again. So here we see
13 the purpose of the engineering analysis is to
14 establish the relationship between equipment cost
15 and increased efficiency and the methodology for
16 this is to look at the efficiency level approach.
17 As I mentioned on the previous slide, we use the
18 efficiency information obtained from the market
19 assessment to select which efficiency levels to
20 look at, basically did reverse engineering, tear-
21 downs and cost modeling to develop estimates of
22 manufacturer production costs at each efficiency

1 point. We incorporated a number of sources,
2 equipment tear-downs and cost modeling
3 manufacturer interviews, equipment testing,
4 manufacturer product literature and certification
5 data.

6 So here was the first step in looking at
7 the efficiency levels that were going to be
8 analyzed. Basically we had the baseline, the max
9 tech which is the highest efficiency available and
10 the intermediate efficiency levels. So looking at
11 the gas-fired and the oil-fired, both of them were
12 doing pretty much all of the levels that are
13 available since we had so few. I think we didn't
14 do the 90 for the gas. But that was the only one
15 that didn't actually get included in this. So
16 this table shows a quick summary of which
17 efficiency levels we were looking at. This is
18 sort of a high level description of what happens
19 during the engineering analysis.

20 So after we got our efficiency levels,
21 we select models for tear-down, and try to be
22 representative of typical models on the market.

1 We conduct the physical tear-downs. In each
2 physical tear-down we catalog each individual
3 component of the furnace, measure it, weight it,
4 put it in a BOM spreadsheet and those BOMs act as
5 inputs for our cost model and the cost model, you
6 know, includes a lot of information about material
7 prices, fabrication processes, you know, labor
8 rates, things like that that would go into the
9 final part cost.

10 So once we get the cost estimate for
11 each component, they're summed with the cost
12 estimate for the furnace. We conduct manufacturer
13 interviews to further refine the inputs to the
14 cost model. And so, this slide basically shows
15 the breakdown of what we're looking at when we're
16 talking about these costs. So the full
17 manufacturer selling price is broken down into the
18 production cost and the nonproduction cost. Your
19 nonproduction cost is mainly SG&A, R&D and
20 interest. And we'll cover a lot of that later
21 when we talk about how we get to the manufacturer
22 selling price from the manufacturer production

1 cost.

2 It's important to note that the
3 production cost includes direct labor, direct
4 material and overhead. And so, this slide is just
5 a general description of how we try to go about
6 doing the engineering analysis. So the first step
7 is usually to develop a baseline MPC. Then we
8 would look at the design options and the
9 technology used to achieve each efficiency level
10 higher than the baseline and that would help us to
11 develop an efficiency pathway by which
12 manufacturers would be able to achieve higher
13 efficiency levels. Then we use the cost modeling
14 and the tear-down results to calculate the MPCs
15 for each efficiency level above the baseline and
16 generate the cost efficiency curve which is the
17 relationship between the MPC and the efficiency
18 level.

19 So this slide summarizes the design
20 options that we primarily looked at. As I alluded
21 to at the end of the screening analysis, we've got
22 basically going from 80 to 81 and from 81 to 82 in

1 the gas and then from 81 to 82 in the oil, looked
2 primarily at increasing the surface area for the
3 primary heat exchanger and then of course to get
4 to the max tech level in both cases we would need
5 to have the addition of the condensing secondary
6 heat exchanger as the primary design that drives
7 efficiency. And of course with that, you know,
8 you would have cabinet size increases and
9 condensate disposal components and things like
10 that. But we'll talk about that in a bit.

11 So this slide is just to hopefully make
12 the results of the engineering analysis a little
13 bit more clear. As I mentioned earlier, the gas-
14 fired units are typically packaged in a single
15 package with a commercial air conditioner. And
16 the gas-fired commercial furnace results, they
17 only include the cost of the furnace components.
18 They don't include the cost of the air
19 conditioning components. We did that to try to
20 normalize out any cost differences that might have
21 been caused by the air conditioning.

22 So the cost at the higher efficiency

1 level, as I said, only reflects the changes to the
2 furnace components. But they also do reflect the
3 changes that would be necessitated for instance by
4 the addition of a condensing heat exchanger. So
5 when we looked at the amount of cabinet space
6 available, we saw that the overall cabinet size
7 would need to increase to accommodate the
8 secondary heat exchanger. And so, that
9 incremental difference in cost was included in our
10 estimates.

11

12 And then lastly for the oil-fired, those
13 are -- as I mentioned, typically standalone units.
14 They're not packaged with an air conditioner. So
15 the MPC for those actually reflects the entire
16 unit cost rather than just a portion of the unit
17 cost. So now, this side --

18 MR. SACHS: Adam?

19 MR. DARLINGTON: Yes?

20 MR. SACHS: If we could go back to that
21 slide, this is Harvey.

22 MR. DARLINGTON: Yep.

1 MR. SACHS: Do we find that there's
2 essentially zero freestanding non-weatherized
3 commercial furnaces, gas-fired?

4 MR. DARLINGTON: No. There are some.

5 MR. SACHS: There are some. Are they 2
6 percent of the models or 10 percent of the models?

7 MR. DARLINGTON: It was about 7 percent
8 I think I showed on that earlier slide. So the
9 non- weatherized were standalone units, going back
10 to the slide I showed in the market assessment.

11 MR. SACHS: Okay. Thank you. I didn't
12 pick that up.

13 MR. DARLINGTON: Yeah. What slide is
14 that? Slide 21. Okay. So for the tear-down
15 analysis for the gas-fired units, DOE tested and
16 tore down two gas- fired units. One unit tested -
17 - or sorry, rated at 80 percent and tested at 82.
18 One rated at 82 and tested at 82. So basically
19 what happened with the engineering analysis is we
20 made an assumption based on the product
21 literature, based on the manufacturer feedback
22 during interviews about how the size of the heat

1 exchanger would change.

2 So we did the tear-down of the 82
3 percent and we estimated that about a 10 percent
4 increase in heat exchanger surface area gives you
5 a 1 percent increase in thermal efficiency. So we
6 used that estimate to sort of based on the tear-
7 down of the 82 percent back up the 80 and 81
8 percent thermal efficiency. And so, we modeled
9 the size difference of the heat exchanger based on
10 these assumptions to determine our MPC estimates.
11 And so, that's a little bit different I guess from
12 what we described with going from the baseline up
13 which is why I wanted to highlight that. But
14 essentially it leads to this. So this is our cost
15 efficiency curve for the gas-fired commercial
16 furnaces.

17 And as you can see down there in the
18 non- condensing range, you know, we're looking at
19 a 10 percent increase in heat exchanger material,
20 which is only translating to about \$5, \$6 at those
21 lower efficiency levels and then you see a really
22 big jump going up to condensing with the addition

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1 of the secondary heat exchanger with the
2 additional cost of expanding the outer packaging
3 and then also with the additional cost of the
4 condensate disposal components as well. And so,
5 again, just a reminder, those are -- that's for
6 the furnace components only. So that would not be
7 an entire packaged rooftop system per se.

8 And then, to the oil-fired, this one
9 would be standalone, as I mentioned. So that's --
10 this is for the entire unit. And again, looking
11 from 81 to 82, we're looking at about \$20 for heat
12 exchanger size increase and then 82 to 92, again
13 we're looking at condensing secondary heat
14 exchanger, expanding the outer jacket and
15 packaging. And then, so if we want to keep going,
16 after we get to MPCs, the next step is to go from
17 the MPCs to the MSPs which is the selling price
18 and we do that by applying manufacturer markup.
19 The markup is initially based on SEC 10K reports
20 from publicly-available, publicly-traded companies
21 that provide annual reports and information on
22 this.

1 And we calculate an industry average
2 markup based on market share weighting and then we
3 talk to manufacturers during our interviews about
4 the markup that we calculate. And if necessary,
5 we'll calibrate that based on manufacturer
6 feedback and so for this particular rulemaking
7 we're estimating a 1.31 markup for gas-fired
8 commercial furnaces and 1.28 for oil. And the end
9 result of the engineering analysis is the MSP.
10 And so, MSP as you can see on the slide, it equals
11 the MPC times the manufacturer markup plus the
12 shipping cost. So the manufacturer markup is
13 applied, the shipping cost is added and is not
14 marked up and that gives us the results shown on
15 this slide, as you can see how the MSP compares to
16 the MPC and it looks like we have a question.

17 MR. BROOKMAN: Joanna Mauer has a
18 question. Joanna, please speak.

19 MS. MAUER: Hi. This is Joanna Mauer
20 from ACEEE. I'm sorry. I wanted to just go back
21 for a minute to Harvey's comment about two stage
22 and modulating furnaces and ask a question which

1 is in applications where you are using heating
2 throughout the day, are there significant gas
3 savings in the field from two-stage or modulating
4 furnaces compared to single-stage units?

5 MR. BROOKMAN: Jill?

6 MS. HOOTMAN: I would not -- this is
7 Jill Hootman from Trane. I haven't done direct
8 analysis of that. But I would say from my
9 experience not as much significant savings as
10 you've seen in cooling for sure. You know, the
11 industry does make two-stage and modulating. Like
12 I said, it has been my experience that those are
13 from more customer demands about the fact that
14 they have higher outside air percentages. It's not
15 necessarily about saving.

16 It's just about making it more
17 comfortable instead of blasts of full heat
18 exchanger on and off. It's more of a soft way of
19 handling the midrange temperatures inbetween at
20 that higher outside air. So it's more of a
21 comfort need than it is a demand for saving
22 significant energy.

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1 MR. BROOKMAN: Joanna?

2 MS. MAUER: Thanks, Jill.

3 MR. BROOKMAN: Okay. Thank you.

4 Aniruddh Roy has a question or comment. Please,
5 Aniruddh?

6 MR. ROY: Thank you, Doug. So I just
7 have a question regarding the manufacturer
8 production cost, the incremental increase from 80
9 to the next levels. As far as I guess, you know,
10 you identify the increase in heat exchanger
11 surface area as being the design option that leads
12 to those changes or incremental increase.

13 So have you considered the cost of maybe
14 retooling in order to increase the heat exchanger
15 surface area as well as the cost that would be
16 incurred, let's say, to overcome any additional
17 pressure drops through the heat exchanger and
18 also, you know, to account for providing more
19 airflow across the heat exchanger.

20 And so, other components that may need
21 to be factored into that, is all that rolled over
22 into, let's say, an incremental \$10 cost from 80

1 percent to 82 percent?

2 MR. DARLINGTON: Yeah. So I mean, we
3 did a --

4 MR. BROOKMAN: Adam Darlington.

5 MR. DARLINGTON: Oh, sorry. Adam
6 Darlington. So I think we did look at what you
7 mentioned about, you know, the additional fan
8 power that would be needed to overcome, you know,
9 the additional pressure drop from maybe a larger
10 heat exchanger.

11 So when we looked into this issue, you
12 know, when we did the tear-downs, so from an
13 inducer fan side, we saw restrictor plates to
14 restrict the airflow. So we assumed that they
15 could just be made less restrictive and be a
16 relatively minor adaptation and so the inducer fan
17 wouldn't actually need to change.

18 And then, as far as the actual blower,
19 the assumption there was that it's more size based
20 on the system ductwork than on anything related to
21 the furnace and that's what we kind of -- the
22 conclusion that we came to when we looked at the

1 product literature is that a lot of times that's
2 driven more by the cooling side and more by the
3 system that it's actually going into than the
4 furnace components.

5 But we certainly welcome, you know, your
6 feedback as to whether that's your experience or
7 whether, you know, changes need to be assumed for
8 that.

9 MR. ROY: Okay.

10 MR. BROOKMAN: Jill?

11 MS. HOOTMAN: Do you have more,
12 Aniruddh? I don't want to interrupt you.

13 MR. ROY: No, Jill. Please, go ahead.

14 MS. HOOTMAN: So Jill Hootman, Trane.
15 So I've got a question. What you define as a
16 combustion blower or the fan for the space,
17 combustion blower is something that is blowing fan
18 -- you know, into the heat exchanger.

19 MR. DARLINGTON: Yeah. No, I didn't
20 mean to say combustion blower, if I did.

21 MS. HOOTMAN: Okay.

22 MR. DARLINGTON: So there's an inducer

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1 fan, right?

2 MS. HOOTMAN: Right, okay.

3 MR. DARLINGTON: And so, there's usually
4 a blower which is the return air to the building.

5 MS. HOOTMAN: Yeah, exactly. Okay, I
6 just wanted to understand what you were -- okay.

7 MR. DARLINGTON: Apologies if I
8 misstated, yeah.

9 MR. BROOKMAN: Additional thoughts,
10 questions, comments here? Bob Whitwell, please,
11 you are now unmuted we hope.

12 MR. WHITWELL: Yes. Thank you. This is
13 Bob Whitwell from Carrier. First, a question and
14 then a comment. So as I look at the technical
15 support document in the engineering section, I see
16 the \$5 that it cost to go from 80 to 81 and then
17 another \$5 roughly to go from 81 to 82. And it
18 appears that that analysis is all done on a
19 250,000 Btu per hour input, a heat exchanger,
20 which is basically at the lower end of the range
21 that DOE covers. The range has no upper end and
22 so we have gas heat sections that go up to 2

1 million Btu and beyond in the industry.

2 So my question to DOE and Navigant is
3 did you scale the cost based on input capacity or
4 did you use that same \$5 and \$10 independent of
5 the size of the heat exchangers?

6 MR. DARLINGTON: Yeah, this is Adam at
7 Navigant. So we do the analysis at a
8 representative capacity, as you pointed out, and
9 we -- the representative capacity was at 250,000.
10 And so, the assumption there is that serves as a
11 good point to judge the cost effectiveness. As
12 far as the engineering analysis goes, that's where
13 we stopped it. We didn't do any scaling at higher
14 or lower capacities. And I'll defer to the LBNL
15 team about whether that was included in the LCC,
16 if anything was done. Was that? No? Yeah, no.
17 So it's all based around the representative
18 capacity of 250,000.

19 MR. WHITWELL: Well, wouldn't you agree
20 that as you go up in heating capacity, the size of
21 the heat exchangers would grow and if you have to
22 increase the heat exchanger size by 10 percent or

1 20 percent, that the additional -- that the cost
2 would be much higher as you go up to larger sizes?

3 MR. BROOKMAN: Mike Rivest?

4 MR. RIVEST: Yes, absolutely. So you
5 know, in the selection of our representative unit
6 is meant to be -- you know, the economics are done
7 on that unit and then applied to the whole class.
8 The assumption is that the cost-benefit analysis
9 at 250,000 is representative of, say, the 1
10 million product class. So in this situation, the
11 cost of the product would go up but so would the
12 savings because the amount of energy used is a lot
13 greater. If you think there are reasons to
14 believe that those costs don't scale, you know, in
15 the same manner, then that's something that could
16 be looked at.

17 MR. BROOKMAN: Bob, you've still got
18 the floor.

19 MR. WHITWELL: Yeah, so I think that
20 that should be evaluated, whether there would be -
21 - whether that scaling would hold as you go up in
22 size and may have to add not just change the

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1 length but maybe add some additional heat sections
2 which would include additional inducer fans and
3 additional burners and gas valves.

4 MR. RIVEST: It would be helpful in your
5 comments if you like provided a capacity to us to
6 look at. So you know, maybe that could become a
7 second representative unit for us to look at.

8 MR. WHITWELL: Okay.

9 MR. BROOKMAN: Okay.

10 MR. WHITWELL: Okay.

11 MR. CYMBALSKY: This is John from DOE.
12 Do we have the market data on what's being sold
13 capacity-wise that would help? So I think the
14 250,000 is the common -- a common size. Do we
15 have another?

16 FEMALE: [Off mic]

17 MR. CYMBALSKY: Well, I'm not asking for
18 all the data. How about, you know, if we're going
19 to do two representative units, maybe if a million
20 is the right one, can we get some data on the cost
21 of the million and we can work with that?

22 MR. BROOKMAN: I don't know whether

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1 the manufacturers present can come gather that or
2 whether we need to rely on Aniruddh or somebody to
3 do a survey. He moved? Oh, sorry.

4 FEMALE: It would be Frank.

5 MR. BROOKMAN: Frank, okay. I can't
6 keep up with the movement. So thank you for the
7 request, John. Harvey Sachs?

8 MR. SACHS: Harvey Sachs. Referring to
9 slide 42, we have 1.31 as the markup inferred for
10 gas-fired commercial furnaces. How does that
11 compare with the markup inferred for commercial
12 rooftop air conditioners? I'm just looking for a
13 calibration.

14 MR. DARLINGTON: One moment. Chris is
15 looking up what was used for the commercial air
16 conditioners. It should be the same.

17 MR. LAU: Yeah, it's roughly the same.

18 MR. DARLINGTON: It's roughly the same.

19 MR. BROOKMAN: Chris Lau?

20 MR. LAU: Yeah. So for the -- this is
21 Chris Lau with Navigant. For the commercial air
22 conditioner rulemaking, there were a range of

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1 capacity sizes and the markups there ranged from
2 roughly 1.3 at the low end to 1.4 for the very
3 largest units.

4 MR. SACHS: Thank you. That's
5 reassuring about precision without stating
6 anything on accuracy. Thanks.

7 MR. BROOKMAN: Jill?

8 MS. HOOTMAN: Jill Hootman, Trane. But
9 agreed, Harvey, if we had that kind of range, I
10 mean, it's this kind of same range for these kind
11 of products. So maybe a flat 1.3, and I agree, we
12 need to possibly look at another size range and
13 let you know the distribution between those size
14 ranges, between the 250,000 and another size range
15 because the cost -- I believe the costs go up
16 exponentially versus the savings. But I'll have
17 to get those comments for you.

18 MR. BROOKMAN: You don't think they
19 scale just directly.

20 MS. HOOTMAN: No. It does not scale
21 directly.

22 MR. BROOKMAN: Harvey?

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1 MR. SACHS: Thanks. As I said, my
2 mental -- this is Harvey. My mental model is that
3 the manufacturer's processes are very similar
4 because the units are integrated and so I was just
5 looking to see that the inferred markups were
6 similar.

7 MR. BROOKMAN: Okay.

8 MR. SACHS: I should have done my
9 homework.

10 MR. BROOKMAN: Did you cover the
11 engineering analysis slide?

12 MR. DARLINGTON: Yeah, and we moved to
13 the comment slide.

14 MR. BROOKMAN: Okay. Let's proceed
15 with the presentation content.

16 MR. DARLINGTON: Okay. Yeah, so I mean,
17 I'd just --

18 FEMALE: Push the mic, please.

19 MR. DARLINGTON: Yeah. So this is Adam
20 again. So before we, you know, had those handful
21 of comments and that discussion, I was just
22 getting to actually the comment request slide. So

1 here we've got, you know, general request for
2 comments on the engineering analysis and in
3 particular we were looking for comment about the
4 efficiency levels analyzed, including the max tech
5 efficiency levels and specifically the 82 percent
6 thermal efficiency level.

7 And then we were also looking at --
8 looking for comment on the incremental
9 manufacturing costs above the baseline. And so, I
10 think we already had some discussion on that but
11 I'll turn it over to you, Doug.

12 MR. BROOKMAN: Yes. We've begun to
13 cover that. We welcome any additional thoughts or
14 comments related to these comment boxes. Jill,
15 please?

16 MS. HOOTMAN: Jill Hootman, Trane. I
17 think that we're ignoring an elephant in the room.
18 Eighty- two percent is condensing. It is
19 definitely condensing at parts of the operating
20 map. So I think we have to realize that we will
21 be developing not only aluminized but heavy-grade
22 aluminized and/or stainless steel heat exchangers

1 to meet an 82 percent, especially if we look at
2 lifetime reliability that we want to have on these
3 heat exchangers. So I think we've missed and our
4 comments will indicate that I think you've
5 miscalculated the amount of beefiness to the heat
6 exchanger that we'll have to make at 82 percent
7 because the operating map definitely has points
8 that condense.

9 MR. BROOKMAN: Okay. Thank you.
10 Mike?

11 MR. RAY: Mike Ray. I would say that I
12 would agree with Jill but with one exception and
13 that is she said to perhaps beef up the aluminized
14 steel heat exchanger. I would think that
15 everybody would be going to stainless steel at
16 that point. You're at a --

17 MS. HOOTMAN: I'm just being nice.

18 MR. RAY: Yeah. As it is, when you look
19 at it, when you're in the 80, 81, 82 range, you're
20 at a point in some areas where you have condensing
21 furnaces and that hurts the longevity of the heat
22 exchanger itself.

1 I think Roger Hunt from our company
2 submitted comments in the last round and he
3 pointed out and attached a picture of a heat
4 exchanger that had only been into -- installed for
5 three to five years and it was all rusted out.
6 And in certain areas of the nation, that's going
7 to be an issue.

8 MR. BROOKMAN: Okay. Thank you.
9 Yeah? Oh, thank you. Bob Whitwell, please.
10 You're unmuted.

11 MR. WHITWELL: Okay. Okay, thank you.
12 This is Bob Whitwell, Carrier. I just wanted to
13 go back to the comment previously about larger
14 heat exchanger not having an impact on the air
15 side resistance. As we know, when you go from a
16 straight air conditioner to a year-round air
17 conditioner with gas heat, the minimum efficiency
18 level drops by two-tenths of a point and that's to
19 account for the increase in internal losses in the
20 cabinet due to the heat exchanger and the fan
21 power that's required to overcome those losses.
22 So in a packaged rooftop unit, the gas

1 furnace can account for as much as 40 to 45
2 percent of the total internal losses in the
3 cabinet. So with that in mind, there is going to
4 be some increase in fan power associated to
5 increasing the heat exchangers by 10 to 20
6 percent. So just a comment. I know that the
7 assumption was that there would be none. The
8 reality is that there will be something and so
9 manufacturers will have to design to overcome
10 that.

11 MR. BROOKMAN: Okay. Doug Kosar,
12 you're next. Please speak.

13 MR. KOSAR: Can you hear me?

14 MR. BROOKMAN: Yes.

15 MR. KOSAR: Yeah. I was referring back
16 to a conversation five minutes ago, 10 minutes ago
17 regarding potential second size range to evaluate.

18 Based on some of my recent but limited
19 experience, there may be a point around 400,000
20 Btu per hour input where it may be common practice
21 to transition from a single furnace to two
22 furnaces in packaged equipment and that would be a

1 transition point where you'd see the additional
2 components associated with the second furnace, the
3 additional gas valve, inducer fan. That may be a
4 transition point where you may see a different
5 price regime.

6 MR. BROOKMAN: Okay. Thank you. Do
7 we have additional, perhaps final comments in
8 response to the comment boxes here, engineering
9 analysis? Adam?

10 MR. DARLINGTON: Yeah, and I guess we
11 just wanted to follow up about the comments
12 regarding the 82 percent level and the certain, I
13 guess, portions of the country where you would
14 experience condensing in the heat exchanger. I
15 guess what portion of the country would you
16 estimate that that is a problem for or is there
17 kind of a general region?

18 MR. BROOKMAN: Mike, you started with
19 this.

20 MR. RAY: Yeah, I'd have to do some
21 research to tie down exactly where it is. But I
22 am aware of certain areas of the country where

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1 we've witnessed that from our salesforce and not
2 necessarily on our equipment by the way.

3 MR. DARLINGTON: Okay.

4 MR. RAY: I'd just point that out.

5 MR. VON WENTZEL: Constantin von
6 Wentzel, Navigant, here. In particular, we would
7 appreciate comments in terms of your unit
8 shipments. It's not necessarily geographic area
9 but, you know, what percentage of your products
10 are affected by these kinds of areas where 82
11 percent in your estimation requires the use of
12 stainless steel heat exchangers.

13 MR. BROOKMAN: Okay. Any additional
14 thoughts or comments here before we take a break?
15 Let's take a break. It's 10:45. We'll break for
16 15 minutes, which means we'll resume right at
17 11:00. And we'll probably go a little bit past
18 noon before we break for lunch since we had this
19 window of opportunity here. So please make sure
20 to wear your badge visible in the building. I
21 think you know the restrooms are on both ends of
22 the hall. There's a coffee shop down on the

1 ground floor and I'll see you and start back up at
2 11:00.

3 (WHEREUPON, the foregoing recessed.)

4 MR. BROOKMAN: So let's resume, pick
5 up where we left off and I believe that was slide
6 45, energy use, markups analysis. We've had
7 really good comments so far. Appreciate that.
8 Let's keep that going. And we're going to hear
9 from Victor Franco.

10 MR. FRANCO: Good morning. My name is
11 Victor Franco. I'm from Lawrence Berkeley
12 National Laboratory and I'll be presenting now the
13 markups and energy use analysis. So the markups
14 analyses are used to determine the commercial
15 consumer prices from the manufacturer's selling
16 price, discussed in the engineering analysis, for
17 both baseline and higher efficiency equipment.

18 The appropriate markups for determining
19 commercial consumer equipment prices depend on the
20 type of distribution channels through which the
21 equipment moves from the manufacturers to
22 purchasers. At each point in the distribution

1 channel, companies mark up the price of the
2 equipment to cover their business costs and profit
3 margin. There are two primary types of
4 distribution channels, described the way most
5 equipment passes from manufacturer to consumer as
6 shown in the two flowcharts here, one involving
7 distributors and contractors and one of the
8 manufacturers to the consumer via a national
9 account.

10 While these two primary channels are
11 also distinguished by new and replacement market
12 segments, as shown here, also the DOE also
13 distinguishes between small and large mechanical
14 contractors. The fractions for each are shown in
15 this slide as well. As we can see, the primary
16 distribution channel is going from the
17 manufacturer, wholesaler to either the small or
18 large mechanical contractor and then to consumer.
19 The national account goes from the manufacturer
20 and as a proxy we include the wholesaler markup as
21 well and then to the commercial consumer.

22 To actually get the markups for each of

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1 these market participants, we take into account
2 the direct cost, expenses and profits from various
3 sources. As described before in the engineering
4 analysis, the manufacturer markup includes the
5 U.S. Securities and Exchange Commission 10K
6 reports. For the wholesaler markup, we use the
7 2012 profit report from HARDI. For the mechanical
8 contractor markups, we use ACCA 2005 financial
9 analysis report, together with the U.S. Census
10 Bureau 2007 economic census for the plumbing and
11 HVAC contractor sector. For the general
12 contractor markup, we use also the U.S. Census
13 Bureau 2007 economic census for the commercial
14 building construction sector. In addition, we
15 include sales taxes. These come from 2013 Sales
16 Tax clearinghouse data.

17 For this analysis, we include both
18 baseline markups and incremental markups.
19 Baseline markups relate the MSP of baseline
20 equipment to commercial consumer customer purchase
21 price. Incremental markups relate the increase in
22 MSP of more efficient equipment to the increase in

1 commercial consumer purchase price. These costs
2 cover only the expenses that vary with the MSP
3 such as operating expenses and profits. Fixed-
4 costs such as overhead and labor do not scale with
5 increased efficiency. DOE applied the baseline
6 markets to the baseline level and incremental
7 markups to the incremental difference in MSP.

8 MR. RAY: Doug, do you want comments or
9 questions?

10 MR. BROOKMAN: Please, yes. Whenever
11 you -- yes, go ahead, Mike.

12 MR. RAY: Mike Ray. Excuse me. On
13 slide 46, when we look at the either the
14 replacement or the new construction, the bottom
15 version where it says manufacturer national
16 account and then commercial consumer, in those
17 steps, where's the contractor in that because
18 somebody has to do the installation and somebody
19 has -- and they have to have their markup involved
20 in that as well. So in that step somewhere there
21 has to be a contractor and their markups and
22 everything involved in that sales step, so.

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1 MR. FRANCO: Correct. We're just
2 referring to the national account. This is Victor
3 Franco, national account. We assumed that it goes
4 directly from mostly the manufacturer to
5 commercial consumer. Many times these might
6 involve just in-house contractors. But please
7 submit your comments to correct that.

8 MR. BROOKMAN: Mike, follow-on?

9 MR. RAY: Okay. Mike Ray. Yeah, in
10 general, our internal group is there to support
11 the -- to support the large and small contractors
12 who do the actual installations themselves. And
13 as such, we're not doing performance contracting
14 per se and so we don't have a group that goes out
15 and does the installations. In this model, as you
16 see here, the piece that is missing is that
17 contractor there that needs to -- that needs to
18 have the markup and all. I think --

19 MR. BROOKMAN: Mike, does the
20 commercial consumer, does that person generally
21 hire the contractor or is that person associated
22 with the wholesaler?

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1 MR. RAY: Well, yeah. Jill, you want to

2 --

3 MR. BROOKMAN: Jill, go ahead please.

4 MS. HOOTMAN: Jill Hootman, Trane.

5 There's every flavor with the national accounts.

6 So you know, if you're a Walmart, you might have

7 two key contractors across the United States that

8 do all your installations. Yes, we might be

9 selling directly to Walmart but Walmart will still

10 have to pay that contractor for the installation

11 and/or, you know, all the other sheet metal and

12 all the other stuff that has to happen. They're

13 paying them for that.

14 So there is that incremental step and

15 then there are other cases where they really --

16 the national accounts really act just like the

17 step above. They go through the chain just like

18 that. The only uniqueness I think that really

19 falls in national accounts is that we might not

20 sell to a wholesaler. We sell directly. It goes -

21 - the invoices directly invoice to them. But

22 there still is a contractor. They don't have their

1 own contracting arms for all intents and purposes.
2 They might have somebody who goes around and
3 repairs units and does some of those kinds of
4 things.

5 But actual change out of units, they're
6 almost always going to a licensed contractor to do
7 that. Yes, some of our companies do have
8 performance contracting arms of our businesses.
9 But they're acting as a contractor too and they're
10 getting -- they have a profit stream just, you
11 know, a margin markup just as they would as a
12 contractor as well.

13 MR. BROOKMAN: Harvey Sachs.

14 MR. SACHS: This is Harvey Sachs, and
15 recognizing the enormous variety, particular OEM-
16 owned distribution versus independent
17 distribution, national accounts and everything
18 else, I guess I'm old school and always thought
19 markup referred to the value added by someone who
20 takes ownership of the equipment.

21 So the contractor on a national account
22 where you're doing a direct sale to the ultimate

1 owner will hire a contractor to do the installing
2 and the sheet metal and all of that. But is there
3 -- and he has a profit margin. But is he really
4 seeing a markup on the equipment itself?

5 MS. HOOTMAN: He is putting a markup on
6 --

7 MR. BROOKMAN: Jill, please.

8 MS. HOOTMAN: Jill Hootman, Trane. He
9 is putting -- they are putting a markup on it. It
10 may not be at the same markup if they were to,
11 like you said, take on that responsibility of
12 buying the unit and warranting the unit and all
13 of that, the long -- you know, so it might not be
14 the same. But there still is a markup. You know,
15 it's been a while since I've been in that business
16 and being on the sale side of things. So I can't
17 quote the numbers. But there is. There is
18 something there.

19 MR. SACHS: So I think we're all saying
20 the same thing, that it's pretty heterogeneous and
21 hard to analyze appropriately.

22 MR. BROOKMAN: Mike?

1 MR. RAY: Mike Ray. I would say that
2 the top model really is -- explains the whole
3 process. Now, there may be a little bit of a less
4 step involved with national accounts. But in
5 general, the top example is the best example of
6 how the whole process works.

7 MR. BROOKMAN: Can you comment on the
8 distributions that are listed there, the
9 quantities?

10 MR. RAY: As far as?

11 MR. BROOKMAN: Well, do you think
12 they're in the ballpark or not?

13 MR. CYMBALSKY: Well, I guess the real
14 question -- this is John, from DOE. The real
15 question is I think we're all recognizing that the
16 national accounts might have a different markup,
17 if in fact the cut of the markup might be a little
18 different. So what I guess DOE is going to say is
19 we think -- let's just look at the replacement
20 side here. We think that 14 percent falls into
21 that bucket.

22 I guess what we're asking from you is

1 let's assume that that's the correct 14 percent.
2 How does that differ then the model that Mike just
3 described that's more normal? And we agree. We
4 say, you know, the preponderance of the
5 replacement market's going through there. But if
6 we both agree that there's this national accounts
7 bucket that's a little bit different, how would
8 the markup be different from the top set of
9 flowcharts there?

10 MS. HOOTMAN: I can't say without doing
11 a little research.

12 MR. CYMBALSKY: Okay. I guess that's
13 what we're looking for. So I think -- and maybe
14 it's just 1 or 2 percent or whatever. But I think
15 we all recognize there might be a little different
16 set of streams there and for that process. So to
17 the extent we can differentiate, great. If we
18 can't, we'd like to hear that comment as well.

19 MR. BROOKMAN: Yes, Alex?

20 MR. LEKOV: Alex Lekov, Lawrence
21 Berkeley National Laboratory. So just to clarify,
22 if in this - - if in this chain, based on your

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1 input, is it fair if we replace the wholesale
2 label with the contractor label if this will be a
3 better presentation of this channel?

4 MR. BROOKMAN: Jill?

5 MS. HOOTMAN: So Jill Hootman, Trane.
6 So you have a manufacturer to essentially a retail
7 owner, right, direct to an owner. That's where
8 the sale of the equipment might happen. And you
9 also have manufacturer to a contractor in the
10 national accounts.

11 So the sale of the equipment itself
12 could be two different ways: directly to that
13 eventual owner, Target, Walmart, whatever or to a
14 contractor.

15 In the case that it went to Walmart,
16 Walmart then contracts with a contractor to make
17 that installation of that unit and pay a price to
18 them. So there's the step of the contractor after
19 the sale of the equipment.

20 MR. BROOKMAN: Mike?

21 MR. RAY: Mike Ray, and if the
22 contractor wants to stay in business, he needs to

1 mark up that equipment. And if the contractor's
2 not a smart businessman and doesn't mark up for
3 the cost of that equipment, then eventually it
4 will drive him out of business.

5 So he's got to take into account because
6 most of the time the national accounts require
7 that you maintain it or you're responsible for it
8 for a period of one year. Under those
9 circumstances, you know, the contractor, he has to
10 put his warranty in it as well as his markups in
11 order to make sure that it's a profitable business
12 for him.

13 MR. BROOKMAN: Okay, thank you.

14 MR. FRANCO: Thank you for those
15 comments. Victor Franco. Now, here are the
16 different markups for the different markup
17 participants that were calculated using the data
18 sources I reported before. So we have the
19 wholesaler, mechanical contractor, general
20 contractor and sales taxes. For the replacement
21 market, we include sales taxes and for new
22 construction we don't include sales taxes.

1 The overall markups calculated then are
2 shown here in the overall markup and for the
3 national account they're lower as shown here as
4 well. The table below includes the overall markup
5 for the sample and we have a gas-fired commercial
6 warm air furnaces and oil-fired commercial warm
7 air furnaces. So you can see the baseline markup
8 and the incremental markup here.

9 Just to note that this includes
10 weighting of, for example, new construction. We
11 assume that for gas-fired commercial warm air
12 furnaces 80 percent of the market is at the
13 replacement and 20 percent are new construction
14 while for oil-fired CWAFFs, they're 95 percent and
15 5 percent new construction. So we invite any
16 additional comments for the markup analysis at his
17 point.

18 MR. BROOKMAN: Jill?

19 MS. HOOTMAN: Jill Hootman, Trane. So I
20 think we were saying a little bit earlier,
21 especially when we asked you and Harvey asked you
22 how does this compare with CUAC. These are the

1 exact same units. I realize that we don't have
2 the break necessarily in this rule.

3 But no question, the costs and the
4 markups are more when you start to talk about the
5 larger sizes here and the larger package units.
6 So the scaling that that has might be more
7 appropriately used or maybe you're weighting it
8 somehow, agreed you don't necessarily have the
9 sales distribution. But you now, we have to
10 consider that I think because it's the exact -- it
11 works exactly the same as CUAC.

12 MR. FRANCO: Thank you for that comment.

13 MR. BROOKMAN: Additional thoughts
14 related to markups analysis before we move on?
15 Okay.

16 MR. FRANCO: Thank you. Victor Franco
17 again. Now we're going to talk about the energy
18 use characterization. We determined the annual
19 energy consumption for commercial warm air
20 furnaces at the different considered efficiency
21 levels, defined the annual energy cost and
22 savings. This is an important part of the

1 lifecycle cost analysis and payback period
2 analysis. So I'll be discussing this later today.

3 The basic method is we take into account
4 the total energy use. We take into account the
5 fuel use and the electricity use. For this fuel
6 use, we basically calculate the burner operating
7 hours and multiply that by the input capacity.
8 The input capacity is fixed 250 kBtu per hour as
9 discussed earlier.

10 The burner operating hours are
11 determined using the thermal efficiency at the
12 specific efficiency level and they take into
13 account the heating building load based on CBECS
14 and RECS data. And they also the existing
15 efficiency of the existing commercial furnace and
16 some adjustment factors that I'll be discussing in
17 two slides.

18 The electricity use is also taken into
19 account and I'll be discussing that in further
20 detail. But to note that it includes the impact of
21 non-heating season energy use, specifically for
22 condensing furnaces because of the circulating fan

1 used in air conditioning. Before going in further
2 detail in terms of the energy use calculations, I
3 wanted to take a look at the building sample, how
4 we determined what buildings were using what type
5 of furnace.

6 So first, we take CBECS and RECS sample
7 and we determine if they are -- if they have
8 furnaces that are used in the building. Then, we
9 take a count, the criteria for the square footage
10 to determine if they're actually using a
11 commercial equipment or they're using residential
12 equipment. In the case of commercial equipment,
13 we assume that commercial space of 3,750 square
14 feet is the minimum to be commercial size.

15 And finally, we take into account what
16 fuel type the furnace. If it's gas, then it goes
17 to the gas-fired commercial furnaces sample. If
18 it's oil, it goes to the oil-fired commercial
19 furnaces sample. On the slide, there's a table
20 that lists what the actual count of the different
21 -- in our sample for CBECS and RECS. As you can
22 see, there's close to 1,500 buildings that are

1 being sampled for gas-fired and a little bit more
2 than the hundred buildings for oil- fired
3 equipment. Now, let's look a little bit more
4 detail in terms of how we calculate the heating
5 fuel use.

6 So as I mentioned before, we're taking
7 into account the burner operating hours times the
8 input capacity of the commercial furnace. The
9 burning operating hours are the building heating
10 load divided by the useful output. What we mean
11 by useful output is any -- obviously the output
12 capacity of the furnace but we also take into
13 account any electrical components that might
14 provide heat. The building load in 2018 accounts
15 for many adjustments to the building load and it's
16 based on the heating use, energy use that's
17 provided from CBECS and RECS data. Then we
18 multiply this by the thermal efficiency of the
19 existing unit and we do a number of adjustments.

20 We adjust for average climate
21 conditions. We also adjust for climate change,
22 projections by 2018 and also for the building

1 shell efficiency. Finally, we take into account
2 how many commercial furnaces are used to meet the
3 heating load because we're using a single capacity
4 of 250, a lot of buildings will actually use more
5 than one unit. So our threshold is 7,500 square
6 feet per commercial furnace. So if a building has
7 15,000 square feet, we assume that it has two
8 units that are being used and we are just
9 calculating -- for the impacts, we are just
10 calculating that one unit. But we divide the
11 energy use by two essentially for that specific
12 example.

13 So these are the results of the fuel use
14 for our building sample. So again, for gas-fired
15 we have close to 1,500 buildings that are used in
16 our analysis. The original energy use that's
17 being reported from CBECS and RECS is around 210
18 million Btus and our calculations by 2018, because
19 of the adjustment factors that I talked about
20 before, we're calculating 163 by 2018. Similar is
21 for oil-fired, from 161 reported by CBECS and RECS
22 to a little bit more than 117 million Btus per

1 year and this is per unit. Next, we calculate the
2 electricity use.

3 So the electricity use is basically we
4 multiply the burner operating hours times the
5 power of the electrical component that are typical
6 in a furnace such as circulating fan, inducer,
7 ignition device and we adjust that by a ratio of
8 the electrical components on time to the burner on
9 time. In addition, we take into account auxiliary
10 equipment outside of the furnace such as the
11 condensate pumps and heat tape that might be used.
12 Finally, we take -- yes?

13 MR. BROOKMAN: Harvey Sachs?

14 MR. SACHS: Yes, Harvey Sachs. Victor,
15 I'm confused on slide 53. When you in your table
16 say average energy use it's fairly clear you're
17 using from the distributions on the graph that
18 you're using the mean rather than the median.

19 MR. FRANCO: That is correct, yes.
20 These are average, yes. The median would be
21 slightly less. The result would be less. But this
22 is the average. You're correct, the mean.

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1 MR. SACHS: My eyeball may be just
2 distorting, but it looks like it'd be a lot less.

3 MR. FRANCO: Yeah, I believe that's --

4 MR. SACHS: I'm not sure I understand
5 why you chose the mean. But it may be I'm not
6 thinking straight.

7 MR. FRANCO: No. Yeah, no. You are
8 correct. They're about 10 to 15 percent less.
9 Yeah, the mean -- the actual median is reported in
10 the TSD and their values are below there.

11 MR. SACHS: Thank you.

12 MR. FRANCO: So going back, this is
13 Victor Franco. The electricity use, we take into
14 account the difference in electricity use for the
15 circulating fan in the cooling mode and we take
16 into account the standby energy use as well. The
17 values for the different components for in terms
18 of power are listed here. The circulating fan is
19 assumed to be about 1,500 watts which is about a
20 two horsepower unit.

21 The inducer fan is about a hundred
22 watts, the ignition device, 25, and 10 for the

1 standby. Here are the summary results. So again,
2 here are the average values, as we saw before.
3 The average value for the baseline for the fuel
4 use, 163 and the electricity use, a little bit
5 more than a thousand kWh. And the savings for
6 both the gas-fired and the oil-fired equipment.

7 MR. BROOKMAN: Harvey Sachs?

8 MR. SACHS: Harvey Sachs. I'm missing
9 something. Your 80 percent TE on page -- slide 55
10 is 163.4 annual fuel use which is a whole bunch
11 lower than the 210 on slide 53 and I'm not seeing
12 the different derivations immediately.

13 MR. FRANCO: Yes, thank you for that
14 clarification. So the 210 represents the actual
15 reported CBECS and RECS energy use and to the side
16 we have the estimated heating in 2018 which is
17 163.4 which you see in the table. The primary
18 difference is these adjustment factors for average
19 climate conditions, the building shell efficiency
20 and some accounting of the climate change by 2018.
21 I hope this clarifies.

22 MR. CYMBALSKY: So 15 years of things

1 that happen, right?

2 MR. FRANCO: This is again -- the most
3 data -- most of the data comes from CBECS 2003
4 which is -- it was in 2003. We're trying to
5 project to 2018, 15 years. a lot of things have
6 changed in terms of building shell and --

7 MR. SACHS: It's a 20 percent
8 difference.

9 MR. FRANCO: Correct and also the
10 efficiency of the units.

11 MR. CYMBALSKY: The regional -- well,
12 the regional difference, right? So a lot of the
13 building construction has moved south in this
14 country. So the heating degree day average when
15 you look from 2003 to 2018 is a big deal.

16 MR. SACHS: Okay. This is Harvey.
17 Thank you, John and Victor.

18 MR. BROOKMAN: Jill?

19 MS. HOOTMAN: No.

20 MR. BROOKMAN: Okay.

21 MS. HOOTMAN: I'll wait. I think his
22 next slide is going to help me.

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1 MR. FRANCO: So yes, let's move to the
2 request for comment. So we're requesting comment
3 on the use of CBECS and RECS for determining the
4 energy consumption of this equipment in both
5 residential and commercial buildings. We seek
6 comments on the actual methodology for determining
7 the energy use for commercial equipment and any
8 other -- any other comments related to the energy
9 use characterization.

10 MR. BROOKMAN: Jill?

11 MS. HOOTMAN: Jill Hootman, Trane. So
12 you know, as we said before, we think that we
13 would recommend not just only analysis at 250,000
14 but at some other higher point and, yes, we'll
15 bring those comments on what recommendation of
16 what that is. If so, then isn't it true, like on
17 slide 54, you'd go through that calculation for
18 that as well as when we recommend another upper --
19 okay, I just wanted to make sure about that.
20 Okay.

21 MR. FRANCO: Yeah, correct. We would
22 actually assign some buildings with a higher input

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1 capacity as appropriate and others with the lower
2 capacity.

3 MS. HOOTMAN: Right.

4 MR. BROOKMAN: Michael McCabe?

5 MR. MCCABE: It's Michael McCabe.

6 Following up on Harvey's question and looking at
7 slide 53, if you compare those figures for the
8 2003 CBECS and what you're projecting in 2018, how
9 do those compare to what the AEO is forecasting?

10 MR. FRANCO: Good question. The AEO
11 does actually use -- right now it uses CBECS 2003.
12 We're using the same assumptions in terms of the
13 building shell, the climate and the correction for
14 average climate conditions. So they're actually
15 very, very close.

16 MR. MCCABE: Michael McCabe. So the
17 2018 figures are close to what the AEO is
18 projecting?

19 MR. FRANCO: That is correct, yes.
20 We're using exactly the same parameters. So the
21 building shell index actually comes from AEO for
22 the commercial side and the projections for

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1 climate change come from AEO as well and the
2 normalization to normal conditions is the same
3 methodology that AEO 2013 uses.

4 MR. MCCABE: Thank you.

5 MR. BROOKMAN: Yes, Mike?

6 MR. RAY: Mike Ray. As we look at our
7 electricity use, I'm guessing that we probably
8 haven't taken into account the impact of a
9 variable frequency drives that are being mandated
10 as part of ASHRAE.

11 FEMALE: [Off mic] motors.

12 MR. RAY: Yeah, and so from a constant
13 fan as well as other operations, the variable
14 frequency drive will adjust the speed of those
15 fans and will reduce the energy use in certain
16 applications and then, so I'm sure that wasn't
17 considered.

18 MS. HOOTMAN: But --

19 MR. FRANCO: Thank you for those
20 comments. Please if you can provide those in
21 writing, that would be helpful as well.

22 MR. BROOKMAN: Additional thoughts on

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1 these comment boxes? Frank Stanonik, welcome.

2 MR. STANONIK: Frank Stanonik, AHRI. And
3 this has come up in a couple other commercial
4 rulemakings. I believe it's the 2012 CBECS data
5 is being worked over somewhere I guess. What's
6 the -- do you have any better sense of whether
7 that data will be released in time to be
8 considered in this rulemaking?

9 MR. BROOKMAN: John Cymbalsky?

10 MR. CYMBALSKY: I'm noting that we have
11 an EIA employee in the room. I'm curious if Kevin
12 wants to --

13 MR. BROOKMAN: Do you wish to step
14 forward to this microphone here, please?

15 MR. JARZOMSKI: Hi, Kevin Jarzomski.
16 Kevin Jarzomski, EIA. I don't actually work on
17 CBECS but as I understand it, they've already
18 begun releasing characteristic data and the energy
19 consumption data should be released later in the
20 summertime. So it's forthcoming.

21 MR. BROOKMAN: Okay, thank you. Doug
22 Kosar, please. You're unmuted I hope.

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1 MR. KOSAR: Yes, thank you. This is
2 Doug Kosar, GTI.

3 MR. BROOKMAN: Doug, you're just
4 slightly garbled. Please get close to your
5 telephone or whatever you're using.

6 MR. KOSAR: Okay. I'm using a mic on my
7 computer. Is that any better?

8 MR. BROOKMAN: That's better. Yeah,
9 get close.

10 MR. KOSAR: I had a question on slide 55
11 and then a comment as well. On slide 55, are you
12 showing positive kWh savings over the course of
13 the year?

14 MR. FRANCO: Yes, that is correct. It
15 is a little bit of an artifact of how we conduct
16 the analysis in terms of having a fixed input
17 capacity. Because we have a fixed input capacity
18 for both the 80 percent thermal efficiency and 92
19 percent thermal efficiency, the actual -- and a
20 lot of the components are similar, for example,
21 the burner and other, that there's an actual
22 savings because of reduced operating hours.

1 You have about 12, 13 percent higher
2 efficiency. That offsets the cooling. I didn't
3 go into detail how we calculate the cooling. We
4 assume 5 percent increased energy use in the
5 cooling side because of having the secondary heat
6 exchanger. So if you could provide any data, that
7 would be very helpful for us.

8 MR. KOSAR: Yeah, we've experienced
9 quite the contrary with the -- especially when we
10 go to condensing level efficiency. The
11 incremental pressure drop in these systems do
12 experience that year-round with the inline
13 components if we're talking about an RTU. So we
14 saw additional kWh consumption over the course of
15 the year since they were fitted with these higher
16 heat exchangers. So I would take a second look at
17 those savings calculations because it should
18 actually be negative as you increase to a higher
19 efficiency level.

20 And one other general comment, I know
21 we're talking about average savings for commercial
22 warm air furnaces. What we've seen in actual

1 monitoring in the field is huge diversity in the
2 runtime of RTUs which basically equates to your
3 burner on-time. So we may see equivalent hours
4 that range here in Chicago from say, 1,200 kWh to
5 literally zero on some RTUs that are serving the
6 core of a building in a large footprint- type of
7 structure.

8 So I understand we're looking at the big
9 picture here in terms of average numbers. But the
10 reality on any given building is that you've got
11 significant diversity in runtimes of these
12 commercial warm air furnaces and RTUs and savings
13 you see on average you're going to see a much
14 wider range in actual practice.

15 MR. FRANCO: Thank you for your comment.
16 We tried to take that into account using the
17 building sample, as you can see on the previous
18 slide. We have a variety of field use. You would
19 expect to see the same electricity -- differences
20 in electricity use from our analysis.

21 MR. KOSAR: Yeah, the point I was trying
22 to make, I think on any given building you're

1 going to have a distributed group of RTUs on the
2 rooftop that those that serve the core of the
3 building must be much higher runtime than those
4 that serve the corner of the building, much
5 shorter.

6 MR. FRANCO: Thank you. Appreciate your
7 comment.

8 MR. BROOKMAN: Yeah, thanks, Doug.
9 Final comments on these request boxes on slide 56?
10 Anything related to energy use characterization
11 you wish to add? Yes, Mike?

12 MR. RAY: Mike Ray. Victor, in the
13 calculation, did you take advantage of the ASHRAE
14 building models and utilize those as the baseline?

15 MR. FRANCO: No. We did not. But we
16 were able to compare it to those models and our
17 energy use estimates take into account all the
18 adjustments are similar. This provides a little
19 bit more of a wider distribution as you would see
20 in the field.

21 MR. RAY: Okay. As follow-up to that
22 then, you said a little different than what

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1 ASHRAE, a little different being 2 percent, 10
2 percent, 20 percent? What's --

3 MR. FRANCO: So previous ASHRAE
4 estimates, but this was back maybe five or more
5 years ago, were similar to the CBECS, around 200
6 million Btu. Our estimates are now because of all
7 these adjustments is down to 160. If we use the
8 same building model and adjusted it, we should get
9 about the same, 160.

10 MR. BROOKMAN: Final comments, because
11 we're going to move on here. Okay.

12 MR. FRANCO: Thank you. Victor Franco
13 again. Now, we're moving to lifecycle cost and
14 payback period analysis. The first slide here is
15 just an overview of the lifecycle cost and payback
16 analysis, is showing the different inputs that we
17 use. On the top of this flowchart we're showing
18 the total - - how to calculate the total installed
19 cost. As in the engineering analysis, one of the
20 major inputs is the manufacturer cost. Then we've
21 already described the markups. Those two
22 components give us the equipment price. In

1 addition to that, we consider installation costs.

2 In the lower part of this flowchart, we
3 consider the operating costs. So we've already
4 described the energy use characterization. That
5 will give us the energy consumption. We then also
6 calculate the marginal energy prices, either
7 natural gas or electricity, to produce annual
8 energy costs. The operating costs also include
9 repair and maintenance costs to produce the annual
10 operating expenses.

11 In addition to that, we take into
12 account the lifetime discount rate energy price
13 trends to come up with the lifetime operating
14 costs. So both the components, the total
15 installed cost and the lifetime operating cost
16 give us the lifecycle cost and the payback period
17 as well.

18 So looking a little bit more at how we
19 conduct the lifecycle cost and payback period
20 analysis, it's an economic evaluation that the
21 commercial consumer perspective. The equations
22 are as shown here and in addition the analysis

1 models, the uncertainty and variability of the
2 inputs using the Monte Carlo approach and
3 probability distributions using Excel and Crystal
4 Ball. We've included as part of the documents
5 that are publicly available a spreadsheet, an LCC
6 spreadsheet that has all these calculations.

7 This is just a summary of all the inputs
8 that I described before. I won't read all through
9 this but just it's good to if you want to go and
10 compare it to the flowchart, the definitions and
11 the different methodologies that we've used. I'll
12 go in more detail in a lot of these in the next
13 few slides.

14 First, we have the commercial consumer
15 equipment prices. So we discussed we used markups
16 to convert the manufacturer production cost into
17 the actual commercial consumer equipment prices.
18 In addition to this, we have used PPI data to
19 project price trends over the analysis period, as
20 you can see in the graph shown below.

21 MR. BROOKMAN: Michael McCabe?

22 MR. MCCABE: It's Michael McCabe.

1 Victor, this consumer price trend, is that applied
2 to both the base case and the standards case?

3 MR. FRANCO: Victor Franco. That is
4 correct, yes, base case and standards case. So to
5 produce the total installed costs, we have also a
6 major component is the installation cost. We have
7 three major components to the installation cost
8 for this equipment. First off, we have the basic
9 installation costs and again, as discussed
10 earlier, we're only accounting for the
11 installation costs of part of the equipment. This
12 is a lot of times it's part of a packaged
13 equipment. We're trying to only include
14 installation costs related to the furnace
15 component.

16 These basic installation costs include
17 putting in place, heating up the furnace, the
18 piping related to the gas or oil equipment,
19 ductwork hookup, electrical hookup, any permit
20 removal and disposal fees. This would be the same
21 for all efficiency levels. The adders for higher
22 efficiency equipment would be the next two items.

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1 For a lot of this, weatherized condensing
2 equipment, this higher efficiency equipment
3 includes the condensate withdrawal costs. These
4 include pipe for the actual condensate, the pump,
5 condensate neutralizer, heat tape and electrical
6 outlet. The next slide will show you in more
7 detail these costs.

8 In addition to that, for estimation of
9 installation costs for indoor equipment, we have a
10 thorough methodology to calculate these costs
11 household to household. In terms of how the
12 venting and condensate withdrawal costs are
13 applied, we take into account the installation
14 location of this equipment. We assume that 95
15 percent of gas-fired equipment is installed
16 outdoors and 5 percent of equipment is installed
17 indoors. For oil-fired equipment, we assume that
18 all equipment is installed indoors. So for this
19 indoor equipment, we include these venting
20 installation costs.

21 Our data sources include our 2013 RS
22 Means mechanical cost data, manufacturer

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1 literature and consulting information.

2 MR. BROOKMAN: Mike?

3 MR. MCCABE: Hate to step back, but
4 Victor, on slide 62, did you have different
5 installation costs for new construction versus
6 replacement in there?

7 MR. FRANCO: Yes. Yes, we do. We have
8 a cost model for replacements and a different cost
9 model for new construction, which includes, for
10 example, the builder markups and includes having
11 to higher cost for having to replace the
12 equipment. If you have to vent the equipment,
13 then all equipment is assumed to be required new
14 venting for new --

15 MR. MCCABE: Also the condensate, the
16 handling of the condensate that's unique for an
17 existing building versus what it would be for a
18 new construction.

19 MR. FRANCO: Exactly, yes.

20 MR. MCCABE: Okay. Thank you.

21 MR. FRANCO: Thank you for that comment.
22 Since condensate withdrawal is one of the main

1 components for the installation cost for
2 condensing equipment, here are some of the
3 assumptions that we use. For the condensate pipe,
4 essentially for all installations we consider it
5 both indoor and outdoor. The condensate pump is
6 for 50 percent of installations that don't have
7 CUAC. So that would be mainly for indoor
8 equipment. For freeze protection is applied to
9 all of the installations, a hundred percent of the
10 outdoor installations. So that's pretty much all
11 installations of gas-fired. The electrical outlet
12 is supplied if we include a pump or a heat tape
13 for 50 percent of the installations. And the
14 condensate neutralizer is applied to 12.5 percent.

15 MR. BROOKMAN: Mike?

16 MR. MCCABE: Okay, so the electrical
17 outlet that you list for 50 percent of the jobs,
18 if we look back on the previous cost or increase
19 that we had that was either \$5 or \$10, this
20 doesn't -- that's not included in that
21 calculation, is it?

22 MR. BROOKMAN: Constantin?

1 MR. VON WENTZEL: Constantin von
2 Wentzel, Navigant Consulting. I believe the
3 electrical outlet is only required for condensing
4 applications. So the \$5 to \$6 increase was from
5 80 to 82 percent, noncondensing as opposed to the
6 scenario being described here which was a
7 condensing application.

8 MR. MCCABE: Okay, thank you.

9 MR. BROOKMAN: Harvey Sachs?

10 ME SACHS: Harvey Sachs. Deep in the
11 abscesses of my cranium, there's memory of a
12 large-scale study of RTUs in California in which
13 refrigerant charge was an issue.

14 So I've sort of worked on the assumption
15 that if there is an RTU, there's a way to get AC
16 for running -- pulling a vacuum or other
17 maintenance operations. And that would seem to be
18 available for the condensate pump or heat tape as
19 well. So I'm not -- am I wrong or where is this
20 AC outlet need coming from? You know.

21 MS. HOOTMAN: So --

22 MR. BROOKMAN: Jill, please.

1 MS. HOOTMAN: Jill Hootman, Trane.
2 Harvey, describe that condensate, you know, you're
3 going to have -- you're going to have it coming
4 out of the unit and a lot of times it's run on top
5 of the roof. There are some installations it
6 could go down through the roof. But on top of the
7 roof, you're going to have to have that wrapped in
8 heat tape so it's constantly energized. It's
9 constantly energized and I don't think the
10 convenience outlet in a unit itself, then you're
11 going to unplug that and then when you want to run
12 your vacuum pump, use it.

13 You see what I'm saying? What if you're
14 on the roof? You don't want that de-energized
15 during all these heating hours. So it's going to
16 be another -- I think it's another. I agree with
17 him. It's another electrical outlet that is
18 constantly energized and heating anytime. It
19 could never be off. If it's off, it now has a
20 failure.

21 MR. BROOKMAN: Mike?

22 MR. RAY: Mike Ray. I think NEC code

1 says that you have to have one outlet within 25
2 feet of other units so that there's service
3 capability. And so, you could have one outlet
4 serving four or five different units and in the
5 case of the heat tape, you want that to be running
6 constantly. And if you have four or five
7 different units, you'll need outlets for each one
8 of those.

9 MR. BROOKMAN: Thank you.

10 MS. HOOTMAN: Good point.

11 MR. BROOKMAN: Bob Whitwell, you're
12 next.

13 MR. WHITWELL: Yeah, I've had my
14 question already came up. So I'm all set. Thank
15 you.

16 MR. BROOKMAN: Thank you.

17 MR. FRANCO: Victor Franco again. So
18 now, we're going to be talking about the operating
19 costs. We already talked about the energy use
20 characterization. We would multiply that times
21 the energy prices to come up with the energy use
22 operating cost. The energy prices are developed

1 for marginal monthly prices by different areas to
2 match up with the building location, the sample
3 building. We use the most current data we have
4 available for annual energy prices. We multiply
5 that times monthly price factors to come up with
6 monthly data and then we multiply that times
7 marginal price factors.

8 The data comes from EIA for all the
9 different prices including the electricity prices,
10 natural gas, LPG and fuel oil comes from the same
11 data sources. The monthly energy price factors
12 are developed using the same monthly data and the
13 marginal energy price factors are determined by
14 using that monthly data for a 10-year period for
15 the locations we analyzed.

16 Next, we look at the energy price trends
17 to go from 2012 average monthly marginal energy
18 prices to the years in our analysis from 2018 to
19 2040. We use directly the EIA 2013 by Census
20 Division. After 2040, we use the trends from 2030
21 to 2040 to project the future.

22 Another component of the operating costs

1 are repair and maintenance. Repair cost is the
2 cost of replacing or repairing the components of
3 the commercial warm air furnaces that have failed.
4 We use data from 2013 RS Means facility repair and
5 maintenance as well as manufacturer literature,
6 equipment cost data and Consumer Reports data on
7 residential furnaces. We did not have data about
8 commercial furnaces in terms of frequency of
9 repair. So that would be good if that data is
10 available.

11 In terms of maintenance costs, we
12 calculate the labor and materials required to
13 maintain the equipment. The sources are 2013 RS
14 Means facilities repair and maintenance data, also
15 CBECS and RECS reports, how frequently the
16 building might be repairing the unit and we also
17 take into account for oil products the
18 availability of low-sulfur oil for -- fuel oil for
19 different parts of the country. Especially for
20 condensing designs, we take into account having to
21 maintain the condensate neutralizer and having to
22 check the condensate withdrawal system. These

1 costs are reflected in the costs shown below. As
2 you can see, there's incremental cost both on the
3 repair side and the maintenance side. These are
4 annualized values, average values.

5 Next, we come to the other component of
6 the lifecycle cost --

7 MR. BROOKMAN: Frank Stanonik?

8 MR. STANONIK: Frank Stanonik, AHRI.

9 And I don't know if this has come up in the part
10 of the meeting I missed, but on your maintenance
11 costs, has there -- well, has the point been
12 raised yet that on the 82 percent thermal
13 efficiency because these are mostly outdoor units
14 that we have some concerns that in fact although
15 it won't be designed for condensing there will
16 certainly be conditions that make that a much
17 greater concern than if this was an indoor furnace
18 and we think that at the 82 level there in fact
19 might be some additional maintenance costs simply
20 because the greater likelihood that it will be on
21 occasion condensing and it's not really designed
22 for that, which would if nothing else require

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1 closer monitoring of the furnace.

2 MR. BROOKMAN: We did get some
3 comment on that earlier today.

4 MR. STANONIK: Okay.

5 MR. BROOKMAN: And the department
6 requested specifics in writing. For example,
7 where you might find that condition of it being
8 condensing regionally, by use, that kind of
9 comment, yes.

10 MR. STANONIK: All right. Well, then I
11 think the point would just be, you know, we're at
12 this point certainly not convinced that the
13 maintenance cost is basically unchanged as you get
14 to that 82 level. Okay, thanks.

15 MR. BROOKMAN: Yeah, and we did also,
16 just so that you'll know, receive the comment that
17 some of the other manufacturers had observed other
18 units where the heat exchanger had been degraded.
19 Okay, and in a short period of time. Okay. Bob
20 Whitwell, he wants to go back to slide 55 when
21 time is right. Let's do that now. Slide 55.

22 MR. WHITWELL: Okay, thank you. Sorry

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1 for taking the group back.

2 MR. BROOKMAN: No, no. It's okay.

3 We want to be complete here.

4 MR. WHITWELL: So could you explain
5 again where the energy savings comes from in the
6 case of the -- of cases one, two and three, up, up
7 and up on the gas-fired furnaces? I'm referring
8 to the savings shown over on the far right-hand
9 side.

10 MR. FRANCO: So this would be to the
11 electricity consumption savings. Is that correct?

12 MR. WHITWELL: Yes.

13 MR. FRANCO: Okay. This is Victor
14 Franco. The electricity consumption savings,
15 basically there's an offset between the savings --
16 potential savings from reduced operating hours of
17 the unit because we're assuming a fixed input
18 capacity. So essentially our input capacity is
19 250 kBtu for the 80 percent unit which is about
20 200,000 kBtu. For the same 250 input capacity
21 unit for that 92 percent, you're getting a much
22 higher output capacity. That leads to less

1 operating hours.

2 So when we multiply a lot of our
3 different components by that reduced 10 to 15
4 percent operating hours, we get some savings.

5 That's offset by the cooling. We had assumed that
6 there was a 5 percent increased power in terms of
7 cooling and heating because of the secondary heat
8 exchanger and the circulating fan. That more or
9 less balances out with the effect that I just
10 talked about and that gives us a slight savings.

11 So please provide comments about our
12 methodology and about the actual impact on the
13 cooling or just the cooling impact in terms of the
14 power to check if our assumptions are correct.

15 MR. WHITWELL: Okay, thank you. Okay,
16 thank you.

17 MR. FRANCO: Thank you. So going back,
18 we're going back to the lifetime. So the other
19 components of the lifecycle cost analysis,
20 lifetime is the age of the furnace, once it's
21 retired from service. We gathered information
22 from national surveys and shipment data to

1 determine distribution of lifetimes.

2 For CUAC equipment, we're actually using
3 an ASHRAE database that provides commercial CUAC
4 data. This is the same data that's used for the
5 CUAC analysis and we're using exactly the same
6 distribution from that previous analysis.

7 For oil-fired furnaces, we did not have
8 that same data, either shipments or a survey for
9 the data and we're using as a proxy the oil-fired
10 furnace residential data from the 2011 DFR. As
11 you can see, the mean and median lifetimes are
12 very similar. The median lifetime is about 18
13 years for gas-fired and for oil-fired it's about
14 26 years.

15 MALE: [Off mic.]

16 MR. FRANCO: Next we come up with
17 discount rates for lifecycle cost analysis. These
18 are used to determine the present value of the
19 lifetime operating cost expenses. We are using
20 calculated as a weighted average of the capital
21 costs using the capital cost asset price model for
22 different economic sectors. The primary source

1 for the data comes from Damodaran Online database
2 of company debt and equity financing. We do
3 calculate discount rate for different sectors in
4 the commercial side including retail, property
5 owners, medical services, industrial, lodging,
6 food service, office, state/local government,
7 federal government and other. The table shows the
8 mean discount rate and the standard deviation. So
9 we do for each of these we do have a distribution
10 and that's taken into account in our analysis.

11 Next is the base case efficiency
12 distributions. Base case efficiency distributions
13 reflects the projected market share of equipment
14 at the different efficiency levels in the absence
15 of standards. So in essence not all consumers
16 purchase the equipment at the current efficiency
17 level. And the commercial consumers already
18 purchase equipment at a higher efficiency level.
19 We did not have at the time of the analysis any
20 data on the actual market shares. So we used the
21 AHRI database and the model availability to
22 determine these market shares in 2018.

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1 We assumed that the condensing 92
2 percent for commercial warm air furnaces, the
3 market share would be around 1 percent by 2018 and
4 that it's zero percent for indoor equipment for
5 either gas-fired or oil-fired equipment and the
6 other fractions just come directly from the
7 available models.

8 MR. BROOKMAN: Frank Stanonik?

9 MR. STANONIK: Frank Stanonik, AHRI. So
10 at the 81 percent level, all right, I'm trying to
11 understand that. So it says percent. What's the
12 93 percent for the 81 percent? What does that
13 mean? What am I reading there or what am I
14 supposed to understand from that I guess?

15 MR. FRANCO: Yes, this is Victor Franco,
16 just to clarify. So one column is the outdoor
17 equipment and the other column is indoor
18 equipment. We assume that there's a 95 percent of
19 the equipment for the gas-fired commercial is
20 outdoor, 5 percent is indoor.

21 MR. STANONIK: SO we're reading down.
22 So in terms of that, so 93 percent of whatever

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1 were the indoor units would be at 81. Okay, okay.

2 MR. FRANCO: That is correct.

3 MR. CYMBALSKY: So 93 percent of 5
4 percent. Got it.

5 MR. FRANCO: So now, we conclude the
6 methodology portion of the lifecycle cost before
7 going to the results and we request any general
8 comments on the methodology. Specifically, DOE
9 seeks comment on the approach and data sources
10 used for the installation costs especially for
11 more efficient equipment.

12 We also seek comment on the methodology
13 and data sources for the maintenance and repair
14 costs, especially for more efficient equipment.
15 We seek comment on the approach DOE uses for
16 calculating the lifetime of this equipment and
17 finally DOE seeks comment on the base case
18 efficiency distributions that we calculated for
19 2018 in the absence of amended energy conservation
20 standards.

21 MR. BROOKMAN: Comments? Comments
22 here? Okay, we're going to move on.

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1 MR. FRANCO: So next we come up with the
2 LCC and payback analysis results. As you can see
3 here, you can see the average installed costs, the
4 average lifetime operating cost, average LCC and
5 the average LCC savings as well as the fraction of
6 net costs, no impact, net benefit and the median
7 payback periods for different efficiency levels
8 both for the gas-fired and oil-fired equipment.

9 MR. BROOKMAN: Yes, Mike?

10 MR. RAY: Can you explain the average
11 installed cost, just that column?

12 MR. FRANCO: Yes. The average installed
13 cost is actually the average total installed cost.
14 That includes both the equipment and the
15 installation cost. This might be a little bit
16 confusing because it's just for the portion of the
17 gas equipment. So the actual --

18 FEMALE: [Off mic.]

19 MR. FRANCO: Exactly, yes. But if you
20 add the CUAC plus this, you would get the overall
21 -- potentially the overall cost of the equipment,
22 the actual equipment.

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1 MR. BROOKMAN: Harvey Sachs?

2 MR. SACHS: Harvey Sachs. Jill, I guess
3 in my simple mind, I've been assuming that this
4 really is incremental cost between a RTU with no
5 heating capacity and a gas pack.

6 MR. BROOKMAN: Jill, please use the
7 microphone.

8 MS. HOOTMAN: Jill Hootman. Yeah, I
9 agree, Harvey. But here's the thing is it never
10 happens that way, right? You're going to get the
11 whole unit with the -- if your gas fails and you
12 now need to replace your unit, you're going to get
13 the whole unit, the cooling, everything.

14 You're going to have to pay that
15 whatever increased amount for the entire unit even
16 though your cooling was probably operating, right?
17 You're never going to just replace just the
18 heating side. You have to replace the whole unit
19 and the incremental costs that go with replacing
20 that. It isn't just -- even though they did this,
21 they arbitrarily pulled out just the heating side.
22 It's never pristine like that.

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1 MR. SACHS: Harvey Sachs. And vice-
2 versa.

3 MS. HOOTMAN: For cooling?

4 MR. SACHS: Yeah.

5 MS. HOOTMAN: Yes, yes.

6 MR. CYMBALSKY: But I think -- this is
7 John from DOE. But if we're just focusing on the
8 efficiency changes in the gas part of the unit,
9 the rest is a wash if you assume all that's the
10 same, so. I mean, you could just add \$5,000 or
11 whatever it is to every one of these. But the
12 delta is still the delta.

13 MS. HOOTMAN: Right. I understand what
14 you're saying in the analysis. I think that it
15 comes -- and this is Jill Hootman from Trane. I
16 think it comes to bear more in the fact that
17 whether they will actually repair or replace those
18 decisions.

19 MR. CYMBALSKY: Right.

20 MR. BROOKMAN: Mike?

21 MR. RAY: I think it ties back to --
22 this conversation that we're having also ties back

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1 to the fact that we'd like to have all this rolled
2 into one rulemaking. I think you've highlighted
3 the issue because you've got a piece right now
4 that you're cutting out for the gas furnace.
5 You've got a piece that we're talking about for
6 the cooling side and thus the reason why and I
7 know you've heard this before.

8 MR. CYMBALSKY: So I was waiting, right?
9 I was waiting for the comment. I was surprised it
10 took us until noon to get it.

11 MR. BROOKMAN: 12:20, in fact.

12 MS. HOOTMAN: I have to admit, I take --

13 MR. CYMBALSKY: Yeah, so DOE, you know,
14 obviously lining up the compliance dates for those
15 two rules since it's, you know, one box obviously
16 is something DOE understands is economically
17 important to the manufacturers. So the extent
18 legally we can do all that stuff, but you know,
19 clearly it's something that would make sense to
20 the department.

21 MR. BROOKMAN: Mike?

22 MR. RAY: Shifting directions back to

1 the installed cost piece, in the case, the example
2 that I mentioned earlier in the day where there
3 was a heat exchanger, it was a competitor's heat
4 exchanger but where the heat exchanger rusted out
5 and in the end it was only three to five years
6 old, yes, because the unit was only three to five
7 years old, the unit was still in reasonably good
8 operating condition. They had to physically
9 dismantle the unit and put it -- and up a new heat
10 exchanger back in and then reassemble the entire
11 unit and hopefully address the issue of what
12 caused it to rust in the first place. But and
13 that was not an unusual situation that that
14 happened.

15 But and as it was, that furnace was an
16 82 percent furnace. And since a major piece had
17 failed but it was still a relatively new unit,
18 they had to -- they said let's go ahead and just
19 keep replacing those heat exchangers. But and
20 that's not included in how in the calculation to
21 replace a heat exchanger in three to five years or
22 in seven years or whatever. I know that's not

1 part of the calculation and that's one of the
2 challenges I think from an industry standpoint.

3 We don't want our customers to have to
4 go through that pain of having to replace a heat
5 exchanger. You know, hey, my unit's only seven
6 years old or 10 years old. You know, having
7 something like that occur is not a fun thing to
8 do. If you're a contractor having to do it and
9 face your customer with it but also just in
10 general, as a manufacturer, because the customers
11 will be getting in touch.

12 MR. BROOKMAN: Michael McCabe?

13 MR. MCCABE: Michael McCabe. Victor,
14 this is a question that's somewhat out of your
15 analysis but given the work that LBNL has done,
16 you may have come across something. On slide 71,
17 given how little the installed cost changes from
18 the baseline to level two, the 82 percent, you've
19 got and the payback periods are so short, under a
20 year, have you come across any reason why more
21 consumers are not buying the more efficient units?
22 So this is really consumer behavior question.

1 MR. FRANCO: Yes. We didn't actually
2 conduct that type of analysis. But it might be
3 model loyalty. There was one manufacturer that
4 produced that model. Definitely comments in that
5 regard would be greatly appreciated for us to more
6 appropriately evaluate that.

7 MR. CYMBALSKY: It's interesting. If
8 you go back to the engineering slide that, you
9 know, the mode that was rated at 80 actually
10 performed over 82 in our testing and the one that
11 was rated at 82 performed at 82. So I don't know
12 what that means, but I'll just make that
13 statement.

14 MR. BROOKMAN: Are we ready to move
15 on here? Frank?

16 MR. STANONIK: Frank Stanonik, AHRI.
17 And well, I'll apologize in advance again if I'm
18 bringing up issues that I missed this morning.
19 Listening to that last conversation and then the
20 couple others, but first of all, I think, John,
21 you just pointed something out that again I don't
22 know if it came up but if in fact products -- if

1 the minimum is 82, then a manufacturer, it's
2 totally correct to assume that his production
3 units -- his production units will have
4 efficiencies on either side of that.

5 You know, assuming he's following the
6 law and complying and doing the test procedures,
7 you know, his rate will have to have the average
8 on 82 and when he produces them they're going to
9 be on either side. The ones that are on the other
10 side of 82, and again, we don't have that data
11 necessarily but let's just for sake of the
12 discussion say that the deviation was plus or
13 minus 2 percent. And again, I'm not saying that's
14 it because I don't know that.

15 But let's say it was. That means the
16 manufacturer knows that in some cases he
17 potentially is going to be sending out products
18 that are going to be operating at 84 percent,
19 okay? That from the manufacturer's perspective is
20 absolutely unacceptable for an outdoor unit. That
21 will have condensate problems. That may be the
22 one that dies within five months or whatever the

1 number was.

2 But the point of all this is that as
3 we're looking at that level, we think the
4 installed cost is going to be very different
5 because a manufacturer is going to have to protect
6 -- I'll say protect themselves. They want to
7 provide the same levels of reliability of the
8 product. So they will have to do things and
9 encourage installation practices that basically
10 are intended to thwart any unintended condensation
11 and associated problems.

12 So we have a -- we think that the
13 installed cost here which is you're basically
14 looking at the cost of added heat exchanger or
15 whatever, in the practical sense has been
16 underestimated and we'll try and give you some
17 different estimates, some better information that
18 we would say we think the installed cost is
19 probably going to be more like this level because
20 we manufacturer again will have to in their
21 installation instructions put information that
22 essentially is intended to do things that avoid

1 I'll say foreseeable condensate problems even
2 though it's, you know, again will every unit
3 necessarily have it.

4 Well, I don't think you can say if it's
5 being installed in San Diego or whatever. I don't
6 know that I'd be too worried. But you know, from
7 the industry's perspective, we don't know let's
8 say that those units that were coming down the
9 line and just, you know somehow they were firing
10 and operating in the 83 percent efficiency or
11 whatever. You know, we don't know that they end
12 up either in San Diego or Minneapolis or New York
13 City or Boston or whatever.

14 MR. BROOKMAN: Okay.

15 MR. STANONIK: So I think there's a
16 bigger issue there than it's unfortunately not
17 quite as simple as this chart would show.

18 MR. FRANCO: Thank you. I appreciate
19 your comment. I'll move on to the next part of
20 our analysis. DOE takes into account subgroup
21 analysis. So for these commercial products, we
22 look at small businesses to evaluate the impact on

1 this portion of the markets. The results are
2 shown here. A comparison of the LCC and median
3 paybacks are very similar, as can be seen from the
4 table. That concludes the LCC and payback
5 analysis and at this point we would request
6 comment on any other questions about the lifecycle
7 cost. Specifically we would request comment on
8 consumer subgroup analysis.

9 MR. BROOKMAN: Should we break for lunch
10 or should we keep going?

11 MR. SACHS: What does John, our leader,
12 think our estimated time --

13 MR. CYMBALSKY: I think we can get
14 through this in an hour if we --

15 MR. BROOKMAN: I don't think -- I
16 think an hour -- I think we should break for lunch
17 if it's going to take an hour.

18 MR. CYMBALSKY: What does everyone else
19 think? I'm leaning the other way even though my
20 stomach is growling.

21 MR. SACHS: I reluctantly agree with the
22 honorable Mr. Cymbalsky.

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1 MR. BROOKMAN: All right. I'm
2 comfortable to keep going if you want to keep
3 going.

4 MR. CYMBALSKY: I can order some donuts.

5 MR. BROOKMAN: It seems like he's got
6 some right there. Okay, it seems like we're going
7 to keep going. Okay, let's proceed. Shipments,
8 NIA, RIA, MIA.

9 MR. FRANCO: So we now go into the
10 shipments, NIA, RIA and MIA analysis section.
11 I'll be -- I'll present the shipments, NIA, RIA
12 and MIA analysis next. The shipments analysis is
13 used to project -- to calculate the projected
14 shipments from the analysis period from 2018 to
15 2047 with and without the energy conservation
16 standards. The shipments analysis takes into
17 account two major market segments, new
18 construction and replacements. New constructions
19 are determined using the projected commercial
20 floor space and the projected market share in that
21 new construction market.

22 Replacements are determined based on

1 historical shipments and the survival function.
2 We also take into account fraction of units that
3 are demolished, that is the actual building that
4 are demolished. Efficiency projections are also
5 taken into account in terms of the base case and
6 standard case. We also take into account the
7 impacts of standards on shipments in terms of the
8 price elasticities. The commercial consumer
9 decisions are influenced by the purchase price and
10 operating cost. Some consumers may choose to
11 repair rather than replace their commercial
12 equipment.

13 Here is a flowchart showing the
14 shipments analysis. So on the top part, this is
15 how we calculate the new construction shipments,
16 as I mentioned before. We're matching the
17 projected new construction commercial flow space
18 with the commercial equipment saturations for the
19 new construction market and for the replacement
20 shipments we're taking into account historical
21 annual shipments and retirement function. On the
22 replacement side we also take into account some

1 demolitions and adding these two give us the total
2 shipments, the annual shipments during the
3 analysis period.

4 In terms of data sources, we're using
5 AEO 2013 for the projected new construction
6 commercial floor space and the saturations come
7 from historical data in CBECS and RECS. The
8 historical annual shipments is a mixture of
9 different sources. We have only one data point
10 for just gas-fired commercial warm air furnaces in
11 1994. We have historical data from CUAC which is
12 also used in the CUAC rulemaking that goes from
13 1980 to 2012 using both AHRI data and census data.
14 To come up with commercial warm air furnaces
15 shipments, we calculate a ratio of the CUAC
16 shipments to the commercial warm air shipments
17 based on the 1994 data.

18 Based on that data, we come up with
19 about 80 percent of CUAC shipments are CUACs with
20 gas-fired commercial warm air furnaces. We didn't
21 have any data for oil-fired equipment. So we came
22 up with a ratio between oil-fired and gas-fired

1 equipment based on residential furnace shipments.
2 The retirement function comes from the lifetime
3 distribution, which was a few slides ago and is
4 further described in TSD chapter eight.

5 Here are the historical and projected
6 shipments. We're projecting around 250,000 to a
7 little bit more than 300,000 shipments during the
8 analysis period from 2018 to 2047. Oil-fired
9 equipment accounts for about 1 percent of those
10 shipments. DOE seeks comment on the methodology
11 and data sources used in these projections.
12 Specifically, DOE is interested in any historical
13 data that can be gathered that would be more
14 accurate for the commercial warm air furnaces.
15 DOE also seeks comment on the impacts of the
16 amended standards on the product shipments,
17 including any equipment switching that might --
18 DOE might need to take into account.

19 MR. BROOKMAN: Comments on the
20 shipments analysis? Okay.

21 MR. FRANCO: Next, we come to the
22 national impact analysis. The national impact

1 analysis serves to estimate the national impacts
2 of the energy conservation standards over the
3 lifetime of the commercial warm air furnaces
4 shipped between 2018 and 2047. There are two
5 components that we take into account to calculate,
6 the national energy savings, which is the
7 difference in the annual energy use between the
8 base case and the standard cases, summed over the
9 lifetime of the equipment shipped between 2018 and
10 2047, and the net present value, which is the
11 difference between the present value of the
12 installed cost and the present value of the
13 operating cost over the analysis period from 2018
14 to 2047. These values are discounted. The method
15 we use I'll be describing in further detail in the
16 next few slides.

17 This slide shows a flowchart of the
18 actual analysis. Again, we start with the
19 shipments analysis to give us the annual
20 shipments. We calculate the base case energy use
21 based on the annual energy consumption times the
22 annual shipments analysis which will give us the

1 base case cumulative energy use. In the standards
2 case, we do exactly the same and we come up with a
3 standards case cumulative energy use. We multiply
4 this by the site to source energy conversion
5 factors to come up with the national energy
6 savings.

7 The net present value, again we start
8 with the shipments analysis, annual shipments
9 data. From the LCC analysis, we have average
10 energy cost, maintenance and repair cost and total
11 installed cost both for the base case and standard
12 cases. We then compare the cumulative operating
13 cost savings between the case base and standard
14 case and the cumulative total consumer cost
15 increases. We discount both of these and come up
16 with a net present value.

17 This slide further describes the inputs
18 and some of the sources. The annual unit energy
19 consumption comes from the LCC energy analysis,
20 energy use estimates. The shipments are described
21 previously in the shipments analysis. The
22 equipment stock is determined by the annual yearly

1 stock of the annual shipments in the lifetime over
2 the equipment class. For this equipment, there is
3 no rebound effect. I will be talking a little bit
4 more about the base case efficiency distributions.
5 But basically we use a roll-up scenario.

6 And we request comment on historical
7 shipments data to determine these further. Site-
8 to- power plant conversion factors are determined
9 from AEO 2013. Full-fuel-cycle is also determined
10 from AEO 2013. Total installed cost and operating
11 cost per unit come from LCC analysis. Results,
12 the discount rate used for the national net
13 present value is 7 percent and 3 percent real and
14 this comes from OMB's regulatory analysis
15 guidelines.

16 Here are the base case efficiency
17 distributions. As mentioned before, we use a
18 roll-up when we're complying to standards. The
19 equipment at or above the efficiency will not be
20 affected in the roll-up scenario. So for example,
21 our base case assumptions are for the gas-fired
22 warm air furnaces 67 percentage at the baseline

1 and 24 percent are at 81 percent. If the standard
2 is set at efficiency level one, basically it's 67
3 plus 24 which will give us 90 percent at that
4 efficiency. The efficiencies above that will not
5 be affected.

6 We do apply a trend in terms of the
7 condensing efficiency. We start off in 2018 at 1
8 percent of the market and we assume that that will
9 increase to 5 percent of the market by 2047.

10 MR. BROOKMAN: Mike?

11 MR. RAY: Minor points, but just on
12 slide 83, obviously it's rounding numbers. But
13 they're off just by a hair. It's not a big deal
14 but just noted that.

15 MR. FRANCO: Yeah, below there's a
16 little bit of a note that says the rounding, yes.
17 Thank you for that. Next, DOE determined the
18 trial standard levels. DOE has five trial
19 standard levels that is a mixture of the
20 efficiencies for gas-fired and oil-fired
21 equipment. TSL 1 is the most commonly efficiency
22 level above the baseline for a gas-fired equipment

1 and at the baseline for oil-fired equipment.
2 Therefore, 81 percent for both. Two through four
3 are a mixture. So TSL 2 is 81 percent for gas, 82
4 percent for oil. TSL 3 is 82 for gas, 81 percent
5 for oil. And TSL 4 is 82 percent for both gas and
6 oil. TSL 5 is at the max tech. For this NOPR
7 analysis, DOE is proposing TSL 4 as a proposed
8 level.

9 Next, we present the results from the
10 national impact analysis. First, we'll look at
11 the national energy savings in CWAFFs. These are
12 by TSL. So the first few rows are the primary
13 energy savings and the last three rows are the
14 full-fuel-cycle energy savings. For the proposed
15 level at TSL 4, the full- fuel-cycle energy
16 savings are a little bit more than half a CWAFF.

17 Next are the net present value. They're
18 reported at both 3 percent and 7 percent. For TSL
19 4, at 3 percent it's about 2.7 billion and at 7
20 percent discount rate, a little bit more than 1
21 billion. This concludes the national impact
22 analysis and at this time we request any comments

1 on the analysis from interested parties,
2 specifically related to rebound effect and base
3 case efficiency distribution trends.

4 MR. BROOKMAN: Comments on national
5 impact analysis? Michael McCabe?

6 MR. MCCABE: Victor, right at the top
7 you asked for comments on the rebound effect. As
8 I understand it, EIA in the annual energy outlook
9 does include rebound effect for commercial heating
10 and cooling. But it's not being included here.
11 Are there any data out there that EIA should
12 consider as to drop it from their analysis?

13 MR. FRANCO: Thank you so much, Mike.
14 I'm not aware of what that level is of the rebound
15 effect. We did get stakeholder comments that there
16 was no rebound effect for this rulemaking. So any
17 information would be useful to further quantify if
18 that is true or not.

19 MR. MCCABE: Okay. I think -- this is
20 Michael McCabe again. I think John looks like
21 he's getting about ready to chime in since he's
22 got some background with --

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1 MR. CYMBALSKY: I do, yeah.

2 MR. MCCABE: A little bit of background
3 with EIA and the annual energy outlook.

4 MR. CYMBALSKY: Yeah. So this is John
5 at DOE, a former EIA modeler. Yeah, you know, I
6 did the residential model so I'm not as up to
7 speed on the commercial side. But I do believe
8 they have a rebound and it's based on the --
9 there's a rich literature here that the range for
10 rebound effect on some of these -- and if you look
11 by end use, some of them are actually positive and
12 not negative.

13 So the studies out there show a large
14 range. I think EIA picked a number more like -0.3
15 or -0.25. I'm not sure. But we'd have to go back
16 and look at that. But lots of arguments on both
17 sides here. So I don't -- we assumed none and
18 took comment and again we're happy to take comment
19 again on that.

20 MR. BROOKMAN: Okay. Frank Stanonik?

21 MR. STANONIK: Frank Stanonik, AHRI. On
22 slide 85, so if you look at the primary energy

1 savings between -- well, you know, one and two is
2 81 percent, three and four is 82 percent. So the
3 primary energy savings at three or four is in fact
4 more than double what is one or two, right? So
5 then but if I go back to slide 55, the annual fuel
6 use, the savings at level one is 1.9 million Btu
7 and at level two it's double, straight double.

8 The annual electrical savings is for the
9 81 is 12 kWh per year. At 82, it's just less than
10 double. So if you will, the per unit consumption
11 numbers indicate roughly 1 percent get you double
12 and yet the national energy savings, that's
13 certainly more than double. What am I -- what
14 changes at the national energy savings level to
15 kind of alter that proportion?

16 MR. FRANCO: Thank you so much, Frank,
17 for that question. This is Victor Franco again.
18 It is a little bit confusion once you're comparing
19 the lifecycle costs and the energy use and
20 comparing it to the national impact. The main
21 thing to consider there is that for the energy use
22 it's kind of the average at that efficiency level.

1 Once we look at either the LCC savings
2 or the national impact analysis, we're looking at
3 it in terms of the base case. There's a number of
4 consumers that are already at 81 percent. So
5 there's a fraction that wouldn't have any savings
6 at 81 and when you're going from 81 to 82, those
7 actually do have savings and it's about close to
8 24 percent of the market.

9 MR. BROOKMAN: Harvey Sachs? No?
10 Okay.

11 MR. SACHS: He answered it when he
12 clarified.

13 MR. BROOKMAN: Yeah, thank you.
14 Michael McCabe?

15 MR. MCCABE: It's Michael McCabe.
16 Victor, following up on that, I would expect then
17 that the savings would be going down, you know, in
18 the NIA rather as compared to the engineering
19 because if you've got more -- if you've got 20
20 percent of whatever the number the consumers are
21 already buying at that level, then the average per
22 unit savings is going to be lower than what it

1 would be in the engineering analysis.

2 MR. CYMBALSKY: Right, so that's -- this
3 is John from DOE. So I don't know if this came
4 out clear. But a lot of the market's at 81. So
5 but 80 to 81, there's a bunch of percentage guys
6 already buying at 81. So that was a small delta.
7 But there are not a lot at 82. So that's a bigger
8 delta. So if the number suggested more were
9 already buying at 82, what you just said would be
10 true. But it's actually 81 where they're buying
11 already.

12 MR. BROOKMAN: Okay. Thank you,
13 John. Final comments on national impact analysis?
14 Okay, we're moving on to regulatory impact
15 analysis.

16 MR. FRANCO: Victor Franco again, going
17 back to regulatory impact analysis. Just one
18 second. Okay, there we go. So the purpose of the
19 regulatory impact analysis is to assess the
20 national impacts of non-regulatory alternatives to
21 mandatory amended energy conservation standards.
22 Basically we modified the NIA spreadsheet to

1 evaluate the non-regulatory alternatives such as
2 the no regulatory action, consumer rebates,
3 consumer tax credits, manufacturer tax credits,
4 voluntary energy efficiency targets and bulk
5 energy purchases.

6 The output of this analysis is NES and
7 NPV for non-regulatory alternatives. No
8 alternative was found to be as beneficial as the
9 proposed energy conservation standards. Further
10 information about this analysis and the results is
11 presented in chapter 17 of the TSD.

12 MR. BROOKMAN: Manufacturer impact
13 analysis. Chris Lau?

14 MR. RAY: Before we jump to that?

15 MR. BROOKMAN: Yes, Mike Ray?

16 MR. RAY: Mike Ray. Where is the TSD in
17 chapter 17? I went out and looked at -- I went
18 out and pulled down as many files as I could in
19 preparation for this and I found a few of these.
20 But I didn't find -- I don't know that I found a
21 regulatory impact analysis and you're referencing
22 chapter 17. So I assume that there is a list of

1 chapters that are available yet I think there's
2 only six files out on the website.

3 MR. FRANCO: Victor Franco. There is
4 one single TSD file that's actually available and
5 it includes all the chapters and appendices. If
6 you go through that file, close to the bottom
7 there's chapter 17. It's available there. So
8 there are six files, correct. Some of them are
9 the analytical tools, the spreadsheets. There's
10 two PDF files. One is the NOPR notice and the
11 other one is actually the TSD. That's the larger
12 file.

13 MR. RAY: Okay. Thank you.

14 MR. LAU: Afternoon, folks. My name is
15 Christopher Lau. I'm with Navigant. I'll be
16 presenting the manufacturer impact analysis. The
17 primary purpose of the manufacturer impact
18 analysis, or the MIA, is to assess the impacts of
19 amended standards on commercial warm air furnace
20 manufacturers as an industry. The second purpose
21 is identifying and qualifying the impacts on
22 manufacturer subgroups such as small business

1 manufacturers. And the final portion of the MIA
2 involves discussion of direct employment,
3 potential capacity constraints and other federal
4 regulations that go in effect around the
5 compliance date of the standard.

6 The primary tool we use is the
7 government regulatory impact model. It is a cash
8 flow model used to represent the industry as a
9 whole. The major output of the model is an
10 industry net present value, a metric used to
11 succinctly quantify the impact of standards on
12 manufacturers. We also conduct interviews to
13 validate and refine the inputs to the model, the
14 government regulatory impact mode, or the GRIM,
15 and to better understand qualitative issues.

16 The analysis is conducted in three
17 general phases. Phase one, we built an industry
18 profile from publicly-available information.
19 Phase two, we use content from the MTA, the
20 engineering analysis and shipments analysis to
21 outline the industry in the GRIM. And in phase
22 three, key inputs are validated with manufacturers

1 and qualitative issues are discussed in
2 interviews. We use this content to refine the
3 GRIM to better reflect the industry.

4 As I mentioned before, the model itself
5 relies on several analyses we've already discussed
6 today. We use financial and product information
7 from the market and technology assessment. We
8 take manufacturer production costs from the
9 engineering analysis and we use shipment forecasts
10 from the shipment analysis. These inputs are
11 essentially locked in before we run our model. To
12 complete our model, we supplement two key pieces
13 of information; markup scenarios and conversion
14 cost scenarios.

15 For this rule, we developed high and low
16 cases for the manufacturer markup scenarios and we
17 also developed high and low cases for the
18 conversion cost scenarios. This results in four
19 different sets of results, all four presented in
20 the TSD -- [coughs] -- excuse me. I'm a little
21 sick today.

22 The NOPR itself focuses on two of those

1 scenarios, the ones with the least and greatest
2 change in INPV, the percent range of potential
3 impacts on the industry. What we found was
4 actually that for markups, the results are not
5 particularly sensitive to the markup assumptions.
6 Our markup scenarios, to be simplistic, are
7 measures of the industry's ability to pass on the
8 cost of the standard to its customers. However,
9 since we didn't see much change in the variable
10 cost for manufacturers, I think we discussed this
11 a bit earlier, you know, like 3 to 4 percent
12 change in MPC for gas-fired units and 1 to 2
13 percent change in MPC for oil-fired units. The
14 conversion costs were really the driving factor in
15 the INPV results.

16 And so, if you look here in the base
17 case, we estimate that the industry, just for the
18 furnace unit -- right, there again is an arbitrary
19 distinction -- but the base case value is roughly
20 75 million at TSL 4. The model shows a loss of 15
21 percent to 58 percent for the industry and those
22 are really tied to the conversion cost scenarios.

1 In one case, we estimate the industry having put
2 together upfront investment of \$20 million and the
3 high case it's up from an investment of \$60
4 million. It's a fairly significant range there
5 and something I'd like to focus on today.

6 In interviews, when we spoke to
7 manufacturers, there was consensus that product
8 conversion costs were the real driver here. But
9 at the same time, we received a really wide range
10 of feedback, everything from numbers in the
11 thousands and numbers in the millions on a per
12 manufacturer basis. More difficult for us, the
13 feedback received was fairly high level. You
14 know, it was fairly vague as to what the
15 components of those costs were.

16 So it made it hard for us to -- it made
17 it challenging for us to do our validation work of
18 those numbers. So in the discussion today, it
19 would be helpful to the department and to the
20 analytic team to understand the industry's
21 estimates of those conversion costs -- capital
22 conversion costs and product conversion costs but

1 also understanding how the industry arrives at
2 those estimates, what are the key components.

3 On the tooling side, you know, what's
4 the equipment tooling necessary, how many pieces.
5 On the R&D side, more detailed estimates of the
6 redesign costs, you know, the engineering time,
7 the lab time, the kinds of safety testing, heat
8 limit testing, reliability testing, just
9 understanding how those costs add up to the fairly
10 significant numbers the industry has proposed and
11 that we heard in interviews.

12 [Off mic conversations]

13 MS. HOOTMAN: Jill Hootman, Trane. So I
14 think we've said this before too. It becomes very
15 hard to just quantify gas heat because associated
16 fans will have to change, therefore cabinets will
17 have to change, therefore major redesign as far as
18 we're concerned. You know, costs, if we have to
19 redesign a heat exchanger, it is a long
20 development.

21 Average time in test labs can be
22 significant, six to eight weeks just to prove out

1 your design and then you start your reliability
2 testing and your reliability testing, it cycles on
3 and off, on and off, on and off, looking at heat
4 surfaces and where you have, you know, hot spots
5 and wear and all of that. Those can take years to
6 actually do those reliability tests. I would
7 hasten to guess probably two to three years just
8 to do that cycle testing.

9 We don't really -- we don't --
10 historically if you look at designs and
11 historically if you look at those packaged units,
12 we are upgrading, doing various different things
13 on the cooling side more often than we're doing on
14 heating because we don't want to touch heating
15 because it is so long, so -- and there's not as
16 many variations as well, you know, that are used
17 in -- in other words, there might be six or eight
18 models and they're used in various different
19 configurations. Every time you change the
20 configuration, you have new testing.

21 So let's say I do have a 250,000 Btu and
22 you think, oh, there's an economy of scale there.

1 Well, every single time I put that in a horizontal
2 unit, I have new testing. I put it in a down flow
3 unit, I have new testing. I put it in a different
4 cabinet, I have new testing. Every single time
5 those heater overloads have to be looked at,
6 airflow profile has to be looked at in order to
7 determine hot spots on the heat exchanger and
8 where it might have failures.

9 So really this testing is sometimes in a
10 way longer than cooling testing that actually
11 happens. Plus on the whole I would say that, you
12 know, I might have one lab to 10 chambers that
13 could do cooling in a test lab but I only have one
14 that might be able to do heating. So my
15 availability of where I might be able to do heat
16 testing might also be a problem. Since this has
17 no upward bounds like we said that were up to 2.5
18 million, 2 million Btu heat exchangers, there're
19 actually probably no labs that do those. We test
20 them outside and you have to wait for temperatures
21 to be adequate to test those.

22 So you know, you're waiting for Mother

1 Nature to be able to test those. You know, coming
2 up with exact numbers right now, I can't say them.
3 I'll certainly, you know, look at that when we
4 provide comments on all of this. But I think to
5 say that it's just the heat exchanger development
6 is wrong. It definitely has way bigger effects in
7 the whole unit. So I would agree with your \$60
8 million. It's probably upwards more than that.

9 MR. BROOKMAN: Okay.

10 MR. LAU: Thank you.

11 MR. BROOKMAN: Michael McCabe?

12 MR. MCCABE: Michael McCabe. Chris,
13 quick question. One of the purposes of the MIA is
14 to capture cumulative regulatory burden between
15 the residential furnace proposed rule and the
16 commercial furnace proposed rule, DOE identified
17 it's either 19 or 20 rules that would affect the
18 HVAC industry. And what your slides don't touch
19 on is how you captured the cumulative regulatory
20 burden. Could you touch on that?

21 MR. LAU: Sure.

22 MR. RIVEST: I'll take that one.

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1 MS. HOOTMAN: Yes.

2 MR. BROOKMAN: Mike Rivest?

3 MR. LAU: Yeah, they're just
4 prescription.

5 MS. HOOTMAN: Wow.

6 MR. RIVEST: Well, I'll try to -- this
7 is Mike Rivest, Navigant. That's a sweeping
8 question, Mike. Let's look at this particular
9 slide about the industry -- it focuses on the
10 value of a particular industry, the industry
11 that's being regulated in this rule. It's an
12 industry that we quantify at \$75 million and so we
13 put the bounds of the industry at the product
14 shipments that are being regulated today.

15 So when we talk about regulative burden,
16 it can mean a number of different things. As I --
17 as we define the industry more broadly, we are
18 increasing the revenues as well. So you're
19 increasing the denominator, you know. So in a
20 way, you're diluting the impact, if you will,
21 right? So from a percentage point of view, if you
22 look at the impact here of -58, 55 percent, if I

1 start bringing in the central AC rule and all
2 those other rules, your denominator is getting
3 really, really large and your percentage impact is
4 actually going down, down. You know, it's going
5 to be a lesser number.

6 So I don't think that's what you have in
7 mind. I think cumulative burden in some
8 situations can be the cumulative burden of
9 multiple rulemakings on one particular product
10 within a certain timeframe for example. That's
11 not happening in this rule. So it's not being
12 captured in that way. There might be qualitative
13 considerations where there are pooled resources
14 for R&D or test labs, for example, where, you
15 know, if those are known to us, then those would
16 be reported to the department and taken into
17 consideration in the decision-making.

18 So that type of information you gave
19 earlier is extremely helpful, Jill. So you know,
20 if test chambers are shared resources with those
21 other products, the residential furnaces for the
22 heating products, for example, that would be

1 helpful to know or maybe even the R&D resources
2 such as engineers or pooled resources. So that
3 would be helpful. But on the INPV calculation
4 itself, you know, increasing the number of rules
5 under consideration is not something we've done.
6 I don't think it's something that was intended to
7 be done.

8 MR. BROOKMAN: Harvey Sachs?

9 MR. SACHS: This is Harvey Sachs and I
10 certainly don't claim to speak for everyone in the
11 advocacy community. But if I try to think about
12 this a little bit holistically, given that 93 to
13 95 percent of the gas-fired warm air furnaces are
14 integral parts of RTUs, I think that I can be very
15 sympathetic to the desire to have the RTU be the
16 regulated product including both its cooling and
17 its heating and preferably figuring out how to
18 include its ventilating function as well, that I
19 think Jill and Mike have made a pretty strong case
20 that there is a strong interaction as we think
21 about heat exchanger size, which is the basic
22 component in the warm air furnace with other

1 aspects of the RTU design.

2 And I don't know how to handle this,
3 given the multiple actors including ASHRAE 90.1
4 for commercial equipment. I think it is incumbent
5 upon all of us as a community to start thinking in
6 these directions.

7 MR. RIVEST: You know, in the context of
8 two rules going on simultaneously or maybe not
9 simultaneously but, you know, overlapping -- I
10 mean, there can be quantitative consideration of
11 economies of grouping them. So for example, that
12 \$60 million could be reduced if it was done -- the
13 R&D program corresponded or, you know, coincided
14 with a rooftop standard.

15 Well, the R&D requirements, you know, if
16 you're doing the testing and you're having to, you
17 know, to do a lot of testing for the fans or, you
18 know, I assume when you're going to be determining
19 for example the fan size or the motor size and the
20 statics and things like that, you'll want to have
21 the proper furnace installed. So you'd want to do
22 that once I assume. So there might be some

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1 savings in having the two rules together that
2 could be taken into account. That's something, you
3 know, you're in a position to tell us.

4 MR. SACHS: I think you're addressing --

5 MR. BROOKMAN: Harvey, microphone.

6 MR. RIVEST: That's not what you were
7 getting at?

8 MR. SACHS: I think you're directly
9 addressing the representatives from industry. But
10 I'm saying that my goal is energy savings and the
11 less expensive it is to get the energy savings,
12 the more likely it is we are to get them. And in
13 that sense, the advantages of synchronizing, that
14 may be the simplest way to describe it, the
15 processes for what we call the unitary commercial
16 air conditioner and the warm air -- commercial
17 warm air furnace ought to be seized and we have
18 not as a community, including the ASHRAE
19 community, figure out how to do that and I think
20 that ensures inefficiencies.

21 MR. LAU: This is Chris Lau with
22 Navigant. Harvey, I think we're speaking the same

1 language. And to that point, you know, we have a
2 set of conversion costs for the cooling side of
3 the rooftop units from the CUAC rulemaking and we
4 have a set of conversion costs here for the
5 heating side. And when we went out and spoke to
6 manufacturers a while back, we got these estimates
7 of conversion costs from them.

8 And in part of those conversations, I
9 know that part of the costs you see here, that \$60
10 million is them taking into account the redesign
11 of the cooling side also, right, because the
12 cooling side -- the way the schedule was when we
13 did these interviews, it was that the CUAC rule
14 would go into effect, then I think it's two years
15 later the warm air furnace rule would go into
16 effect. And there are interactions there. And so
17 --

18 MR. SACHS: Harvey, interrupting
19 impolitely, the next cycle of 90.1 which I think
20 is 2016 and that has standing in this room as
21 well.

22 MR. LAU: Right, and so, to Mr. McCabe's

1 point and echoing something Mike Rivest said
2 earlier, you know, it would be helpful -- you
3 know, given the department's heard that the CUAC
4 and the commercial warm air furnace rulemaking
5 should be aligned, if they were aligned, how would
6 that affect some of these conversion costs we're
7 seeing today because that would be -- that would
8 create a very quantitative indication of why they
9 should be aligned.

10 MR. BROOKMAN: Harvey?

11 MR. SACHS: Thank you. This is Harvey
12 again. Thank you and I appreciate that, Chris. I
13 think there's a process question but there's also
14 a question of what is the product. And from my
15 perspective on commercial warm air furnaces is
16 that 5 to 7 percent are non-weatherized products.
17 Everything else is more integrated into a single
18 cabinet than, for example, the central AC and
19 furnace on the residential side. It's a much more
20 integrated design from my perspective.

21 MR. RIVEST: So you should be looking
22 over there when you say that.

1 MR. CYMBALSKY: I've already spoken my
2 piece on that. I think that my understanding
3 though is that what, you know, I'll say it a
4 little more bluntly than Chris just did, that if
5 these were aligned, that there would be some
6 synergy in the cost needed to redesign the RTU as
7 a -- you know, a thing that does both the heating
8 and the cooling and that it would be preferred by
9 the manufacturers to have those in line because
10 I'm assuming the cost wouldn't be additive. There
11 would be some decrement in the total. Did we get
12 the math right now?

13 MR. SACHS: This is Harvey.

14 MR. CYMBALSKY: I'm saying --

15 MR. SACHS: Yes, yes.

16 MR. CYMBALSKY: Okay. Then why don't we
17 just say that?

18 MR. SACHS: So why don't we take that
19 savings in energy savings?

20 MR. CYMBALSKY: Okay. We just said it,
21 so okay. I think we could -- you know, we look
22 forward - - obviously we're not going to get

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1 anything here today. We didn't expect to. But
2 you know, we're putting the plea out for whatever
3 you can do to help the department make, you know,
4 a decision on that. So the numbers obviously
5 would help policymakers and that to get to that
6 spot. So why don't we just move on to the small
7 businesses at this point?

8 MR. LAU: All right. Moving on to --
9 Chris Lau, from Navigant. Moving on to the next
10 slide, we did do a small business subgroup
11 analysis. We identified two small manufacturers.
12 One produced gas-fired product. They account for
13 17 of the 254 listing in the -- it says the AHRI
14 directory here but it's actually in the combined
15 directory that we put together. What we found was
16 their product mix was not substantially different
17 from some of their larger competitors, meaning
18 that they were not the only manufacturer that only
19 produced baseline equipment.

20 We also found one oil-fired commercial
21 warm air furnace manufacturer. They account for
22 11 out of the 16 listings in the directory,

1 indicating that they are fairly substantial in
2 this niche. They also offer the most efficient
3 products in the market and so we believe that they
4 are a leader in this niche and in general DOE was
5 unable to identify any publicly- available data
6 that would lead to the conclusion that the small
7 manufacturers would be differentially impacted
8 from the average in the industry than their larger
9 competitors though DOE does recognize that small
10 manufacturers may need to allocate a greater
11 portion of their available technical resources
12 than competitors, and may need to access outside
13 capital.

14 And so, with that, you know, we have
15 multiple requests for comment. I think we've
16 stated many of these. But essentially we seek
17 comment as always on the number of small
18 manufacturers and the potential impact to those
19 small manufacturers and the severity of those
20 impacts.

21 Again, sometimes it can be very
22 difficult to find public information on these

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1 manufacturers and we do want to make sure we
2 properly consider the impacts on them. DOE seeks
3 comment on the potential impacts of the amended
4 standards on the industry, on the conversion costs
5 for the industry, on the key drivers, again that
6 level of detail on the key drivers of those
7 conversion costs and then on changes in
8 manufacturer prices and markups. And finally, we
9 invite all comment on the MIA.

10 MR. BROOKMAN: Mike?

11 MR. RAY: I assume that you went to them
12 direct and asked them specifically.

13 MR. LAU: We did.

14 MR. RAY: Okay, yeah. I would assume
15 that you would. But yeah.

16 MR. BROOKMAN: Jill?

17 MS. HOOTMAN: So it's a detail I know in
18 this that I just have a question on where -- how
19 you derive the number of production workers
20 affected --

21 MR. LAU: Sure.

22 MS. HOOTMAN: -- because I'm quite

1 shocked by the number.

2 MR. LAU: Sure. So the number of
3 production workers actually primarily falls out of
4 three pieces of information. One is we use the
5 annual survey of manufacturers, so U.S. census
6 data on typical production workers' wages in this
7 industry. Then we look at the MPC for the
8 engineering analysis and the percentage of that
9 MPC that we estimate to be labor content. And
10 then, we look at shipments, national shipments.

11 And so, basically we're saying for
12 example there's a hundred shipments and \$10 of
13 that is labor content, then out of that \$1,000,
14 how many workers does it take to produce those
15 units. So a thousand dollars can be backed into
16 annual worker wage. I mean, obviously the example
17 the numbers are way too small but --

18 MS. HOOTMAN: Yeah, the numbers are way
19 too small.

20 MR. BROOKMAN: Mike Rivest?

21 MR. RIVEST: Mike Rivest. I think that
22 goes back to the definition of the industry.

1 We're only considering the revenues associated
2 with the heating section and you may have in mind
3 the full packaged unit. No? I mean, if each of
4 these units cost, like you said, said if it's \$400
5 and, you know, I've been looking at these surveys
6 of manufacturers for I don't know how many years
7 now, but typically it's 10 percent is labor.

8 Take 10 percent of the cost, not of the
9 sales price. It's 10 percent and that average
10 labor cost is under -- it's under \$20. It's just
11 a multiplication. So I don't know how -- and then
12 we add in for indirect labor. So you know, not
13 the people actually on the line but the people --

14 MS. HOOTMAN: The suppliers.

15 MR. RIVEST: No, we don't add in for the
16 suppliers, but -- I mean, the supervisors in the
17 plant, things like that. And that's how we build
18 up our labor estimates. So I'd be surprised that
19 we're that far off if we're talking about the same
20 thing.

21 MS. HOOTMAN: All right. Well, this is
22 where I have the issue. I can look at three

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1 manufacturing facilities that make these gas
2 furnaces and I have on order in those
3 manufacturing facilities dedicated just to heat
4 exchangers and making them the number that you
5 have in here, 200 people.

6 MR. RIVEST: Okay.

7 MS. HOOTMAN: So that's where I go, huh,
8 I got --

9 MR. RIVEST: That's good information. I
10 mean --

11 MS. HOOTMAN: -- people making that and
12 I'm just one of the many people that you just --
13 you know, so that's where I go how did you back
14 into it because it's not in actuality what's
15 happening.

16 MR. RIVEST: Okay. That's good
17 information. I mean, I think --

18 MR. VON WENTZEL: Constantin von Wentzel
19 here at Navigant. Any information that you can
20 submit to us, we would appreciate. There might be
21 an issue where your manufacturing assets are
22 shared across a wider range of product. So that

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1 might be where the 200 people come from as opposed
2 to 200 people being dedicated only to 250,000 Btu
3 furnaces.

4 MS. HOOTMAN: Okay. So that's a good
5 thing. Is it just the 250,000 or to all of the
6 furnaces under commercial warm air?

7 MR. VON WENTZEL: No, no.

8 MS. HOOTMAN: Okay.

9 MR. VON WENTZEL: No, no. I mean, it's
10 just that's where the \$40 would come in, right?

11 MS. HOOTMAN: Okay.

12 MR. VON WENTZEL: I mean, obviously if
13 you're building a million Btu furnace, you're
14 going to require more tubing, more labor, more
15 everything.

16 MS. HOOTMAN: Yeah, right. Okay.

17 MR. RIVEST: But more simply, we have
18 the revenue, our revenue estimates per year and
19 then, like I said, labor is about 10 percent. Are
20 we far off there?

21 MS. HOOTMAN: Yeah, and I heard you say
22 that before and I admit I didn't find it in here.

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1 But you said this is a \$75 million industry.

2 MR. RIVEST: That's the value per year.

3 MS. HOOTMAN: That's the value
4 pertaining to commercial warm air furnaces. Is
5 that right?

6 MR. RIVEST: Right.

7 MS. HOOTMAN: And I realize that's a
8 subsection of -- I mean --

9 MR. RIVEST: Right. You may want to
10 look at it.

11 MS. HOOTMAN: So I'll comment. If
12 that's the amount --

13 MR. RIVEST: The annual sales -- it's
14 about --

15 MR. LAU: \$70 million.

16 MR. RIVEST: \$70 million revenue.

17 MS. HOOTMAN: Okay.

18 MR. RIVEST: So that would be --

19 MS. HOOTMAN: Off the top of my head,
20 because we don't pull it apart, I'd have to do
21 some figures on that.

22 MR. RIVEST: Back out the markup and

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1 then take 10 percent of that and then take 15 --

2 MR. BROOKMAN: So while they're
3 looking, just for the record, we've had this
4 exchange going back and forth for several minutes
5 between Mike Rivest and Jill, so we know who's
6 speaking here.

7 MS. HOOTMAN: Thank you.

8 MR. BROOKMAN: And Chris, when you
9 find that number, did you find the number?

10 MR. LAU: The annual revenue is roughly
11 \$70 million.

12 MS. HOOTMAN: Seventy, okay.

13 MR. BROOKMAN: Okay, so in this last
14 conversation, boy, we've really illustrated the
15 benefits of getting really good comment from the
16 manufacturers, really very, very beneficial.
17 Okay, Chris, keep going.

18 MR. LAU: That's actually my last slide,
19 and I'll hand it back to Victor.

20 MR. FRANCO: Thank you. This is Victor
21 Franco again. Now, we're going to be looking at
22 the environmental impacts and indirect employment

1 analysis. As part of the environmental impacts,
2 we take into account the emission impacts in the
3 analysis to estimate the emission reductions
4 resulting from the amended standards.

5 These include the full-fuel-cycle
6 emissions that include the power plant and
7 upstream emissions and include the fugitive
8 methane emissions.

9 The method for determining this is using
10 outputs from AEO 2013 both in the reference and
11 standard cases to estimate marginal emission
12 factors. The results of these for TSL 4 are shown
13 below. Energy savings from the proposed standards
14 are expected to be the following reductions.
15 Further information about the methodology and
16 about the results are provided in chapter 13 of
17 the TSD.

18 In addition, DOE took account of the
19 monetization of these emission reductions to
20 estimate the potential monetary benefit of reduced
21 power plant emissions resulting from the
22 considered energy conservation standards. DOE

1 used the most current social cost of carbon values
2 developed through the interagency reviews. The
3 interagency estimates are shown in this next
4 slide, range from \$12 to \$119 per metric ton. For
5 emission reductions that occur in later years, SCC
6 values grow in real terms over time. DOE also
7 monetized NOx emissions reductions resulting from
8 amended standards. These range from \$476 to
9 \$4,893 per short ton. DOE calculated monetary
10 benefits using the median value of \$2,684 per
11 short ton.

12 The results are shown in this next
13 slide. For TSL 4, the CO2 monetized emission
14 reductions ranged from \$175 million to \$2.6
15 billion. More details about the methodology and
16 about these results are included in chapter 14 of
17 the TSD. DOE requests comments on this part of
18 the analysis, specifically seeks comments on its
19 approach for conducting the emissions analysis for
20 commercial warm air furnaces. Also DOE seeks
21 comment on the approach for estimating monetary
22 benefits associated with emissions reductions,

1 including in the social cost of carbon values
2 used.

3 MR. BROOKMAN: Frank?

4 MR. STANONIK: Frank Stanonik, AHRI.

5 I've got to ask why are we measuring -- why is the
6 cost of CO2 in a metric ton but the NOx is in
7 short tons? Could we use the same ton? But the
8 more serious question is so what's -- you
9 explained that you're -- maybe I'm more familiar
10 with the estimates for the social cost of carbon
11 and the CO2 numbers. At least I have some idea
12 where they came from. Where did you get the
13 estimate for the value of the NOx emission
14 reductions? Did that come from the same social
15 cost of carbon? No? I didn't think so.

16 MR. CYMBALSKY: Yeah, so I'm more
17 familiar with the social cost of carbon numbers as
18 well, which come from an interagency agreement
19 and, you know, we're basically told what to use
20 here. That's not a DOE thing. As for the NOx,
21 I'm pretty sure we're getting the value from what
22 EPA has done in this area. So the numbers I

1 believe are 28 -- if you look at the totals, yeah,
2 the carbon values are much, much higher, so.

3 MR. STANONIK: Frank Stanonik. I guess,
4 John, I was looking quite the opposite. I'm
5 looking at --

6 MR. CYMBALSKY: I meant when you add
7 them up. I mean, not --

8 MR. STANONIK: Oh, oh. Yeah, okay.

9 MR. CYMBALSKY: When you look in the
10 summary table shows that the carbon -- the sum of
11 the carbon benefits in the rule are much bigger,
12 threefold or so.

13 MR. STANONIK: Right. But the value of
14 a reduced ton of NOx is factors time higher than
15 the CO2. Yeah, okay.

16 MR. BROOKMAN: Michael McCabe?

17 MR. MCCABE: Michael McCabe. Victor, I
18 apologize for this question but I should have
19 asked back on the NIA but this discussion just
20 reminded me. At TSL 5, the condensing, are you
21 capturing any fuel switching from gas-fired
22 furnaces to heat pumps and how is that captured in

1 the environmental impact analysis?

2 MR. FRANCO: Thank you for that
3 question, Mike. For this analysis, we did not
4 take into account any equipment switching or fuel
5 switching. DOE is not proposing currently
6 condensing as a standard and that was not
7 analyzed. If you want to provide comments to
8 that, if DOE should analyze that, please do.

9 MR. BROOKMAN: Frank Stanonik?

10 MR. STANONIK: Frank Stanonik. Sorry,
11 one more question. I just want to make sure. So
12 on slide 96, all those estimated reductions, are
13 those just reductions associated with the -- what
14 do I call it, with the generation of the energy
15 whatever or as an example in the case of nitrogen
16 oxides, is it actually looking at the actual NOx
17 emissions of the furnace itself?

18 MR. FRANCO: I believe it's a mixture
19 for both. But it's mainly from the electricity.

20 MR. BROOKMAN: It's a mixture --

21 MR. CYMBALSKY: It's the combustion of
22 fuel.

1 MR. FRANCO: Combustion of fuel, yeah.

2 MR. CYMBALSKY: So it doesn't matter
3 where it happens.

4 MR. FRANCO: Next, we look at the
5 utility impact analysis, assesses the impacts of
6 the electric installed capacity and generation
7 resulting from the adoption of these amended
8 standards. We modeled this based on the energy
9 savings impacts on the different TSLs using NEMS-
10 BT to generate forecasts that deviate from the AEO
11 reference case, AEO 2013.

12 The output is the total in electricity
13 generation, changes in primary fuel, changes to
14 the mix of electricity generation by fuel type and
15 changes to total installed capacity. Detailed
16 results are provided in chapter 15 of the TSD as
17 well as more details about the methodology.
18 Finally, DOE took into account the indirect
19 employment impact analysis to assess the overall
20 impact on indirect national employment from the
21 amended standards that results from shifting
22 consumer expenditures among goods and services and

1 changing product and energy costs.

2 The methodology used the impact of
3 sector energy technologies (ImSET) model to
4 evaluate indirect employment impacts. Changes in
5 national equipment and energy expenditures from
6 the NIA are entered as inputs into the ImSET. The
7 net labor impacts will be small over time due to
8 small magnitude of the short-term effects. More
9 details about this analysis are provided in
10 chapter 16 of the TSD as well as the methodology
11 that was used.

12 MR. BROOKMAN: So as you can see in
13 the agenda, now is another opportunity for closing
14 remarks, summary comments here as we move towards
15 the end of the meeting. Frank?

16 MR. STANONIK: And again, if this has
17 come up before, you can just tell me to be quiet.
18 I think --

19 MR. SACHS: So moved.

20 [Laughter.]

21 MR. STANONIK: I think one of the issues
22 we have a concern about is that the trial levels

1 may in fact result in increasing the size of the
2 unit and if that is an outcome of a trial level,
3 that now does incur potentially some installation
4 costs, certainly in a replacement situation
5 because most of these units are in fact placed on
6 top of a platform I guess I'll call it or whatever
7 and if the unit ends up -- and again, realizing
8 we're talking about inputs from 226,000 to 2
9 million or whatever or more.

10 But in any case, if that bigger unit
11 requires some rework of, if you will, the
12 installation platform or whatever, that's a cost I
13 think that at this point hasn't been factored in
14 and we have a concern that it is going to be
15 there. And again, I only bring it up now because
16 I probably missed my chance since I came in late.

17 MR. BROOKMAN: Additional comments
18 here as we move towards the end of the meeting?
19 Harvey Sachs?

20 MR. SACHS: Harvey Sachs, thank you.

21 MR. BROOKMAN: Thank you. I'll turn
22 it back to John Cymbalsky for closing remarks.

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1 MR. CYMBALSKY: Okay, thanks, Doug. So
2 this last slide here just again shows how to
3 submit comments. Please use the email box as
4 opposed to regular mail if you can. The comment
5 period will close just before midnight, April 6th,
6 2015. So again, thanks for everyone for braving
7 the weather this morning to join us in person.
8 And for those of you on the webinar, thanks for
9 participating as well. I think the meeting went
10 well today. We appreciate all the comment we
11 received and again look forward to more in your
12 written comments over the next month. Thanks
13 again. Bye.

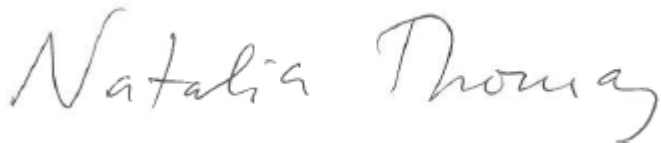
14 (WHEREUPON, the foregoing adjourned at
15 1:29 p.m.)

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