U.S. DEPARTMENT OF ENERGY

+ + + + +

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

+ + + + +

PUBLIC MEETING: ENERGY CONSERVATION STANDARDS FOR COMMERCIAL WARM AIR FURNACES

+ + + + +

CALL # 50402 EE-5B

+ + + + +

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.

P R E S E N T

DOUG BROOKMAN,
Meeting Facilitator, Public Solutions

DAVE CASE,
U.S. Department of Energy

JOHN CYMBALSKY,
Office of Energy Efficiency and Renewable Energy, Building Technologies Office, U.S. Department of Energy

ERIC STAS,
Office of the General Counsel, U.S. Department of Energy

A L S O P R E S E N T

DAN ARNOLD,
Nortek Global HVAC

ADAM DARLINGTON,
Navigant Consulting

VICTOR FRANCO,
Lawrence Berkeley National Laboratory

JILL HOOTMAN,
Trane

KEVIN JARZOMSKI,
U.S. Energy Information Administration

DOUG KOSAR,
Gas Technology Institute

CHRISTOPHER LAU,
Navigant Consulting

ALEX LEKOV,
Lawrence Berkeley National Laboratory

JOHN LOHRER,
U.S. Department of Justice, Antitrust Division

JOANNA MAUER,
ACEEE

MICHAEL MCCABE

SAM MCCLIVE,
Navigant Consulting

MIKE RAY,
Lennox International

MICHAEL RIVEST,
Navigant Consulting

ANIRUDDH ROY,
AHRI

HARVEY SACHS,
ACEEE

FRANK STANONIK,
AHRI

CONSTANTIN VON WENTZEL,
Navigant Consulting

ROBERT WHITWELL,
Carrier

CONTENTS

P R O C E E D I N G S

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

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

MR. BROOKMAN: Thank you. And we'll talk more about the webinar in a moment. I'm going to start with introductions, as I typically do. I'll start to my immediate left, and Harvey, if you'd say your name and organizational affiliation, we can get used to turning these microphones on and off.

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

MR. BROOKMAN: Thank you.

MS. HOOTMAN: Jill Hootman, Trane.

MR. RAY: Mike Ray, Lennox.

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

MR. DARLINGTON: Adam Darlington, Navigant Consulting.

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

MR. LAU: Chris Lau, Navigant.

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

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

MR. MCCLIVE: Sam McClive, Navigant

Consulting.

MR. RIVEST: Mike Rivest, Navigant Consulting.

MR. MCCABE: Michael McCabe, representing myself.

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

MR. BROOKMAN: Thanks again to all of you for braving the cold and ice this morning to get here. All of you received a packet of information I hope. I'm going to do a very brief agenda review. Immediately following this agenda review, there's an opportunity for anybody that wishes to, to make opening remarks, brief summary remarks here at the outset about issues that matter to you.

Following that, we're going to hear the purpose of the public meeting and regulatory authority and rulemaking overview. We'll move from there directly into market and technology assessment and screening analysis. We'll take a break midmorning around about 10:15 or so. Then, engineering analysis followed by markups, energy use characterization, lifecycle cost and payback period analysis.

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

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

I'd ask for your consideration. Please speak one at a time. If you would, say your name for the record each time you speak; you've already gotten used to turning the microphones on and off. There'll be a complete transcript of this meeting made available. If you could, be concise and share the airtime. If you haven't done so already, please turn your cellphone on silent mode and if you can limit the sidebar conversations, that'd be helpful.

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

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

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

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

MR. BROOKMAN: Comments here at the

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

MR. CYMBALSKY: Any on the webinar?

MR. BROOKMAN: Then I think we'll proceed with the content, moving to regulatory authority.

MR. CYMBALSKY: Okay. Thanks, Doug. Still John Cymbalsky at DOE. Okay, so as we probably all know by now, DOE's regulatory authority for most appliances traces back to the Energy Policy and Conservation Act of 1975. There were also updates throughout the years including EPCA 1992, which is what added commercial warm air furnaces as a type of covered equipment.

The statute at this time also set initial standards for commercial warm air furnaces. EPCA also directs DOE to consider amending existing federal energy conservation standards for commercial warm air furnaces whenever ASHRAE amends the levels in 90.1. So, further into the timeline on updates to EPCA, EISA 2007 and the American Energy Manufacturing Technical Corrections Act amended EPCA to require that every six years the secretary publish either a Notice of Determination that standards do not need to be amended for, in this case, commercial warm air furnaces, or a Notice of Proposed Rulemaking that includes new standards. And so, that's what we have here today.

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

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

DOE further defines a commercial warm air furnace as "a warm air furnace that is industrial equipment and that has a capacity as rated by maximum input of 225,000 Btu per hour or more", and you can see the citation in the Code of Federal Regulations.

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

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

Test procedure and efficiency metric,

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

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

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

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

MR. CYMBALSKY: Oh, just to the right.

MR. DARLINGTON: To the right?

MR. CYMBALSKY: Yeah.

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

MR. CYMBALSKY: Yeah.

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

So the market and technology assessment, here we have the purpose and methodology for this particular portion of the analysis. So the market and technology assessment -- the market assessment develops a quantitative and qualitative characterization of the commercial furnace industry, basically looking at manufacturers, market shares, regulatory and non-regulatory programs, historical market information; that type of information.

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

Okay, and so this slide is basically a quick overview of the type of products we're talking about here. So the majority of the market for commercial furnaces are gas-fired commercial furnaces. And typically these units are packaged with the commercial air conditioning system generally installed on rooftops. And so, as you can see on the slide, it says "primarily installed outdoors, supplies heated air to commercial buildings via ducts." Most are manufactured in a single package as I just said, and they are weatherized, meaning they are designed to be installed outdoors.

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

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

This slide is sort of a snapshot of the models distribution. So DOE developed a database based on the AHRI directory; and also for non-AHRI members, DOE looked at product listings on manufacturer websites. And DOE basically maintained the existing equipment class breakdown into gas-fired and oil-fired. And so, on this slide we're showing -- you can see the first two columns, we're looking at 95 percent of the models being gas-fired compared to 5 percent being oil-fired. And then we also, just for informational purposes, are looking at non-weatherized versus weatherized. As you can see there, about tenfold weatherized models to non-weatherized for the gas-fired and then for the oil-fired they were all non-weatherized. And keep in mind this is just distribution of models. So actual unit sales or shipments might be even more skewed in one of these directions.

So the big -- one of the big things that comes out of the market assessment is this, you know, we look at the efficiencies of models on the market. It kind of gives us a starting point, what levels we're going to look at in the engineering analysis. So, as you can see on this slide we're looking at, the current federal minimum standard is 80 percent. There are a lot of models at the baseline. Still a good number at 81 as well, and then a few are at 82, and then just a handful there at the condensing levels about 90 percent and then nothing between 82 and 90 which, as you all probably know, is the near- condensing range.

MR. RAY: Question.

MR. BROOKMAN: Please, Mike?

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

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

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

MR. DARLINGTON: Makeup air, yeah.

MR. RAY: Okay.

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

MR. DARLINGTON: Yeah, and then so this

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

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

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

And so, here we're coming to our first request for comment. Basically we are seeking comment on the proposed equipment classes. We note here in particular there's a question of whether there's a need for separate classes for non-weatherized and weatherized commercial furnaces. And I guess just a little bit of background on that point. So the question kind of relates to whether there are any reasons to have separate product classes for them and I know that, you know, we look at certain technology options that may be more proven in non-weatherized, the obvious example being condensing. But it's such a small portion of the market, it's really unclear if there would be too much benefit, so we're seeking comment on that.

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

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

MR. SACHS: This is Harvey Sachs with a naquestion. Are the hundred percent makeup air units differentiated enough to warrant consideration of a separate product class for them or would that just lead to people doing some submarining by adapting conventional units to provide that function?

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

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

MR. DARLINGTON: Well, sure. But I mean

--

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

MR. BROOKMAN: Louder, Harvey.

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

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

MR. BROOKMAN: Thank you, Adam. Jill?

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

Now, whether you design those units in

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

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

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

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

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

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

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

you can start with the actual illustration here.

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

MR. BROOKMAN: Go ahead. Keep going.

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

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

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

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

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

MR. BROOKMAN: Mike Rivest?

MR. RIVEST: So just from a practical application from product classes and other rulemakings, the thing that's guided DOE in the past has been, you know, can this product achieve the same AFUE values without risking that standard set for one class would render that product non-available. So for example -- so if the standard -- if the standard were set for a regular commercial furnace and at an AFUE that would result in non-availability of gas packs, like a bare unit, for example, that would definitely, you know, create automatically a trigger for a separate product class.

MR. SACHS: So Mike --

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

MR. SACHS: Yes.

MR. BROOKMAN: Harvey Sachs, go ahead.

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

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

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

MR. RIVEST: Okay.

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

Excuse me, one more thing. My memory is short and I forgot about John's comment. I don't see the RTU with return air and the dedicated outdoor air makeup unit as being -- as providing the same immunity to some extent there's an application difference that the hundred percent unit is more likely to be applied in a different system, a dedicated outdoor air system than a mixed air chiller-based or unitary -- large unitary equipment.

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

MS. HOOTMAN: Exactly.

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

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

MR. BROOKMAN: Okay.

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

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

[Laughter.]

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

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

So yes, there are applications. I would agree, Mike. There are applications that have an exorbitant temperature difference it has to overcome and with a hundred percent outside air. So yes, it is burning quite a bit of gas in some applications. I'm sure that northern Minnesota and parts of this country are, you know --

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

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

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

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

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

MR. BROOKMAN: Mike, say it again

please.

MR. RIVEST: What is the product definition?

MR. BROOKMAN: Adam?

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

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

MS. HOOTMAN: No.

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

MS. HOOTMAN: Eighty to 90.

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

MS. HOOTMAN: Yeah. Oh, makeup air?

MR. CYMBALSKY: yeah, the makeup air. No, no the makeup air, so it will span that whole range.

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

MR. CYMBALSKY: Correct.

MS. HOOTMAN: The packaged air units do

not.

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

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

MR. ARNOLD: Okay. Can you hear me?

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

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

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

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

MR. BROOKMAN: Yeah. Okay, try it.

MR. ARNOLD: Hello?

MR. BROOKMAN: Yes, you sound good.

MR. ARNOLD: Okay. Sorry about that. We had two phones going. Yeah, this is Dan Arnold. I'm with Nortek Global HVAC, formerly Nordyne and we do make makeup air units and I would just advocate to keep them in the same class. I just don't really see the justification for a separate class. I've been listening to the discussion and, you know, as was mentioned, they're essentially following the same test procedure more or less to determine the steady-state efficiency.

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

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

MR. DARLINGTON: All right. This is Adam Darlington again. So I'll take us through the screening analysis. The purpose of the screening analysis, as I alluded to previously, is to basically remove from consideration designs that are -- I guess they're not yet quite ready to be considered. So here on the slide we show the four criteria for screening and they are technological feasibility; practicability to manufacture, install and service; adverse impacts on equipment, utility or availability to customers; and adverse impacts on health or safety.

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

So chapter four is the TSD chapter that

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

And then this next slide -- so we also removed condensing -- or, sorry, concentric venting which is generally only applicable in non-weatherized installations because most of these were, you know, as I said earlier, are weatherized and also there's not a great deal of information on the efficiency benefits as far as commercial furnaces. So sort of the key takeaway from this slide is the technologies that were primarily considered in the engineering analysis and they all related to the heat exchanger.

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

And so, that was just kind of a quick run- through of the screening. Here we're inviting comments generally on the screening analysis, you know, whether there are comments about any of the technologies that were in or out. And then, item 2-3, specifically we're asking about the potential for the lessening of product utility or unavailability of product types for any -- you know, any of the commercial furnaces meeting the proposed standards which would be at 82 percent, so would there be any issues with the levels and the technologies considered. So with that, I'll let Doug go from there.

MR. BROOKMAN: Okay. Harvey Sachs?

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

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

MR. SACHS: A steady-state thermal efficiency.

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

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

MR. DARLINGTON: Yeah. Well, even then, so the thermal efficiency test, I think that we're all familiar with, would include the jacket losses and that's not included.

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

MR. BROOKMAN: Jill?

MS. HOOTMAN: So Harvey, I understand what you're saying. I guess I do want to say that the nature of heating in most of this country for comfort conditioning in commercial buildings is one of morning warm-up and then you may never have the heater on again.

MR. SACHS: Good point.

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

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

FEMALE: Mic, please.

MS. HOOTMAN: He thought he hit it.

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

MR. BROOKMAN: Okay. Michael McCabe?

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

MR. DARLINGTON: That's right, yes.

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

MR. DARLINGTON: Did you want to answer that?

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

MR. BROOKMAN: Thank you. Jill?

MS. HOOTMAN: Jill Hootman, Trane. So I would agree if that's all you were to look at. We could probably make them in a commercial arena. It will have way more impact on the installation of that unit. And that's where I think we lose utility and that's where I think we lose and have issues with. While it is in some cases possible to take that caustic condensate and bring it back through the building, you will still have a gap in the curb that is outside that would still need to have heat tape or some kind of protection for freeze protection on it that's not conditioned in the curb.

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

Now, when you are getting up to -- this has no upper end of Btus. When you're getting up into the million and the 2 million Btu heat exchangers that are made in packaged units, that's another question. We don't -- I mean, they're going to get so big and the secondary heat exchangers are going to get so big that by the time you design the fan to go across that, that starts to get huge and significantly starts to have an issue with replacement of existing systems because that cabinet will be big. And we're already the largest load that can go down a highway in those units. So I think we start to lose the ability to put that in, in some of those units.

MR. BROOKMAN: Mike?

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

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

MR. BROOKMAN: Okay, thank you. Harvey?

MR. SACHS: Just a -- this is Harvey. Just a clarification, Mike. My sense has been that the real growth in the RTU industry has been in what amount to almost -- well, to the very largest capacities, the 60 tons, the 40 tons. We probably don't have much difference in the shipping challenges for 10-ton units. They're bigger. You can't put as many of them on the truck.

MR. RAY: Correct.

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

MS. HOOTMAN: Right.

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

MR. BROOKMAN: Jill?

MS. HOOTMAN: Yes. Sorry, yes. Jill Hootman, Trane. But also remember, I mean, almost 60 percent of the business is replacement and so if these units have gotten bigger, they no longer replace themselves easily. So when we get to the point, and I know we will talk about the additional cost that that incurs, so you're right. We start to lose, you know, the ability to put as many on a truck. So our freight and then down the road we'll also lose the ability to replace ourselves. So it has the lessening of some of the product utility.

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

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

MR. BROOKMAN: You sound good.

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

And we have to keep in mind that we would have that impact all year round. So it would be not only impact the cooling efficiency but we also would have that additional fan watts during ventilation periods and also during the heating periods.

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

MR. DARLINGTON: Okay. This is Adam Darlington with Navigant again. So here we see the purpose of the engineering analysis is to establish the relationship between equipment cost and increased efficiency and the methodology for this is to look at the efficiency level approach. As I mentioned on the previous slide, we use the efficiency information obtained from the market assessment to select which efficiency levels to look at, basically did reverse engineering, tear-downs and cost modeling to develop estimates of manufacturer production costs at each efficiency point. We incorporated a number of sources, equipment tear-downs and cost modeling manufacturer interviews, equipment testing, manufacturer product literature and certification data.

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

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

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

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

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

So this slide summarizes the design options that we primarily looked at. As I alluded to at the end of the screening analysis, we've got basically going from 80 to 81 and from 81 to 82 in the gas and then from 81 to 82 in the oil, looked primarily at increasing the surface area for the primary heat exchanger and then of course to get to the max tech level in both cases we would need to have the addition of the condensing secondary heat exchanger as the primary design that drives efficiency. And of course with that, you know, you would have cabinet size increases and condensate disposal components and things like that. But we'll talk about that in a bit.

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

So the cost at the higher efficiency

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

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

MR. SACHS: Adam?

MR. DARLINGTON: Yes?

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

MR. DARLINGTON: Yep.

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

MR. DARLINGTON: No. There are some.

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

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

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

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

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

And as you can see down there in the non- condensing range, you know, we're looking at a 10 percent increase in heat exchanger material, which is only translating to about $5, $6 at those lower efficiency levels and then you see a really big jump going up to condensing with the addition of the secondary heat exchanger with the additional cost of expanding the outer packaging and then also with the additional cost of the condensate disposal components as well. And so, again, just a reminder, those are -- that's for the furnace components only. So that would not be an entire packaged rooftop system per se.

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

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

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

MS. MAUER: Hi. This is Joanna Mauer from ACEEE. I'm sorry. I wanted to just go back for a minute to Harvey's comment about two stage and modulating furnaces and ask a question which is in applications where you are using heating throughout the day, are there significant gas savings in the field from two-stage or modulating furnaces compared to single-stage units?

MR. BROOKMAN: Jill?

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

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

MR. BROOKMAN: Joanna?

MS. MAUER: Thanks, Jill.

MR. BROOKMAN: Okay. Thank you. Aniruddh Roy has a question or comment. Please, Aniruddh?

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

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

And so, other components that may need to be factored into that, is all that rolled over into, let's say, an incremental $10 cost from 80 percent to 82 percent?

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

MR. BROOKMAN: Adam Darlington.

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

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

And then, as far as the actual blower, the assumption there was that it's more size based on the system ductwork than on anything related to the furnace and that's what we kind of -- the conclusion that we came to when we looked at the product literature is that a lot of times that's driven more by the cooling side and more by the system that it's actually going into than the furnace components.

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

MR. ROY: Okay.

MR. BROOKMAN: Jill?

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

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

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

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

MS. HOOTMAN: Okay.

MR. DARLINGTON: So there's an inducer

fan, right?

MS. HOOTMAN: Right, okay.

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

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

MR. DARLINGTON: Apologies if I misstated, yeah.

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

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

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

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

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

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

MR. BROOKMAN: Mike Rivest?

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

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

MR. WHITWELL: Yeah, so I think that that should be evaluated, whether there would be -- whether that scaling would hold as you go up in size and may have to add not just change the length but maybe add some additional heat sections which would include additional inducer fans and additional burners and gas valves.

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

MR. WHITWELL: Okay.

MR. BROOKMAN: Okay.

MR. WHITWELL: Okay.

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

FEMALE: [Off mic]

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

MR. BROOKMAN: I don't know whether

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

FEMALE: It would be Frank.

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

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

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

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

MR. DARLINGTON: It's roughly the same.

MR. BROOKMAN: Chris Lau?

MR. LAU: Yeah. So for the -- this is Chris Lau with Navigant. For the commercial air conditioner rulemaking, there were a range of capacity sizes and the markups there ranged from roughly 1.3 at the low end to 1.4 for the very largest units.

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

MR. BROOKMAN: Jill?

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

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

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

MR. BROOKMAN: Harvey?

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

MR. BROOKMAN: Okay.

MR. SACHS: I should have done my homework.

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

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

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

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

FEMALE: Push the mic, please.

MR. DARLINGTON: Yeah. So this is Adam again. So before we, you know, had those handful of comments and that discussion, I was just getting to actually the comment request slide. So here we've got, you know, general request for comments on the engineering analysis and in particular we were looking for comment about the efficiency levels analyzed, including the max tech efficiency levels and specifically the 82 percent thermal efficiency level.

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

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

MS. HOOTMAN: Jill Hootman, Trane. I think that we're ignoring an elephant in the room. Eighty- two percent is condensing. It is definitely condensing at parts of the operating map. So I think we have to realize that we will be developing not only aluminized but heavy-grade aluminized and/or stainless steel heat exchangers to meet an 82 percent, especially if we look at lifetime reliability that we want to have on these heat exchangers. So I think we've missed and our comments will indicate that I think you've miscalculated the amount of beefiness to the heat exchanger that we'll have to make at 82 percent because the operating map definitely has points that condense.

MR. BROOKMAN: Okay. Thank you. Mike?

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

MS. HOOTMAN: I'm just being nice.

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

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

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

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

So in a packaged rooftop unit, the gas

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

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

MR. KOSAR: Can you hear me?

MR. BROOKMAN: Yes.

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

Based on some of my recent but limited experience, there may be a point around 400,000 Btu per hour input where it may be common practice to transition from a single furnace to two furnaces in packaged equipment and that would be a transition point where you'd see the additional components associated with the second furnace, the additional gas valve, inducer fan. That may be a transition point where you may see a different price regime.

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

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

MR. BROOKMAN: Mike, you started with this.

MR. RAY: Yeah, I'd have to do some research to tie down exactly where it is. But I am aware of certain areas of the country where we've witnessed that from our salesforce and not necessarily on our equipment by the way.

MR. DARLINGTON: Okay.

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

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

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

(WHEREUPON, the foregoing recessed.)

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

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

The appropriate markups for determining commercial consumer equipment prices depend on the type of distribution channels through which the equipment moves from the manufacturers to purchasers. At each point in the distribution channel, companies mark up the price of the equipment to cover their business costs and profit margin. There are two primary types of distribution channels, described the way most equipment passes from manufacturer to consumer as shown in the two flowcharts here, one involving distributors and contractors and one of the manufacturers to the consumer via a national account.

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

To actually get the markups for each of

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

For this analysis, we include both baseline markups and incremental markups. Baseline markups relate the MSP of baseline equipment to commercial consumer customer purchase price. Incremental markups relate the increase in MSP of more efficient equipment to the increase in commercial consumer purchase price. These costs cover only the expenses that vary with the MSP such as operating expenses and profits. Fixed-costs such as overhead and labor do not scale with increased efficiency. DOE applied the baseline markets to the baseline level and incremental markups to the incremental difference in MSP.

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

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

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

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

MR. BROOKMAN: Mike, follow-on?

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

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

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

MR. BROOKMAN: Jill, go ahead please.

MS. HOOTMAN: Jill Hootman, Trane. There's every flavor with the national accounts. So you know, if you're a Walmart, you might have two key contractors across the United States that do all your installations. Yes, we might be selling directly to Walmart but Walmart will still have to pay that contractor for the installation and/or, you know, all the other sheet metal and all the other stuff that has to happen. They're paying them for that.

So there is that incremental step and then there are other cases where they really -- the national accounts really act just like the step above. They go through the chain just like that. The only uniqueness I think that really falls in national accounts is that we might not sell to a wholesaler. We sell directly. It goes -- the invoices directly invoice to them. But there still is a contractor. They don't have their own contracting arms for all intents and purposes. They might have somebody who goes around and repairs units and does some of those kinds of things.

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

MR. BROOKMAN: Harvey Sachs.

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

So the contractor on a national account where you're doing a direct sale to the ultimate owner will hire a contractor to do the installing and the sheet metal and all of that. But is there -- and he has a profit margin. But is he really seeing a markup on the equipment itself?

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

MR. BROOKMAN: Jill, please.

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

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

MR. BROOKMAN: Mike?

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

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

MR. RAY: As far as?

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

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

I guess what we're asking from you is

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

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

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

MR. BROOKMAN: Yes, Alex?

MR. LEKOV: Alex Lekov, Lawrence Berkeley National Laboratory. So just to clarify, if in this - - if in this chain, based on your input, is it fair if we replace the wholesale label with the contractor label if this will be a better presentation of this channel?

MR. BROOKMAN: Jill?

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

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

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

MR. BROOKMAN: Mike?

MR. RAY: Mike Ray, and if the contractor wants to stay in business, he needs to mark up that equipment. And if the contractor's not a smart businessman and doesn't mark up for the cost of that equipment, then eventually it will drive him out of business.

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

MR. BROOKMAN: Okay, thank you.

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

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

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

MR. BROOKMAN: Jill?

MS. HOOTMAN: Jill Hootman, Trane. So I think we were saying a little bit earlier, especially when we asked you and Harvey asked you how does this compare with CUAC. These are the exact same units. I realize that we don't have the break necessarily in this rule.

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

MR. FRANCO: Thank you for that comment.

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

MR. FRANCO: Thank you. Victor Franco again. Now we're going to talk about the energy use characterization. We determined the annual energy consumption for commercial warm air furnaces at the different considered efficiency levels, defined the annual energy cost and savings. This is an important part of the lifecycle cost analysis and payback period analysis. So I'll be discussing this later today.

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

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

The electricity use is also taken into account and I'll be discussing that in further detail. But to note that it includes the impact of non-heating season energy use, specifically for condensing furnaces because of the circulating fan used in air conditioning. Before going in further detail in terms of the energy use calculations, I wanted to take a look at the building sample, how we determined what buildings were using what type of furnace.

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

And finally, we take into account what fuel type the furnace. If it's gas, then it goes to the gas-fired commercial furnaces sample. If it's oil, it goes to the oil-fired commercial furnaces sample. On the slide, there's a table that lists what the actual count of the different -- in our sample for CBECS and RECS. As you can see, there's close to 1,500 buildings that are being sampled for gas-fired and a little bit more than the hundred buildings for oil- fired equipment. Now, let's look a little bit more detail in terms of how we calculate the heating fuel use.

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

We adjust for average climate conditions. We also adjust for climate change, projections by 2018 and also for the building shell efficiency. Finally, we take into account how many commercial furnaces are used to meet the heating load because we're using a single capacity of 250, a lot of buildings will actually use more than one unit. So our threshold is 7,500 square feet per commercial furnace. So if a building has 15,000 square feet, we assume that it has two units that are being used and we are just calculating -- for the impacts, we are just calculating that one unit. But we divide the energy use by two essentially for that specific example.

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

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

MR. BROOKMAN: Harvey Sachs?

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

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

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

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

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

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

MR. SACHS: Thank you.

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

The inducer fan is about a hundred watts, the ignition device, 25, and 10 for the standby. Here are the summary results. So again, here are the average values, as we saw before. The average value for the baseline for the fuel use, 163 and the electricity use, a little bit more than a thousand kWh. And the savings for both the gas-fired and the oil-fired equipment.

MR. BROOKMAN: Harvey Sachs?

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

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

MR. CYMBALSKY: So 15 years of things

that happen, right?

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

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

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

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

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

MR. BROOKMAN: Jill?

MS. HOOTMAN: No.

MR. BROOKMAN: Okay.

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

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

MR. BROOKMAN: Jill?

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

MR. FRANCO: Yeah, correct. We would actually assign some buildings with a higher input capacity as appropriate and others with the lower capacity.

MS. HOOTMAN: Right.

MR. BROOKMAN: Michael McCabe?

MR. MCCABE: It's Michael McCabe. Following up on Harvey's question and looking at slide 53, if you compare those figures for the 2003 CBECS and what you're projecting in 2018, how do those compare to what the AEO is forecasting?

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

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

MR. FRANCO: That is correct, yes. We're using exactly the same parameters. So the building shell index actually comes from AEO for the commercial side and the projections for climate change come from AEO as well and the normalization to normal conditions is the same methodology that AEO 2013 uses.

MR. MCCABE: Thank you.

MR. BROOKMAN: Yes, Mike?

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

FEMALE: [Off mic] motors.

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

MS. HOOTMAN: But --

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

MR. BROOKMAN: Additional thoughts on

these comment boxes? Frank Stanonik, welcome.

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

MR. BROOKMAN: John Cymbalsky?

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

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

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

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

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

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

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

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

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

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

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

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

And one other general comment, I know we're talking about average savings for commercial warm air furnaces. What we've seen in actual monitoring in the field is huge diversity in the runtime of RTUs which basically equates to your burner on-time. So we may see equivalent hours that range here in Chicago from say, 1,200 kWh to literally zero on some RTUs that are serving the core of a building in a large footprint- type of structure.

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

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

MR. KOSAR: Yeah, the point I was trying to make, I think on any given building you're going to have a distributed group of RTUs on the rooftop that those that serve the core of the building must be much higher runtime than those that serve the corner of the building, much shorter.

MR. FRANCO: Thank you. Appreciate your comment.

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

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

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

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

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

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

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

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

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

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

So looking a little bit more at how we conduct the lifecycle cost and payback period analysis, it's an economic evaluation that the commercial consumer perspective. The equations are as shown here and in addition the analysis models, the uncertainty and variability of the inputs using the Monte Carlo approach and probability distributions using Excel and Crystal Ball. We've included as part of the documents that are publicly available a spreadsheet, an LCC spreadsheet that has all these calculations.

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

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

MR. BROOKMAN: Michael McCabe?

MR. MCCABE: It's Michael McCabe.

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

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

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

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

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

Our data sources include our 2013 RS Means mechanical cost data, manufacturer literature and consulting information.

MR. BROOKMAN: Mike?

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

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

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

MR. FRANCO: Exactly, yes.

MR. MCCABE: Okay. Thank you.

MR. FRANCO: Thank you for that comment. Since condensate withdrawal is one of the main components for the installation cost for condensing equipment, here are some of the assumptions that we use. For the condensate pipe, essentially for all installations we consider it both indoor and outdoor. The condensate pump is for 50 percent of installations that don't have CUAC. So that would be mainly for indoor equipment. For freeze protection is applied to all of the installations, a hundred percent of the outdoor installations. So that's pretty much all installations of gas-fired. The electrical outlet is supplied if we include a pump or a heat tape for 50 percent of the installations. And the condensate neutralizer is applied to 12.5 percent.

MR. BROOKMAN: Mike?

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

MR. BROOKMAN: Constantin?

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

MR. MCCABE: Okay, thank you.

MR. BROOKMAN: Harvey Sachs?

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

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

MS. HOOTMAN: So --

MR. BROOKMAN: Jill, please.

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

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

MR. BROOKMAN: Mike?

MR. RAY: Mike Ray. I think NEC code

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

MR. BROOKMAN: Thank you.

MS. HOOTMAN: Good point.

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

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

MR. BROOKMAN: Thank you.

MR. FRANCO: Victor Franco again. So now, we're going to be talking about the operating costs. We already talked about the energy use characterization. We would multiply that times the energy prices to come up with the energy use operating cost. The energy prices are developed for marginal monthly prices by different areas to match up with the building location, the sample building. We use the most current data we have available for annual energy prices. We multiply that times monthly price factors to come up with monthly data and then we multiply that times marginal price factors.

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

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

Another component of the operating costs are repair and maintenance. Repair cost is the cost of replacing or repairing the components of the commercial warm air furnaces that have failed. We use data from 2013 RS Means facility repair and maintenance a well as manufacturer literature, equipment cost data and Consumer Reports data on residential furnaces. We did not have data about commercial furnaces in terms of frequency of repair. So that would be good if that data is available.

In terms of maintenance costs, we calculate the labor and materials required to maintain the equipment. The sources are 2013 RS Means facilities repair and maintenance data, also CBECS and RECS reports, how frequently the building might be repairing the unit and we also take into account for oil products the availability of low-sulfur oil for -- fuel oil for different parts of the country. Especially for condensing designs, we take into account having to maintain the condensate neutralizer and having to check the condensate withdrawal system. These costs are reflected in the costs shown below. As you can see, there's incremental cost both on the repair side and the maintenance side. These are annualized values, average values.

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

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. And I don't know if this has come up in the part of the meeting I missed, but on your maintenance costs, has there -- well, has the point been raised yet that on the 82 percent thermal efficiency because these are mostly outdoor units that we have some concerns that in fact although it won't be designed for condensing there will certainly be conditions that make that a much greater concern than if this was an indoor furnace and we think that at the 82 level there in fact might be some additional maintenance costs simply because the greater likelihood that it will be on occasion condensing and it's not really designed for that, which would if nothing else require closer monitoring of the furnace.

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

MR. STANONIK: Okay.

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

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

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

MR. WHITWELL: Okay, thank you. Sorry

for taking the group back.

MR. BROOKMAN: No, no. It's okay. We want to be complete here.

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

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

MR. WHITWELL: Yes.

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

So when we multiply a lot of our different components by that reduced 10 to 15 percent operating hours, we get some savings. That's offset by the cooling. We had assumed that there was a 5 percent increased power in terms of cooling and heating because of the secondary heat exchanger and the circulating fan. That more or less balances out with the effect that I just talked about and that gives us a slight savings.

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

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

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

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

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

MALE: [Off mic.]

MR. FRANCO: Next we come up with discount rates for lifecycle cost analysis. These are used to determine the present value of the lifetime operating cost expenses. We are using calculated as a weighted average of the capital costs using the capital cost asset price model for different economic sectors. The primary source for the data comes from Damodaran Online database of company debt and equity financing. We do calculate discount rate for different sectors in the commercial side including retail, property owners, medical services, industrial, lodging, food service, office, state/local government, federal government and other. The table shows the mean discount rate and the standard deviation. So we do for each of these we do have a distribution and that's taken into account in our analysis.

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

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

MR. BROOKMAN: Frank Stanonik?

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

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

MR. STANONIK: SO we're reading down. So in terms of that, so 93 percent of whatever were the indoor units would be at 81. Okay, okay.

MR. FRANCO: That is correct.

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

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

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

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

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

MR. BROOKMAN: Yes, Mike?

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

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

FEMALE: [Off mic.]

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

MR. BROOKMAN: Harvey Sachs?

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

MR. BROOKMAN: Jill, please use the microphone.

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

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

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

MS. HOOTMAN: For cooling?

MR. SACHS: Yeah.

MS. HOOTMAN: Yes, yes.

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

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

MR. CYMBALSKY: Right.

MR. BROOKMAN: Mike?

MR. RAY: I think it ties back to -- this conversation that we're having also ties back to the fact that we'd like to have all this rolled into one rulemaking. I think you've highlighted the issue because you've got a piece right now that you're cutting out for the gas furnace. You've got a piece that we're talking about for the cooling side and thus the reason why and I know you've heard this before.

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

MR. BROOKMAN: 12:20, in fact.

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

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

MR. BROOKMAN: Mike?

MR. RAY: Shifting directions back to

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

But and as it was, that furnace was an 82 percent furnace. And since a major piece had failed but it was still a relatively new unit, they had to -- they said let's go ahead and just keep replacing those heat exchangers. But and that's not included in how in the calculation to replace a heat exchanger in three to five years or in seven years or whatever. I know that's not part of the calculation and that's one of the challenges I think from an industry standpoint.

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

MR. BROOKMAN: Michael McCabe?

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

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

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

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

MR. STANONIK: Frank Stanonik, AHRI. And well, I'll apologize in advance again if I'm bringing up issues that I missed this morning. Listening to that last conversation and then the couple others, but first of all, I think, John, you just pointed something out that again I don't know if it came up but if in fact products -- if the minimum is 82, then a manufacturer, it's totally correct to assume that his production units -- his production units will have efficiencies on either side of that.

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

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

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

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

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

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

MR. BROOKMAN: Okay.

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

MR. FRANCO: Thank you. I appreciate your comment. I'll move on to the next part of our analysis. DOE takes into account subgroup analysis. So for these commercial products, we look at small businesses to evaluate the impact on this portion of the markets. The results are shown here. A comparison of the LCC and median paybacks are very similar, as can be seen from the table. That concludes the LCC and payback analysis and at this point we would request comment on any other questions about the lifecycle cost. Specifically we would request comment on consumer subgroup analysis.

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

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

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

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

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

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

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

MR. CYMBALSKY: I can order some donuts.

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

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

Replacements are determined based on

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

Here is a flowchart showing the shipments analysis. So on the top part, this is how we calculate the new construction shipments, as I mentioned before. We're matching the projected new construction commercial flow space with the commercial equipment saturations for the new construction market and for the replacement shipments we're taking into account historical annual shipments and retirement function. On the replacement side we also take into account some demolitions and adding these two give us the total shipments, the annual shipments during the analysis period.

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

Based on that data, we come up with about 80 percent of CUAC shipments are CUACs with gas-fired commercial warm air furnaces. We didn't have any data for oil-fired equipment. So we came up with a ratio between oil-fired and gas-fired equipment based on residential furnace shipments. The retirement function comes from the lifetime distribution, which was a few slides ago and is further described in TSD chapter eight.

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

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

MR. FRANCO: Next, we come to the national impact analysis. The national impact analysis serves to estimate the national impacts of the energy conservation standards over the lifetime of the commercial warm air furnaces shipped between 2018 and 2047. There are two components that we take into account to calculate, the national energy savings, which is the difference in the annual energy use between the base case and the standard cases, summed over the lifetime of the equipment shipped between 2018 and 2047, and the net present value, which is the difference between the present value of the installed cost and the present value of the operating cost over the analysis period from 2018 to 2047. These values are discounted. The method we use I'll be describing in further detail in the next few slides.

This slide shows a flowchart of the actual analysis. Again, we start with the shipments analysis to give us the annual shipments. We calculate the base case energy use based on the annual energy consumption times the annual shipments analysis which will give us the base case cumulative energy use. In the standards case, we do exactly the same and we come up with a standards case cumulative energy use. We multiply this by the site to source energy conversion factors to come up with the national energy savings.

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

This slide further describes the inputs and some of the sources. The annual unit energy consumption comes from the LCC energy analysis, energy use estimates. The shipments are described previously in the shipments analysis. The equipment stock is determined by the annual yearly stock of the annual shipments in the lifetime over the equipment class. For this equipment, there is no rebound effect. I will be talking a little bit more about the base case efficiency distributions. But basically we use a roll-up scenario.

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

Here are the base case efficiency distributions. As mentioned before, we use a roll-up when we're complying to standards. The equipment at or above the efficiency will not be affected in the roll-up scenario. So for example, our base case assumptions are for the gas-fired warm air furnaces 67 percentage at the baseline and 24 percent are at 81 percent. If the standard is set at efficiency level one, basically it's 67 plus 24 which will give us 90 percent at that efficiency. The efficiencies above that will not be affected.

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

MR. BROOKMAN: Mike?

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

MR. FRANCO: Yeah, below there's a little bit of a note that says the rounding, yes. Thank you for that. Next, DOE determined the trial standard levels. DOE has five trial standard levels that is a mixture of the efficiencies for gas-fired and oil- fired equipment. TSL 1 is the most commonly efficiency level above the baseline for a gas-fired equipment and at the baseline for oil-fired equipment. Therefore, 81 percent for both. Two through four are a mixture. So TSL 2 is 81 percent for gas, 82 percent for oil. TSL 3 is 82 for gas, 81 percent for oil. And TSL 4 is 82 percent for both gas and oil. TSL 5 is at the max tech. For this NOPR analysis, DOE is proposing TSL 4 as a proposed level.

Next, we present the results from the national impact analysis. First, we'll look at the national energy savings in CWAFs. These are by TSL. So the first few rows are the primary energy savings and the last three rows are the full-fuel-cycle energy savings. For the proposed level at TSL 4, the full- fuel-cycle energy savings are a little bit more than half a CWAF.

Next are the net present value. They're reported at both 3 percent and 7 percent. For TSL 4, at 3 percent it's about 2.7 billion and at 7 percent discount rate, a little bit more than 1 billion. This concludes the national impact analysis and at this time we request any comments on the analysis from interested parties, specifically related to rebound effect and base case efficiency distribution trends.

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

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

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

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

MR. CYMBALSKY: I do, yeah.

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

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

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

MR. BROOKMAN: Okay. Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. On slide 85, so if you look at the primary energy savings between -- well, you know, one and two is 81 percent, three and four is 82 percent. So the primary energy savings at three or four is in fact more than double what is one or two, right? So then but if I go back to slide 55, the annual fuel use, the savings at level one is 1.9 million Btu and at level two it's double, straight double.

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

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

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

MR. BROOKMAN: Harvey Sachs? No? Okay.

MR. SACHS: He answered it when he clarified.

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

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

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

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

MR. FRANCO: Victor Franco again, going back to regulatory impact analysis. Just one second. Okay, there we go. So the purpose of the regulatory impact analysis is to assess the national impacts of non-regulatory alternatives to mandatory amended energy conservation standards. Basically we modified the NIA spreadsheet to evaluate the non-regulatory alternatives such as the no regulatory action, consumer rebates, consumer tax credits, manufacturer tax credits, voluntary energy efficiency targets and bulk energy purchases.

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

MR. BROOKMAN: Manufacturer impact analysis. Chris Lau?

MR. RAY: Before we jump to that?

MR. BROOKMAN: Yes, Mike Ray?

MR. RAY: Mike Ray. Where is the TSD in chapter 17? I went out and looked at -- I went out and pulled down as many files as I could in preparation for this and I found a few of these. But I didn't find -- I don't know that I found a regulatory impact analysis and you're referencing chapter 17. So I assume that there is a list of chapters that are available yet I think there's only six files out on the website.

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

MR. RAY: Okay. Thank you.

MR. LAU: Afternoon, folks. My name is Christopher Lau. I'm with Navigant. I'll be presenting the manufacturer impact analysis. The primary purpose of the manufacturer impact analysis, or the MIA, is to assess the impacts of amended standards on commercial warm air furnace manufacturers as an industry. The second purpose is identifying and qualifying the impacts on manufacturer subgroups such as small business manufacturers. And the final portion of the MIA involves discussion of direct employment, potential capacity constraints and other federal regulations that go in effect around the compliance date of the standard.

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

The analysis is conducted in three general phases. Phase one, we built an industry profile from publicly-available information. Phase two, we use content from the MTA, the engineering analysis and shipments analysis to outline the industry in the GRIM. And in phase three, key inputs are validated with manufacturers and qualitative issues are discussed in interviews. We use this content to refine the GRIM to better reflect the industry.

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

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

The NOPR itself focuses on two of those

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

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

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

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

So it made it hard for us to -- it made it challenging for us to do our validation work of those numbers. So in the discussion today, it would be helpful to the department and to the analytic team to understand the industry's estimates of those conversion costs -- capital conversion costs and product conversion costs but also understanding how the industry arrives at those estimates, what are the key components.

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

[Off mic conversations]

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

Average time in test labs can be significant, six to eight weeks just to prove out your design and then you start your reliability testing and your reliability testing, it cycles on and off, on and off, on and off, looking at heat surfaces and where you have, you know, hot spots and wear and all of that. Those can take years to actually do those reliability tests. I would hasten to guess probably two to three years just to do that cycle testing.

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

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

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

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

So you know, you're waiting for Mother

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

MR. BROOKMAN: Okay.

MR. LAU: Thank you.

MR. BROOKMAN: Michael McCabe?

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

MR. LAU: Sure.

MR. RIVEST: I'll take that one.

MS. HOOTMAN: Yes.

MR. BROOKMAN: Mike Rivest?

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

MS. HOOTMAN: Wow.

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

So when we talk about regulative burden, it can mean a number of different things. As I -- as we define the industry more broadly, we are increasing the revenues as well. So you're increasing the denominator, you know. So in a way, you're diluting the impact, if you will, right? So from a percentage point of view, if you look at the impact here of -58, 55 percent, if I start bringing in the central AC rule and all those other rules, your denominator is getting really, really large and your percentage impact is actually going down, down. You know, it's going to be a lesser number.

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

So that type of information you gave earlier is extremely helpful, Jill. So you know, if test chambers are shared resources with those other products, the residential furnaces for the heating products, for example, that would be helpful to know or maybe even the R&D resources such as engineers or pooled resources. So that would be helpful. But on the INPV calculation itself, you know, increasing the number of rules under consideration is not something we've done. I don't think it's something that was intended to be done.

MR. BROOKMAN: Harvey Sachs?

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

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

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

Well, the R&D requirements, you know, if you're doing the testing and you're having to, you know, to do a lot of testing for the fans or, you know, I assume when you're going to be determining for example the fan size or the motor size and the statics and things like that, you'll want to have the proper furnace installed. So you'd want to do that once I assume. So there might be some savings in having the two rules together that could be taken into account. That's something, you know, you're in a position to tell us.

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

MR. BROOKMAN: Harvey, microphone.

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

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

MR. LAU: This is Chris Lau with Navigant. Harvey, I think we're speaking the same language. And to that point, you know, we have a set of conversion costs for the cooling side of the rooftop units from the CUAC rulemaking and we have a set of conversion costs here for the heating side. And when we went out and spoke to manufacturers a while back, we got these estimates of conversion costs from them.

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

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

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

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

MR. BROOKMAN: Harvey?

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

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

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

MR. SACHS: This is Harvey.

MR. CYMBALSKY: I'm saying --

MR. SACHS: Yes, yes.

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

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

MR. CYMBALSKY: Okay. We just said it, so okay. I think we could -- you know, we look forward - - obviously we're not going to get anything here today. We didn't expect to. But you know, we're putting the plea out for whatever you can do to help the department make, you know, a decision on that. So the numbers obviously would help policymakers and that to get to that spot. So why don't we just move on to the small businesses at this point?

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

We also found one oil-fired commercial warm air furnace manufacturer. They account for 11 out of the 16 listings in the directory, indicating that they are fairly substantial in this niche. They also offer the most efficient products in the market and so we believe that they are a leader in this niche and in general DOE was unable to identify any publicly- available data that would lead to the conclusion that the small manufacturers would be differentially impacted from the average in the industry than their larger competitors though DOE does recognize that small manufacturers may need to allocate a greater portion of their available technical resources than competitors, and may need to access outside capital.

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

Again, sometimes it can be very difficult to find public information on these manufacturers and we do want to make sure we properly consider the impacts on them. DOE seeks comment on the potential impacts of the amended standards on the industry, on the conversion costs for the industry, on the key drivers, again that level of detail on the key drivers of those conversion costs and then on changes in manufacturer prices and markups. And finally, we invite all comment on the MIA.

MR. BROOKMAN: Mike?

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

MR. LAU: We did.

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

MR. BROOKMAN: Jill?

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

MR. LAU: Sure.

MS. HOOTMAN: -- because I'm quite

shocked by the number.

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

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

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

MR. BROOKMAN: Mike Rivest?

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

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

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

MS. HOOTMAN: The suppliers.

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

MS. HOOTMAN: All right. Well, this is where I have the issue. I can look at three manufacturing facilities that make these gas furnaces and I have on order in those manufacturing facilities dedicated just to heat exchangers and making them the number that you have in here, 200 people.

MR. RIVEST: Okay.

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

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

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

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

MR. VON WENTZEL: Constantin von Wentzel here at Navigant. Any information that you can submit to us, we would appreciate. There might be an issue where your manufacturing assets are shared across a wider range of product. So that might be where the 200 people come from as opposed to 200 people being dedicated only to 250,000 Btu furnaces.

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

MR. VON WENTZEL: No, no.

MS. HOOTMAN: Okay.

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

MS. HOOTMAN: Okay.

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

MS. HOOTMAN: Yeah, right. Okay.

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

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

But you said this is a $75 million industry.
MR. RIVEST: That's the value per year.
MS. HOOTMAN: That's the value pertaining to commercial warm air furnaces. Is that right?
MR. RIVEST: Right.
MS. HOOTMAN: And I realize that's a subsection of -- I mean --
MR. RIVEST: Right. You may want to look at it.
MS. HOOTMAN: So I'll comment. If that's the amount --
MR. RIVEST: The annual sales -- it's about --
MR. LAU: $70 million.
MR. RIVEST: $70 million revenue.
MS. HOOTMAN: Okay.
MR. RIVEST: So that would be --
MS. HOOTMAN: Off the top of my head, because we don't pull it apart, I'd have to do some figures on that.
MR. RIVEST: Back out the markup and

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

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

MS. HOOTMAN: Thank you.

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

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

MS. HOOTMAN: Seventy, okay.

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

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

MR. FRANCO: Thank you. This is Victor Franco again. Now, we're going to be looking at the environmental impacts and indirect employment analysis. As part of the environmental impacts, we take into account the emission impacts in the analysis to estimate the emission reductions resulting from the amended standards.

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

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

In addition, DOE took account of the monetization of these emission reductions to estimate the potential monetary benefit of reduced power plant emissions resulting from the considered energy conservation standards. DOE used the most current social cost of carbon values developed through the interagency reviews. The interagency estimates are shown in this next slide, range from $12 to $119 per metric ton. For emission reductions that occur in later years, SCC values grow in real terms over time. DOE also monetized NOx emissions reductions resulting from amended standards. These range from $476 to $4,893 per short ton. DOE calculated monetary benefits using the median value of $2,684 per short ton.

The results are shown in this next slide. For TSL 4, the CO2 monetized emission reductions ranged from $175 million to $2.6 billion. More details about the methodology and about these results are included in chapter 14 of the TSD. DOE requests comments on this part of the analysis, specifically seeks comments on its approach for conducting the emissions analysis for commercial warm air furnaces. Also DOE seeks comment on the approach for estimating monetary benefits associated with emissions reductions, including in the social cost of carbon values used.

MR. BROOKMAN: Frank?

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

MR. CYMBALSKY: Yeah, so I'm more familiar with the social cost of carbon numbers as well, which come from an interagency agreement and, you know, we're basically told what to use here. That's not a DOE thing. As for the NOx, I'm pretty sure we're getting the value from what EPA has done in this area. So the numbers I believe are 28 -- if you look at the totals, yeah, the carbon values are much, much higher, so.

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

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

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

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

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

MR. BROOKMAN: Michael McCabe?

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

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

MR. BROOKMAN: Frank Stanonik?

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

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

MR. BROOKMAN: It's a mixture --

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

MR. FRANCO: Combustion of fuel, yeah.

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

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

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

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

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

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

MR. SACHS: So moved.

[Laughter.]

MR. STANONIK: I think one of the issues we have a concern about is that the trial levels may in fact result in increasing the size of the unit and if that is an outcome of a trial level, that now does incur potentially some installation costs, certainly in a replacement situation because most of these units are in fact placed on top of a platform I guess I'll call it or whatever and if the unit ends up -- and again, realizing we're talking about inputs from 226,000 to 2 million or whatever or more.

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

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

MR. SACHS: Harvey Sachs, thank you.

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

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

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

CERTIFICATE OF COURT REPORTER

I, NATASHA THOMAS, the Court Reporter before whom the foregoing proceeding was taken, do hereby certify that the proceeding was recorded by me; that the proceeding was thereafter reduced to typewriting under my direction; that said transcript is a true and accurate record of the proceeding; that I am neither related to nor employed by any of the parties to this proceeding; and, further, that I have no financial interest in this proceeding.

____
NATASHA THOMAS
AUDIO REPORTER

CERTIFICATE OF TRANSCRIBER

I, BENJAMIN GRAHAM, do hereby certify that this transcript was prepared from audio to the best of my ability.

I am neither counsel for, related to, nor employed by any of the parties to this action, nor financially or otherwise interested in the outcome of this action.

____
BENJAMIN GRAHAM