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Case: Energy Conservation Standards: Preliminary Analysis For Commercial Packaged Boilers Meeting

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UNITED STATES DEPARTMENT OF ENERGY

ENERGY CONSERVATION STANDARDS:

PRELIMINARY ANALYSIS FOR

COMMERCIAL PACKAGED BOILERS

PUBLIC MEETING

TUESDAY, DECEMBER 9, 2014

FORRESTAL BUILDING, ROOM 8E-089

1000 INDEPENDENCE AVENUE, S.W.

WASHINGTON, D.C.

GROUPS MEMBERS/PARTICIPANTS:

Doug Brookman, Public Solutions

Jim Raba, U.S. Department of Energy

Chuck White, Plumbing-Heating-Cooling Contractors National Association

Frank Stanonik, Air Conditioning, Heating and Refrigeration Institute

Rohit Andhare, Navigant Consulting, Inc.

Eric Stas, U.S. Department of Energy

Adam Darlington, Navigant Consulting, Inc.

Rupam Singla, Lawrence Berkeley National Laboratory

David Winiarski, Pacific Northwest National Laboratory

Felipe Leon, Pacific Northwest National Laboratory

Alex Lekov, Lawrence Berkeley National Laboratory

Harvey Sachs, American Council for an Energy-Efficient Economy

Andrew Allen, Navigant Consulting, Inc.

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GROUPS MEMBERS/PARTICIPANTS:

By Telephone:

Geoffrey Halley, American Boiler Manufacturers Association

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Frank Myers, PVI Industries, LLC

A G E N D A

P R O C E E D I N G S

9:07 a.m.

Welcome and Introductions

MR. BROOKMAN: Good morning everyone, welcome. This is the United States Department of Energy's Energy Conservation Standards Preliminary Analysis for Commercial Packaged Boilers meeting. Today is December 9th, 2014, here in Washington, D.C. in the Forrestal Building.

My name's Doug Brookman, Public Solutions, Baltimore. Nice to see you here this morning. We're going to start with welcoming remarks from Jim Raba.

MR. RABA: Good morning everyone, and welcome. Whether you're attending today this public meeting in person or via the webinar, this is the U.S. Department of Energy's public meeting about commercial packaged boilers, where we'll address our preliminary analysis of this equipment.

The purpose of the preliminary analysis is to address the methodologies and characterize the results thus far for those analyses, discuss particular issues related to each of the analyses, encourage input from interested parties, comments, data and relevant information about the methodologies, assumptions and data sources, and address the next steps in the Department of Energy's rulemaking process.

My name is Jim Raba. I'm the Project Manager for Commercial Packaged Boilers, and I'll be today's Presiding Officer. Moreover, the real expertise behind this rulemaking process is from Lawrence Berkeley National Laboratory and Navigant Consulting.

Today some of our team members are Rupam Singla, Alex Lekov, Rohit Andhare, Andrew Allen, Adam Darlington. General Counsel for the Department of Energy is Eric Stas. The Appliance Standards Program Manager is John Cymbalsky. Our facilitator at today's public meeting, is Doug Brookman, President of Public Solutions, a mediation company. Doug is our go-to guy for public meetings such as this.

MR. BROOKMAN: No.

MR. RABA: Doug, over to you. Thank you.

MR. BROOKMAN: We always start with

introductions. Please state your name and organizational affiliation. You can get used to turning the microphones both on and off.

MR. WHITE: My name is Chuck White. I'm Vice President of Technical and Code Services for the Plumbing-Heating and Cooling Contractors National Association.

MR. STANONIK: Frank Stanonik, Air Conditioning, Heating and Refrigeration Institute.

MR. SACHS: Harvey Sachs, American Council for an Energy Efficient Economy.

MR. DARLINGTON: Adam Darlington, Navigant Consulting.

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

MR. RABA: Jim Raba, DOE.

(Off mic introduction.)

MR. RABA: It's okay, please.

(Off mic introduction.)

MR. ALLEN: Andrew Allen, Navigant Consulting.

MR. LEKOV: Alex Lekov, Lawrence Berkeley

National Laboratory.

MS. SINGLA: Rupam Singla, Lawrence Berkeley National Laboratory.

MR. LEON: Felipe Leon, Pacific Northwest National Laboratory.

Meeting Overview

MR. BROOKMAN: Thank you. Thanks to all of you, and when you are responding to questions during the course of the meeting, we'll use that microphone, okay. All of you received a packet of information as you checked in this morning. I'm going to do a very brief agenda review. You can see it's Slide No. 4 in your packet.

Immediately following this agenda review and a few other preliminary matters, there's an opportunity for anybody that wishes to make brief opening statements here at the outset, issues that you wish to raise here that are important to be featured from your perspective here at the outset.

Following that, we're going to move into a description of the regulatory authority and rulemaking overview, and moving directly to Market

Technology Assessment and Screening Analysis, then Engineering Analysis. We'll take a break mid-morning, around about 10:45, wherever we are in the content at that point.

Returning from the break or whenever we get there, Markups, Energy Use Characterization and then LCC and Payback Period Analyses. Lunch today around about noon. I'll describe the logistics surrounding lunch when we get there, and then returning from lunch, LCC and Payback Period Analysis, continued. National Impact Analysis.

We'll take a break mid-afternoon as needed, around about 2:15, 2:30 or so, and then moving on, Preliminary Manufacturer Impact Analysis, Next Steps. And then at the end of the day, whenever we arrive there, another opportunity for closing remarks. Any other issues that need to be raised at that point, that you think may not have been covered sufficiently.

If you look at page two in your packet, these are the suggested norms that we'd ask that you please speak one at a time. You can turn the microphone on and off as you've gotten used to doing already.

Please say your name for the record each time you speak. They'll be a complete transcript of this meeting. If you could be concise to share the air time and keep the focus here. If your cell phones are not on silent already, please turn them on silent and limit sidebar conversations.

Webinar participants, we welcome you. As Jim Raba has said, please turn your telephones on mute. You can raise your hand in the software that has been provided to be recognized to speak.

We ought to be able to hear you in the room. It's been pretty good of late, so you can participate in this meeting real time. And as moving on through this packet, the Department of Energy is broadcasting this public meeting live over the Internet for interested parties, and I understand we have about 13 or 15 individuals on the line today.

We welcome you and want you to participate in this meeting as you wish to, and all interested parties, both here in person and on the web are encouraged to submit written comments after the public meeting. That's really critical for the Department, to get a good handle on what the concerns of stakeholders are.

So then do you wish to introduce the next element?

MR. RABA: Sure. Well good morning. This is Jim Raba again. This is a time we customarily look to you for any opening statements you wish to make in your remarks. At this time, we invite anyone to share those opening remarks or statements about DOE's preliminary analysis for commercial packaged boilers.

So I invite -- does anybody wish to make an opening statement or brief comments at this time, here live or on the webinar?

(No response.)

MR. BROOKMAN: I see no one in the room. Okay. Then let's proceed with the content in the packet. Okay.

MR. RABA: You see here on the screen an Issue Box, and as we will do throughout the public meeting today, have boxes like this, to encourage your comments. Now during today's presentation, particular issues are prompted for discussion on slides such as this.

Otherwise, comments about any part of the presentation are welcome throughout. When you submit comments, please identify the docket number and/or the regulatory identifier. Comments are due by January 20th, 2015, and their address is there to email, postal or courier to the Department. Any questions so far?

None seen at this time, I can introduce Rohit Andhare, who will talk today now about some of the overview, the definitions and other background information about our presentation today, and the preliminary analysis.

Background Information

MR. ANDHARE: All right. Good morning everyone. So I'll start with the introduction and the overview. The first thing is the regulatory authority. There are four Acts which are relevant to the current rulemaking. The first one is EPCA of

1975. This Act brought about, started the energy conservation standard program at DOE.

The second is EPACT of 1992, and this Act brought commercial packaged products as a type of equipment for the rulemakings. Then we have EISA and AEMTCA. These acts amended EPCA to have DOE review the standards every six years.

The last rulemaking for this equipment was back in July 2009. So six years from then, July 2015, is when by which DOE will complete its review.

So what is a commercial packaged boiler? A commercial packaged boiler is essentially a low pressure packaged boiler. It has a maximum input rating capacity of 300 kBTU per hour, at least 300 kBTU per hour, and it is usually used for commercial space-heating applications.

The definitions are also on the slides, and they can be used for future reference. So these are the current standards that we have for commercial packaged boilers, and this is the result from the July 2009 rulemaking, and here we have ten equipment classes.

Eight of these equipment classes -- so eight equipment classes are formed by classifying the equipment based on the size, that is small or large, the fuel input, the type of fuel, that is gas or oil, and the type of output, that is hot water or steam.

Two of these equipment classes, that is the steam gas-fired, the small and large steam gas-fired boilers, are further classified based on the draft type. So where do we stand? Currently we are -- so we've already released the framework document last year. This was back in September, and then followed by the public meeting in October for the framework document, and we've already released the preliminary analysis TSD chapters, and the comments are due by January 20th, 2015.

There are two rulemakings which are on-going and parallel to this one. The first one is coverage determination for natural draft commercial packaged boilers, and the second one is the test procedure rulemaking for this equipment.

I'd like to note over here that the analysis that is covered under this presentation and in the

TSD chapters is based on the existing test procedures which are mentioned in the CFR.

So here's our time line. We're at Preliminary Analysis. NOPR is, as I said, it's due by July 2015. This is the projected time, and final rule is projected by 2016.

So typically when DOE does its analysis, it considers these seven factors, which are mentioned in EPCA, and all these factors are addressed in the respective analysis. So for example, for the economic impact on consumers and manufacturers, this is addressed by the life cycle cost analysis and manufacturer impact analysis.

So throughout this presentation, we'll be talking about all these analysis and the results, and they address these seven factors. So we're at the Preliminary Analysis, and now we move on to the second topic of discussion, that's the market and tech assessment, and the screening analysis.

We'll first talk about the market -- sorry.

MR. BROOKMAN: Yes, please. Frank

Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. Before we leave the time line, it's -- well, it is related. I'm just curious as to can DOE give us some idea of where the test procedure rulemaking and the coverage determination activities fall in on this time line, because -- and the reason we bring that up is that from my perspective, as we have said in previous comments, it is absolutely necessary that the test procedure revision be done before this rulemaking.

MS. ARMSTRONG: Can I answer that for you?

MR. BROOKMAN: Yeah, that's great.

VOICES: Identify yourself.

MR. BROOKMAN: Ashley Armstrong.

MS. ARMSTRONG: So I'm Ashley from DOE. I wasn't going to say anything, but I was quietly sitting in the back corner.

[Inaudible] I wouldn't believe that.

(Laughter.)

MS. ARMSTRONG: So we agree. We agree, Frank, the test procedure NOPR is expected to come out, I would say the hope is that it will be out early next year. So you will likely see that well in advance. We're trying to get the preliminary analysis out, trying to get some feedback and some additional data to incorporate into the NOPR.

To the extent we make revisions to the test procedure that would impact the measures, obviously they would be rolled into the NOPR analysis, as well as any data. But we wanted to make sure we got this out as early as possible, to start the process of getting some data and good feedback, okay.

MR. BROOKMAN: Thank you, Ashley. Additional questions before we move on? No, okay.

MR. RABA: We're moving on.

MR. BROOKMAN: All right.

Market Impact Assessment/Screening Analysis

MR. ANDHARE: So our second topic of discussion is market and tech assessment and screening analysis. We'll first do the market impact assessment. The purpose of the market and technology assessment is to understand the market, to see how can we divide the equipment into equipment classes, and then we look at the voluntary regulatory programs that are ongoing for this equipment.

We also look at the manufacturers and the trade associations, which are dealing in this equipment, and then we look at what are the constituents of -- what are the components of a commercial package boiler. Once we have that information, we then go on to identifying the technology options that will improve the efficiency of the boiler.

So for the first step, we first divide the equipment based on the ten equipment classes. So here we have 16 equipment classes. Three of those are based on the four factors which are involved for the classification. The first one is the size, the small or large. The second is the type of fuel input, that's whether gas or oil. The third is based on the output, that is hot water steam, and the fourth one is also based on mechanical draft or natural draft.

So the scope of the current rulemaking

includes all commercial boilers that have an input capacity of at least 300 kBTU per hour, and they also include all the factors that I talked about, whether it can be fired by gas or oil, and that's natural gas or propane, and mechanical draft or natural draft in hot water or steam or both.

Here, we will not be addressing electric commercial package boilers, and this is because most of these boilers already reach 100 percent efficiency. So there is very small scope for efficiency improvement and negligible energy savings.

We will also not be looking into standby mode and off mode energy conservation standards. Again, according to our estimates, the standby mode and off mode contribute to very low energy consumption, and most of it is consumed during the active mode of the boiler. We will also not be setting an upper limit for regulating the commercial package boilers.

So once we have -- we have classified the equipment based on equipment classes, we then go on to the analysis. So we hit -- we went through each and every equipment class, and looked at what are the kind of input ratings there are in each equipment class. What are the efficiency levels that we see; what are the kind of materials that are used.

So these are some factors that we looked at for each equipment class. Here is a sample result of the first equipment class that we looked at, that's the small gas-fired mechanical draft hot water. So you will see these charts in the Chapter 3 of the TSD, and over here in the first --

In the first chart we have the average thermal efficiency. So what we did was we divided all the equipment class based on small input rating categories, and then analyzed the efficiencies in each of these categories.

We also looked at the percentage of the distribution of boilers based on the materials. So for this equipment class, we can see that 62 percent is based on copper. And finally, the last chart at the bottom shows the distribution of the boilers, based on thermal efficiency.

So we divided the boilers into condensing and non-condensing, and we saw where most of the boilers lie, at what efficiencies most of them perform.

MR. BROOKMAN: Harvey Sachs.

MR. SACHS: This is Harvey, and as I go back to Slide 20, the last bullet says there's no upper limit of input capacity set for regulating commercial packaged boilers.

MR. ANDHARE: Yes.

MR. SACHS: And it's just having sat through a great deal of discussion of this issue in the Certification and Compliance and Enforcement Negotiated Rulemaking in 2013, I came away somewhat struck by the challenges in actually assuring CC&E for very, very large boilers, and wonder if we're going to have regulation without enforcement or if the Department is planning ahead to enforcement for say 10 million Btu boilers?

MR. BROOKMAN: Eric Stas.

MR. STAS: Eric Stas, DOE. I mean as you know, the standards currently have no upper limit, and then we're confronted with the provision of 42

U.S.C. Section 6095.01, which says that the Secretary can't issue a standard that decreases energy efficiency or increases the maximum allowable energy use, you know, commonly referred to as an anti-backsliding provision. So we have that to contend with.

So that's why we're not considering an upper limit on the capacities at this time. However, I'm sure there are mechanisms available to look at how these units, larger units would be tested. AEDMs is one thing that comes to mind.

So I think the Department is sensitive to those concerns and, you know, we look for comments on how to address those type of concerns.

MR. BROOKMAN: Eric, would just spell out AEDM?

MR. STAS: Alternative --

MR. BROOKMAN: Energy Determination Method?

MR. RABA: This is Jim. Alternative Efficiency Determination Method.

MR. BROOKMAN: Thank you. Okay, thanks.

Okay, Harvey.

MR. SACHS: I think we have a record now. Thank you.

MR. BROOKMAN: Okay. All right.

MR. ANDHARE: So once we have market analysis results, we then go on to identifying what are the components involved in the operation of a boiler. So the slide shows the basic components that are involved. So it's identified by gas or oil for our case at least, for our rulemaking at least, and for oil it will use an oil pump and an atomizer.

The atomizer sprays the oil into the air, and it can be either a mechanical draft system or a natural draft system. A mechanical draft would either have a forced draft fan blower or it could have an inducer draft fan.

Then there are burners. The burners can be of a single stage, double stage or it can be modulating. The burners ignite the air gas or and oil mixture, and this -- and it transfers -- and the flue gases transfer heat to the water in the heat exchanger.

The heat exchanger can also have multiple designs. It can have multiple materials, cast iron, stainless steel, copper fin, copper tube, or fire-tube boilers. It can have multiple designs as well, and the primary mode of heat transfer is convection and radiation.

Once the heat is transferred, the flue gases are vented out through the flue stack. For natural draft, we also have vent damper. This is the basic model of the boiler, and we now -- once we know this, now we can identify how we can improve the efficiency of the boiler.

So these are the technology options that DOE identified for improving the thermal or combustion efficiency. Most of the concentration is on improving the heat exchanger, so either improving the fin tube design or the surface features, and also there's an interest in looking at improvements in burner technology. So there is an option for premix burners or low pressure air-atomized burners.

So that completes our market and tech assessment, and we have some issues of comment.

You'll take them? Doug?

MR. BROOKMAN: No, please.

MR. ANDHARE: So there are two issues for comment over here. The first one is the DOE seeks comment about the scope and technology options to improve combustion and/or thermal efficiency, and the second issue is DOE seeks comment on the appropriateness of its decision to -- tentative decision to classify commercial boilers into 16 equipment classes.

MR. BROOKMAN: So it's useful to get comment on this particular item, particularly Issue 2. Especially if you like what the Department has done, it's useful to indicate that. Frank Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. On Issue 1, I mean I think we've provided comments before. You know, if we're sitting here ten years ago, burner derating was still a practical option. But between efficiency standards and demands of the market, our perspective is that most products have been --

You know, that was one of the easiest and first things that people did to improve the efficiency of their models. So we don't really see that there's much room for further burner derating of boiler models on the market today. So we really think that particular technology option has kind of been there, done that, as opposed to still viable -- still providing some significant benefit.

Other than that, again, we've said, for whatever reasons -- I mean we've said many things. Pulse combustion is just another way to get a condensing boiler. We really don't see it as a distinct technology. But just, I guess just make that statement.

Issue 2, I guess I'm missing something, because when I looked at Slide 12, I got two, four, six, eight, ten classes. How did we get to 16? What am I missing?

MR. BROOKMAN: Back to Slide 19.

MR. STANONIK: Okay.

MR. ANDHARE: Here, there are 16.

MR. STANONIK: Okay, okay. I got it, yep, yep. At this point, we'd certainly agree you can start from there. As the analysis goes forward, we may find out you can squeeze some together. But I guess for the preliminary analysis, we would agree you have to look at it this way.

MR. BROOKMAN: Okay. Thank you, Frank. Additional thoughts on Issue No. 1 and 2? Nothing additional.

MR. ANDHARE: Okay. So --

MR. BROOKMAN: Harvey Sachs.

MR. SACHS: This is Harvey Sachs, and it relates here and it will come up again. But the decision not to really look at modulating burners or multi-stage burners is driven by the defects in the current test procedure, and we think we need in the market analysis in particular to continue to look at the market share and penetration of these, since we anticipate that the next rating method, test method will show the benefits in the field of the use of modulating burners in raising the efficiency, the reported efficiency.

So I think that I'm uncomfortable with the decision not to look at modulating burners, but instead just to consider them baseline technology.

MR. BROOKMAN: Okay, thank you. Do we have any additional thoughts on modulating burners?

MR. ANDHARE: I'd like to supply. So we do look at modulating burners in the market assessment. For example, go here in the bottom slide. We actually look at the distribution of burners that are modulating and are condensing and modulating, and are non-modulating. So we do look at it in the market and assessment stage and then, you know.

The other thing is that current test procedure does not -- it doesn't matter if it's modulating or not, because it has to operate at the full input rating capacity.

MR. SACHS: This is Harvey. I appreciate that the test procedure is a full load test, and that's why it is so totally obsolete, and I very much appreciate that you're including this in the market analysis.

MS. ARMSTRONG: So I'm going to turn the question back to you for a second, and maybe to Frank too. This is Ashley from DOE. I don't know how far the discussions have gone within the HI Committee at AHRI about moving to a part load. Initially, there was some discussion. We also teed it up in the RFI about moving to potentially a part-load type test.

Not to hijack the standards presentation, but -- and there was some, I would say, caution of moving to a part-load test, one from the test program standpoint, but two, at least for this round of rule. I was just was wondering if the HI Committee had come -- I know you were both on the HI Committee. So I don't know if the HI Committee has made any further progress with what they're doing.

That's not to say DOE has made it -- obviously, DOE has made some internal decisions about what they're doing, but I would be interested to know.

MR. STANONIK: Frank Stanonik, AHRI, and HI is the Hydronics Institute section of AHRI. Actually, at this point, our members are much more of the opinion that for this particular process, both this standard rulemaking and the test procedure rulemaking, that we not get into the complexity of part load.

And so that is something we see as will be ultimately addressed by the ASHRAE Standard 155, and in the interim, the industry would -- until that gets finalized, which will still take some time. Our position would be that we proceed with the procedures that we have, which at the moment don't look at part load and that this rulemaking also deal with that situation.

So we recognize that it will ultimately -- there will be procedures that include some part load measures. But we see that as the culmination of the 155 activity, and we just don't see that that will be done in time for either of these rulemakings.

MR. SACHS: This is Harvey, and I'm scared to say what I'm going to say. ASHRAE 155 spent almost 15 years delivering a standard that was stillborn. It could not be implemented. AHRI and HI has been working on 2000, at a pace that continues, and at this point we feel that we're running out of time.

We're running out of time relative to what's happening elsewhere in the world, and relative to the need to reduce the fuel consumed for all sorts of reasons, economic and environmental.

Although I'm going back to my colleagues, I think there needs to be a strong signal that if our friends in the consensus community, which includes me, don't get their act in gear by a firm date, DOE will issue its own standard that reflects the value of part-load capability.

To customers and the industry, it's not choosing what to design and what to select on our building-based applications.

MS. ARMSTRONG: I'm going to ask one follow-on, to put you a little bit on the spot, and don't feel like you need to answer it here. But I will ask perhaps that you consider what that time frame might look like for DOE to consider.

MR. SACHS: Well Ashley, this is Harvey, and having cast asparagus at AHRI and ASHRAE, I have to do the same to DOE, and say that if y'all hadn't -- had started investing and doing appropriate fuel measurements 20 years ago, we'd know what we needed.

Now, just as with residential light

commercial water heating, water heaters, we have a real deficit in knowledge, and at some point, somebody's going to have to say we're jumping in. We're doing the best we can. It's going to work for the next decade while we embark on an aggressive program of fuel monitoring, to find out what the hell is happening. End of rant.

MR. BROOKMAN: Additional comments here before we move on?

MR. STANONIK: Frank Stanonik, AHRI. Certainly the issue of what regulations require, what test procedures require have significant impacts.

But I just want to note that for whatever it's worth, in ASHRAE Standard 90, which covers energy and conservation in commercial buildings, there's actually been requirements for quite some time, that requires controls for the boiler-based heating system, that in fact tried to manage the firing according to the load. That's been there in Standard 90 for a while.

So you know, whether I guess my point here is, you know, whether or not there's today a test procedure for part load, there have been other factors in the market that I think, as you mentioned here, you know, there are a number of models that have modulating controls.

MR. BROOKMAN: Thank you.

MR. STANONIK: I guess the savings is happening.

MR. SACHS: This is Harvey, and again, I'm ahead of my community. I'm casting a blank shell across the bow. But I think this is an area which we are going to emphasize. I think BTS-2000 is an entirely appropriate approach for some industrial applications. Buildings have climate. I think that we just don't know what we see, and this is one of the areas for the market assessment also.

We think we see some shift from using larger boilers, for which we can't get good use information, good information on how they utilize energy in the field at part load, because we don't measure it, toward using trains of smaller boilers, and this is going to have some impact on the market also.

So I think this is an absolutely first order issue for the industry, as well as the purchasers and users. At the same time, I think this proceeding must proceed getting the information required for doing -- for working with a revised test method. But I am not now asking for delay in this proceeding.

MR. BROOKMAN: Okay. Thanks, Harvey. Okay.

MR. ANDHARE: All right, thank you.

MR. SACHS: This is Harvey again. One last time on this. I will submit into the record an ASHRAE journal article from almost a decade ago from Durkin, reflecting the challenges that customers in commercial buildings have in choosing equipment and then selling the choice of the more efficient equipment, given the defects in the standard.

MR. BROOKMAN: Thank you.

MR. ANDHARE: All right. So we now go to the screening analysis. So in the screening analysis, we screen out technologies which fail certain criterias that DOE sets. There are four criterias, and those are mentioned in the slide. I'll just repeat them: That's technological feasibility, practicability to manufacture and install, and the adverse effects on equipment utility and human health.

These are the technology options that pass the screening test. The box on the left shows these options, and as I mentioned earlier, the interest was in looking at options which improve heat exchanger performance, and this involves innovative fin designs and even looking at surface enhancement features.

We also looked at burners, how can we improve the burner performance, there are the three options that I mentioned earlier. The burner derating has an adverse impact on the end user, because the end user would get a lower utility from the boilers. So that's why it's not included. It failed the screening test.

There are some options over here which passed the screening test but were not considered by DOE, and this is mainly because the current -- based on the current test procedure, there is negligible or a very low impact on the energy savings or efficiency improvement. So these are the options, and we now have issues for comment.

So DOE is interested in views about the technological and economic feasibility of the technology options which successfully passed the screening test. Do you have any comments?

(Off-mic comment.)

MR. BROOKMAN: Okay. No comments here, and in particular nothing that was missed here in this Slide 27.

(No response.)

MR. BROOKMAN: No. Okay, thanks. Okay, moving on.

MR. ANDHARE: Okay. So now we go to our third topic of discussion, the engineering analysis. So the purpose of the engineering analysis is to establish the relationship between the manufacturer's selling prices and the efficiency levels. The results that we obtain from the engineering analysis go into all the downstream analysis like life cycle cost analysis, energy use, Manufacturer Impact

Analysis and National Impact Analysis.

So for getting the information for this analysis, we looked at different sources, and our main source of information was the prices that we got from manufacturers and contractors to carry out this analysis.

MR. SACHS: As a matter of record, this is Harvey again, AC Triple E notes that the upper graph of the analysis are based in a snapshot in time, although it's much less relevant for this very mature set of technologies with large international firms involved, than it is for some products.

We would note for the record that DOE has consistently underestimated the changes in cost for advanced technologies as they became standard products or lower-priced premium products with advances in the standards. I think this conceptual model has to be qualified as being a snapshot rather than a movie, as people do their thinking.

MR. BROOKMAN: Okay, thank you.

MR. ANDHARE: Thank you. So there are several steps that we follow to carry out the engineering analysis, and I'll be discussing about these steps more in detail. But they're on your screen for a quick view. So we first will talk about the baseline models.

So the first step is to identify what are the baseline efficiencies. For our case, for our rulemaking, we've used the baseline efficiencies based on the current energy conservation standards for this equipment.

So we also -- the other thing that we also look at is the common technologies that are used in baselines, and this helps us validate if there is an efficiency improvement, then what is that, because what is -- why did that improvement occur?

So for example, if there is a much better burner, then we know that the efficiency improvement is because of that burner. So it kind of helped us validate our findings, and here on the screen we have the baseline efficiencies. I would also like to point out that we'll be using some acronyms to describe the equipment classes.

So for example, SGMDHW would refer to a

small gas mechanical draft hot water, and they're on your screen for your view.

MR. BROOKMAN: Before you move on, Joanna Mauer, who's joining us via the web, has a question is could DOE explain the rationale for considering separate equipment classes for mechanical draft and natural draft boilers?

MR. DARLINGTON: Well I mean so --

MR. BROOKMAN: Adam Darlington.

MR. DARLINGTON: Adam Darlington, Navigant. Sorry. So regarding the steam classes, the natural draft and mechanical draft are already separated in the current standards. The other classes are not currently separated by the standards.

But I think as was explained a few slides ago, we're analyzing 16 product classes on the basis of the coverage determination that DOE is making, where DOE is, I guess, doing the cover determination to clarify its authority to cover the natural draft product classes. So -- and Eric, you can chime in on the legal opinion. But I think that they have to be separated because of that.

MR. BROOKMAN: Eric, do you want to --

(Off mic comment.)

MR. BROOKMAN: Okay.

MR. DARLINGTON: So it has to do with the coverage determination and keeping them separate.

MR. BROOKMAN: Okay. Okay, thank you Adam. Thank you. Okay.

MR. ANDHARE: So then we move on the next step, that is determining the intermediate and max tech efficiency levels. So the intermediate and max tech efficiency levels are -- they identified from the commonly available efficiency levels that we see on the market, and on the bottom over here, the tables, the boxes you can see the efficiency levels that we'll be looking at, and we'll be analyzing all classes, incremental prices for all these.

The reference point is of course the baseline. We will be looking at the efficiency improvement from the baseline and also the incremental price from the price of baseline models. We're also looking at the condensing efficiency levels. So all efficiency levels that have -- that are above 90 percent are condensing boilers efficiency levels.

So after that we move on to collecting the data, and as I mentioned -- sorry yes.

MR. STANONIK: Frank Stanonik, AHRI. So on this slide, and I'll apologize, I've not read the whole TSD yet. So are these the standard trial levels that you're going to be looking at?

MR. DARLINGTON: Adam Darlington, Navigant. So these are the efficiency levels.

MR. STANONIK: Yes.

MR. DARLINGTON: And so when we get to the NOPR phase, we'll construct the trial standard levels out of combinations of these efficiency levels. Is that --

MR. STANONIK: Okay. So I guess I'll ask my question. Then maybe you can -- well, I'll ask the question. So as an example, in the, let's see, small oil mechanical draft hot water, I mean you go from 87 to 98, and there's no question making a condensing oil product has many challenges to it.

But having said that, you know, why no

interim point? I mean there's a huge -- it's like you went from the maximum non-condensing level to really what would be, I would say actually the practical absolute maximum on a condensing level, with no interim values. Why?

MR. DARLINGTON: So these were based on --

MR. BROOKMAN: Adam Darlington.

MR. DARLINGTON: Oh sorry, Adam Darlington, Navigant. So these are based on our view of the market. I can't recall exactly what's out there Frank, but so the 98's included because it's the max tech, and there's a legal obligation to look at the max tech.

As far as an intermediate level, I mean if you think an intermediate level should be there, we'll certainly take that under consideration and look again, and potentially add one for the NOPR.

MR. STANONIK: Okay, Adam. I think your answer that you've looked at what's out there really kind of explains that. Again there's, at the moment, for that particular class of products, not much out there. Okay, thank you.

MR. STAS: And if you have data to back up that suggestion, that would be most welcome.

MR. BROOKMAN: Thank you, Eric.

MR. SACHS: This is Harvey, and I think the inclusion of the low level condensing in the analysis will illustrate the challenges faced in marketing such a product, at a cost-effective price, and it's worth doing for that reason alone.

MR. BROOKMAN: Okay, thank you.

MR. ANDHARE: So the data, the price data that we received from contractors and manufacturers, as we can see, was quite skewed. We received most of the prices for mechanical draft equipment, while very low prices were received for the natural draft.

So it's important to mention here that DOE requires to give us a singular set of results from the engineering analysis, and when we received the prices, they're distributed over a large range of input capacities and over a large range of efficiencies. So it's important to define a representative input capacity for every equipment class, and we chose -- we've identified for small-sized boilers, for small-sized equipment class as 800 kBTU per hour and for large size as 3,000.

These are based on the input ratings that have the maximum number of shipments, annual shipments. So these are the capacities and all the results that are covered in this chapter, in the engineering analysis chapter, are based on these input ratings.

MR. SACHS: Harvey Sachs. I'm going to leave here with my reputation as curmudgeon fully consolidated. But it does seem to me that at some point, there are very few customers interested in buying input capacity. The level field for comparing purchase options is output capacity, and it's with the advent of very high efficiency equipment.

It seems to be about time to migrate to looking at output capacities that are comparable across classes rather than input capacities. Now I don't know if we have to change the law to get there, but I think that would be within the discretion of the Department.

MR. BROOKMAN: Yeah, thank you. Frank.

MR. STANONIK: I'm going to venture into something I really don't know a lot about, and probably something that our friends from the American Boiler Manufacturers Association should be addressing.

But I have a really strong suspicion that when you're getting into this question of prices and so on, that when I go from a large boiler that's like three million BTUs, to the point where I'm talking about, since this is unlimited capacity, since I started talking about boilers that are in the tens of -- potentially tens of millions of BTUs, I think you're dealing with a whole different price structure.

So I mean it's -- I don't have a good sense of how significant this is, but I would just caution that as you go through the analysis, that there may be an upper limit on the large boiler capacity, at which point you change price structures just completely.

I mean, you know, people who as a matter of -- companies as a matter of course that are making boilers, where perhaps their smallest model starts at ten million and goes up from there, I think you're dealing with a totally different price customer situation vis-a-vis, as you said here, you know, the most popular size seems to be three million BTUs. Anyhow, just a little caution.

MR. ANDHARE: Okay, thank you. So now we go on to the methodology, and based on the amount of prices that we received for the different equipment classes, we have classified the methodology into five parts. The general approach caters to those equipment classes for which we had sufficient pricing information, and I'll be discussing about all these, you know, one after the other.

So when we first look at the general approach, there are six steps to be followed in this approach. The first one is to -- we divided all the products based on the equipment classes, all the 16 equipment classes, and then we identified the efficiency levels that we required the intermediate and max tech efficiency levels.

Then we pick the boilers at the representative input capacity. So if for a small equipment class we have 800 kBTU input capacity boilers at their respective efficiency levels, we picked those directly. If there aren't any of those boilers, then we use some statistical and regression techniques to evaluate the price at that capacity.

After that, we pick the boilers at the baseline efficiency levels, and that determines our baseline price. We use this price in the next step to calculate the incremental price. So for example, so we first divide the set into different manufacturers, and then if, for example, for Manufacturer A we have a boiler at 82 percent, which has a price of -- which has some price, and we have a baseline price, we subtract the baseline price from that higher efficiency model.

We do this for all the manufacturers, and then we average it out and we get the price efficiency curve. This is the -- all this description is given in the TSD chapter as well, and the results are also in it.

So that was for the classes for which we had sufficient information. But there are some classes for which we do not have sufficient information, and these are the large gas mechanical draft steam and large oil mechanical draft steam. So these -- the prices for these were based on the equipment classes for which we got the incremental prices.

So for example, over here we have the small gas prices, the incremental prices for the small and large gas mechanical draft hot water. So we took the ratio between the incremental prices and averaged the ratio, and we used this average ratio to calculate the incremental price for the large gas mechanical draft steam. The small gas mechanical draft steam was already obtained through our general approach methodology. You had a question?

MR. SACHS: This is Harvey. Does that scare you?

MR. ANDHARE: Well, we have to deal with whatever prices we had, and we had to --

MR. SACHS: It seems to me, and Mr.

Stanonik's comment a minute or two ago, sort of relates to my own sense. I suspect we're going down orders of magnitude in numbers of products produced per year, as we move from the 800 kBTU to the ten million BTU product.

So we're doing something that looks analogous to extrapolating from Cadillacs to the cost of large excavators, of the class used for strip mining coal.

I would personally be really scared, but you've certainly looked at the data much more closely than I have. I'm speaking from intuitions about manufacturing processes. That stuff is custom designed for specific applications.

MR. BROOKMAN: Robert Glass, who is joining us online, writes the comment that is similar to Harvey's last comment. He says "To support Frank Stanonik's comment, made to order units will be priced higher, due to the engineering work necessary to create this 'one of a kind model.'" Adam Darlington.

MR. DARLINGTON: Adam with Navigant. Just to reply or to clarify with Harvey, I mean so what we're showing here is basically we're using the price efficiency results from one comparison of small to large, and looking at the change there, to go from another comparison of small to large. It sounds like your comment was more -- and so as we explained earlier, the large is a three million BTU per hour boiler.

It sounds like the issue that you're taking is more that the ten million, that we need to have some additional extension to these even larger boilers, and look at those completely separately from the three million BTU per hour boilers?

MR. SACHS: I am suggesting, and thank you for that clarification. But I'm suggesting that I'm extremely uncomfortable, without having the calibration, the restraining input of knowing the number of units per year at any given capacity class.

At this point, you are, for example, assuming a linear regression in both the ones for which we have data and the ones for which you don't have data, and I suspect with those small numbers, that we could find any number of fits that would come close.

Now I may be wrong. I have not read this piece of the TSD, but this just -- I think we need to see a table of shipments by capacity for the industry before we can have any confidence in this.

MR. WHITE: This is Chuck White with PHCC, and certainly anecdotal. But in over 30 years as a contractor, I've put in a lot of boilers, 800,000 BTUs, that type of size. Three million BTUs is 75 to 80 horsepower, probably ten percent compared to the other size.

So, and larger than that, the numbers get even smaller. As referenced earlier, not really so much with steam but certainly with hot water, the trend is modular units to add more. So I think you will find the numbers in those larger classes are certainly going to be fewer, and they definitely are made to order.

If you bought your car made to order, it would cost a lot more than what you go buy off the lot.

MR. BROOKMAN: Great. Thank you, Chuck. That's helpful. Ashley.

MS. ARMSTRONG: This is Ashley. I'm going to clarify one point, and that's not to say that obviously, you know, those who are on the phone or if ABMA is on the phone participating. We welcome feedback on our pricing, especially for the larger sizes. As you know, it is hard to get pricing for built-to-order products. There is some complexity there.

Our cost model does, within itself, within the pricing that we've done, does take into account the volume differences for capacity. So if we're analyzing discrete capacities small and large, there is a volume price difference there and that is built into what you're seeing. It's not linear like you're saying. So there is some benefit there.

Now what Adam's saying is the large unit we looked at is three million, and maybe that price point is different than a ten million unit. We would welcome feedback on that.

We would welcome manufacturers of large

commercial, industrial boilers to work with us to further refine our points. Happy to do that. Happy to walk through that with them, and share with them further about what we did. You too Harvey, if you have data about a ten million --

Like I said, this is our first. We want to put it out for comment. That's the whole purpose of this.

MR. SACHS: I tried real hard to get the ten million unit for my house, but despite its leaky walls, I just couldn't take the whole wall out and I didn't have head room.

MR. BROOKMAN: I want to go back to Chuck. Can you -- you talked about how much linearity would affect the larger sizes and the numbers. Is there kind of a discrete break point there at the high end, where a lot of these units -- can you characterize what's going on with the market?

MR. WHITE: I would say 10 to 15 years ago, it was probably a million BTU boiler would be a very good candidate for going modular. The industry didn't have a lot of product with large capacity and higher efficiency. But that has developed in the last 10 to 15 years significantly.

So now there are products, high efficiency products in the million BTU class that days ago were not there. So it's a selling feature to a customer, to tout the high efficiency abilities, and certainly buying more than one multiple units adds labor and adds product cost, but you can frequently demonstrate the payback.

Kind of circling back a little bit to the large steam boiler discussion there and your price multiplier, your incremental difference, in large boilers there's obviously a number of ways you can manufacture them. But for years, it was square feet of heating surface per horsepower, 500 square feet per horsepower or I'm sorry, five square-foot, ten square feet, what have you.

So higher efficiency means more square feet of surface area, which adds pounds, pounds are dollars. So my gut feeling is that 22,000 compared to the baseline seems like a lot. But I really don't have a way to quantify that.

MR. BROOKMAN: Okay. Harvey Sachs.

MR. SACHS: Harvey Sachs here. BSRIA [Building Services Research and Information Association] has every decade or so done cost comparisons, including condensing boilers, various commercial sizes internationally. It's one resource and another resource that I would commend is the comments from the transcripts of the negotiated rulemaking of 2013 on CCE, where a lot of the manufacturers of this stuff were represented, and I suspect those transcripts could be mined productively.

MR. BROOKMAN: Thank you. Frank Stanonik.

MR. STANONIK: No.

MR. BROOKMAN: No, not at this time? Okay. Additional comments before we move on?

(No response.)

MR. BROOKMAN: All right.

MR. ANDHARE: So next we move on to doing the analysis for condensing small gas mechanical draft hot water and large gas mechanical draft hot water equipment classes. The reason why we separated these is one, is that we didn't have -- DOE did not have enough prices for the condensing boilers, and the second is that the slope, the rate at which the price increases for -- the incremental price increases for the non-condensing levels is much lower than what it is for the condensing levels.

So we took -- so for example, what we did was we added an additional step in sort of classifying it. Based on the companies or the manufacturers, we added an additional step, where we categorized it based on the materials used. So for example, if we have A, B and C of the manufacturers and 91, 92, 93 as the efficiency levels, we classified it based on materials.

So materials, for example A and B manufacturers produce boilers of Material 1, of type Material 1, and the other one -- and C producers, boilers of type Material 2. So we take the average of the prices for Material 1 and similarly for Material 2, and then we come down to the incremental price.

So we subtract the price P2 minus P1, P3 minus P1, P4 minus P1, and take the average for each and all efficiency levels. This is the way we get down to the prices for -- incremental prices for the condensing small gas mechanical draft hot water and large gas mechanical draft water equipment classes.

Similarly, we also use another approach for the small oil mechanical draft and large oil mechanical draft hot water equipment classes. Here we took the slope ratio that we obtained for the small-sized boilers, the small-sized equipment class of the gas-fired equipment class.

So suppose this is the price efficiency curve for the small gas-fired mechanical draft hot water equipment class, then we take the slope of the condensing efficiency levels and the slope of the non-condensing efficiency levels. We take the average and calculate the slope for the condensing efficiency levels using the equation.

So we have to use all these techniques mainly because we do not have enough prices, and we welcome prices from manufacturing contractors for the NOPR stage of the analysis.

For natural draft equipment classes again, as I showed earlier, that only four percent of the prices [we received] were for natural draft, and among the prices we also received a price difference in converting a boiler from a mechanical draft system to a natural draft system.

So we have -- so we took that price differential, which is based on the components that are required for the mechanical draft assembly, like the inducer, inducer fan assembly, the sensors, etcetera, and subtracted it from the natural draft assembly, that includes a vent damper and draft hood.

And we took the price differential and subtracted it from the mechanical draft prices, and this is the way we got the natural draft prices, and then we calculated the incremental prices thereafter.

So these are the methodologies that we used, and this slide and the next slide provides the summary, just for future reference, and finally these are the sample results that we obtained for our analysis.

Here, I'm showing just two analysis, the two equipment classes, that is the small gas-fired mechanical draft hot water and the similar natural draft hot water equipment class, and over here we can see the charts. All this information is in the Chapter 5 of the TSD, the engineering analysis chapter. Now we have issues for comment.

DOE requests comment about the methodology used to calculate incremental prices for increased efficiency for each equipment class. DOE also requests comment about the appropriateness of the incremental prices reported as part of the engineering analysis chapter, and also finally DOE requests additional prices that are price-related information, especially for natural draft boilers, and that will further improve the analysis that you already showed right now.

MR. BROOKMAN: Frank.

MR. STANONIK: It's interesting that for whatever reasons, you weren't able to get enough prices on natural draft boilers. Having said that, obviously AHRI cannot and will not provide information on specific prices, because we just don't try to collect that information.

But having seen the analysis here, we will certainly discuss with our members whether we can provide, give some -- perhaps can provide some comments on the, let's say the percentage change as you go up in each level of efficiency, whether it makes sense or doesn't make sense.

That's about the closest we can come to really addressing issues regarding prices, because as a trade association, that's really something we try to avoid addressing directly. But as I say, I'm a little surprised you didn't get enough information. So we'll see if we can at least indirectly help resolve that issue.

MR. BROOKMAN: Do we have comments on the methodology, the first item?

(No response.)

MR. BROOKMAN: No comments there. Joanna Mauer, who is joining us via the web, asks a question, and the question is "Did DOE try to look at the incremental costs, as opposed to the incremental prices?"

MR. ANDHARE: So we looked at the

manufacturer's selling prices. We did not look at the manufacturer costs. So I think the engineering analysis is primarily for the manufacturer selling prices, what comes out of the manufacturer's assembly.

MR. BROOKMAN: Okay, thank you. And you'll note, if you look at the issue for comment box, the final item, "DOE requests additional price-related information." Frank, I know you're limited. Are there other sources that DOE may not have uncovered yet?

(No response.)

MR. BROOKMAN: At least not that we know about. No? Harvey.

MR. SACHS: This is Harvey. I suggested the BSRIA compendia is available for purchase.

MR. BROOKMAN: Okay.

MR. SACHS: I don't assure the quality, but it is a resource.

MR. BROOKMAN: Okay, thank you. Yes Frank?

MR. STANONIK: I went back and forth about asking this question, and honestly trying not to be, I guess, snide about it. But I'm curious. I mean the Federal government operates many buildings across the United States, and purchases lots of things, including heating systems and boilers.

And again, I have no appreciation, I'm sure, for the complexities of this. But I'm just curious as to what extent information might be available to DOE, you know, in terms of boilers that the Federal government purchases, whether it's an Army base or whether it's a Federal building or whatever.

I just wonder if there's, you know, if there's some way that that information is available, or it's just, you know, or we're dealing with such a complex system? I mean no question, the Federal government is huge, right. It's just, you know, kind of out of the question but that data, you just couldn't find it.

MR. BROOKMAN: Okay.

MR. ANDHARE: Well, I think the other thing is that that will be a much lower subset of the number of equipment class that we have, because we need prices for each equipment class, and the majority of the prices that we found were concentrated in a few equipment class, but not so much in the rest of them.

MR. STANONIK: That -- Frank Stanonik, AHRI. I appreciate that. But not just this rulemaking, many of the rulemakings, and again, it's not an easy thing. But you know, the analysis always runs up against the difficulty of getting, you know, what I would say is a real world price.

In other words, what the ultimate contractor or installer who actually is selling and will be installing the product to the final customer, you know, what the actual cost of that was. These analyses and again, this is, you know, you do what you can and we understand that.

But these analyses come from one end of it only, and usually don't have much data. Okay, so what was the, you know, real price somebody paid for this thing?

MR. BROOKMAN: We have a few questions and comments from individuals on line. Jeff Kleiss writes "Please clarify the size (input rate) of the boilers for the plots on Slide 44."

MR. ANDHARE: So as you can see in the table, the small size -- both of them are small-sized equipment classes, and they range from 300 kBTU per hour to 2,500 kBTU per hour, both of them.

MR. DARLINGTON: This is Adam. Both those specific prices were obtained at 800,000 BTU per hour representative --

MR. ANDHARE: Yeah. So yeah. The equipment class is for the entire thing. But the results are for the 800 kBTU product.

MR. BROOKMAN: Okay, thank you. That's helpful, and Geoffrey Holly or Halley, pardon me, has a comment. Geoffrey, you're next.

MR. HALLEY: Okay, thank you. This is Geoff Halley with ABMA. I've been listening from the start of the meeting, at several times actually, but quite rightly Frank and all the people have talked about the ABMA sizes of boiler, and I think they're in a separate grouping really, from the smaller sizes, below two and a half million input.

I really fail to see how you can take a three million BTU boiler and extrapolate up to what could be an 80 million BTU boiler. You know, the largest hot water boilers that I'm aware of through ABMA are around 80 million input. Forty million is not uncommon, and probably the highest volume is around 12-1/2 million input.

I just don't understand the logic in taking such a small thing and hoping to extrapolate it all the way out, and then that includes not only the cost of testing, the cost of installation and so on, but the cost of maintenance that's used.

I mean it looks to me as though they're using something very small, maybe residential a little bit more in estimated maintenance numbers, and when you've got to climb the ladder to do some of these maintenance checks, you know, there's no relationship.

ABMA's members typically are all modulating burners. You know, there's very few of them that are less -- well, they start at 2-1/2 million and go up basically, up to utility size. I think there's got to be a cap at some point to make it reasonable.

Another thing is in doing this engineering analysis, where you look at the efficiency and the life cycle cost paybacks, if you look at the executive summary, they chart where they use a standard lifetime of 24.8 years, irrespective of efficiency.

Yet if you go to the background information, if you like, in Table 8-F2.1, the condensing boilers are listed as 10 to 50. It's in the majority. There are -- I think there's one that may say 20 years or something like that. But certainly, there seems to be a different standard set up between the executive summary and the data that was available. I was wondering if somebody could explain that to me.

MR. ANDHARE: So what was your --

MR. BROOKMAN: Geoff, you want to repeat the question please?

MR. HALLEY: Yeah. The difference between the executive summary average life time and what was available in the background information that was in Table 8-F2.1, which is also lifetime data.

It's a three-page chart or table, more or less, and in that was several references to commercial boiler lifetime if they're condensing boilers of 10 to 15 years, and yet use a 24.8 year in the executive summary. Is there some specific reason for doing that? It doesn't make sense to me.

MR. BROOKMAN: Go ahead Adam.

MR. DARLINGTON: This is Adam, Geoff. So the lifetime analyses that were done are part of the LCC analysis, and we're actually going to get into that, I guess, a little bit later on.

MR. HALLEY: Yes, sorry. I was having trouble getting in on this conversation, so I probably am loading more than I should have done right now.

MR. BROOKMAN: Well Geoff, since you've joined us, can you describe a more effective way to characterize these size differences and the scaling that --

MR. HALLEY: Well, I think they've got to be, you know. People have talked to the boiler count in these different sizes. They are pretty well all custom engineered. They may be standard heat exchangers, but then they take that standard heat exchanger and install it in something that's custom engineered for each job installation basically.

And so that there's going to be differences from one to the next, you know. The ABMA stance has been, you know, put a cap on the thing at two and a half million input. I don't know whether that's feasible with what's been said by Ashley and people like that.

But I see a lot of problems with testing, the expensive testing and it's -- you know, it's not just the installation. It's the fuel flows, and if you're going to add part-load testing as well, then you're going to, you know, jack up the price of testing significantly, because of the huge fuel flows that we have.

So there was a lot of things to consider once you get beyond this, what I call small boilers, which are, you know, probably less than five million.

MR. BROOKMAN: Geoff, maybe you --

MR. HALLEY: There's a lot of things that have been missed in this analysis, that I don't know whether it's because you didn't get the information or you ignored it basically.

MR. BROOKMAN: Okay. Well maybe you, Geoff, or someone else joining us, either online or here in the room could, in your written comments, describe a more suitable way to characterize these size differences.

MR. HALLEY: Right, yeah.

MR. BROOKMAN: It would be very, very helpful if you could do that. We also have --

MR. HALLEY: Well, I'll certainly do my best, and I do intend to submit written comments.

MR. BROOKMAN: Okay, thank you. Joanna Mauer asks "In general, looking at the incremental prices, we tend to overestimate the actual costs to improve efficiency. Was it not feasible to look at the costs rather than the prices?"

MR. HALLEY: Well you know --

MR. BROOKMAN: Geoff, I was going to -- I directed that toward the presenter.

MR. HALLEY: Oh, okay.

MR. BROOKMAN: Yeah.

MR. ANDHARE: So --

MR. DARLINGTON: I can take this. This is Adam. So yeah. I mean so our traditional, I guess, methodology is to look at the manufacturing costs, for the reasons Joanna states. Looking at the price is a little bit more conservative, because it does include some markups which, you know, can change at higher efficiency levels and things like that.

But to Joanna's question, it was a little bit less feasible here. Boilers are very large and expensive, difficult to purchase, tear down, difficult to handle. So we went with the pricing methodology. It was consistent with the methodology that was used in the last boiler rulemaking, which was also publicly vetted at that time.

No stakeholders really raised concern with doing a pricing methodology then. So it was kind of a previously vetted publicly vetted methodology, and it was also a lot more feasible, in terms of, you know, just gathering price information and coming up with an average price rather than buying a bunch of really big and expensive boilers.

MR. BROOKMAN: Okay, okay.

MR. DARLINGTON: So that was sort of the primary driver.

MR. BROOKMAN: I think that the presenters have done a good job of describing the limitations, the difficulty in trying to fully characterize these huge differences in size and price. Okay. Final comments on this section before we move on, because we're just about due for a break.

So I think at this -- this would be an appropriate time for a break.

MR. RABA: Yes.

MR. BROOKMAN: It's 10:30. Let's take a 15-minute break. Those of you that are familiar with the procedures here at the Department of Energy, please wear your badge visible. The restrooms are on both ends of the hall. There's a coffee shop down on the ground floor, just about directly underneath us.

Go to the elevators and go there and we'll resume at 10:45. We've got a good start on the day, and we'll proceed at 10:45 right here.

(Whereupon, a short recess was taken.)

MR. BROOKMAN: Let's resume. Please take your seats. We're going to pick up where we left off, and Markups, Energy Use Characterization, LCC and Payback Period Analysis.

Markups, Energy Use Characterization and LCC

MS. SINGLA: Okay. So my name is Rupam Singla from Lawrence Berkeley National Lab.

MR. BROOKMAN: Get close to the microphone.

MS. SINGLA: And today I'll be talking about Markups, Energy Use Characterization and the Life Cycle Cost Analysis. Later today, I will also be presenting the Shipments and the National Impact Analysis.

So the next step in the analysis is to determine the markups, in order to determine the consumer price, and we also characterized energy use. We used those both as primary inputs into the life cycle cost analysis. So DOE determined the cost to the consumer of baseline equipment and the cost of more efficient units under new energy conservation standards.

DOE calculates such costs based on the engineering analysis cost appropriate markups. Markups are used in DOE's analysis to convert the manufacturer's selling price to the consumer price. The manufacturer's selling price is what Rohit talked about earlier in the engineering analysis.

For wholesalers and contractors, DOE developed a baseline markup and an incremental markup. Baseline markups are applied to the baseline manufacturer's selling price. They relate baseline efficiency equipment manufacturer's selling price to direct business costs.

Incremental markups are applied to the incremental manufacturer's selling price. Incremental markups relate to incremental change in consumer price to the incremental change in manufacturer's selling price under new energy conservation standards. We make the distinction between baseline and incremental markups, in order to account for cost, fixed costs that do not scale up, such overhead and labor.

Both baseline and incremental markups are calculated for each point in the distribution channel. We'll talk more about distribution channels in just a few moments. Markups were developed for the following market participants: manufacturer, wholesaler, mechanical contractor and general contractor, and sales tax and markups were calculated separately for each geographic region in the analysis.

So this table lists the data sources for the markups analysis. The distribution channels is how the equipment moves from the manufacturer to the purchaser. We developed distribution channels separately for replacement and new construction markets, and we developed these based on stakeholder input.

The manufacturer markup was determined in the engineering analysis, and is based on the U.S. Security and Exchange Commission 10(k) reports from publicly owned commercial boiler manufacturing companies. The wholesaler markup is based on firm income statements from the Heating, Air Conditioning, Refrigeration and Distributors International or HARDI 2013 Profit Report.

The mechanical contractor markup is based on the Air Conditioning Contractors of America or the ACCA 2005 Financial Analysis Report, and the Plumbing and HVAC Contractor sector from the 2007 Economic Census. The general contractor markup is based on the Commercial Building Construction sector in the 2007 Economic Census. Sales tax is based on the 2014 Sales Tax Clearinghouse data.

So this slide presents the market participants for each distribution channel considered. So we considered separate distribution channels for replacement and new construction market. DOE considers an additional distribution channel where the consumer buys directly from the manufacturer through a national account, and you can see the national account is present in both the replacement and new construction markets.

This table shows the results of the markups analysis. For several of the product classes, we show the average baseline and average incremental markups. The markups are actually distribution. This is just the average from the results. So DOE requests several -- DOE has several requests for comments related to the markups.

So DOE seeks comments about whether the considered distribution channels are appropriate for commercial boilers. DOE seeks comments about the percentage of equipment being distributed through the different distribution channels, and whether the share of equipment through each channel varies, based on equipment costs or equipment capacity.

DOE also requests comments about its proposed approach to developing estimates of future commercial package boiler retail prices. Finally, DOE requests recent data to establish the markups in commercial consumer price for the parties involved, for the distribution of the equipment.

MR. BROOKMAN: Chuck.

MR. WHITE: This is Chuck White with PHCC.

So a question relating to sales tax. Especially in the larger products, some of the products in some products would be tax-exempt if they're for manufacturing purposes. Do you have any way to recognize that, or is that something that's skewing the data?

MS. SINGLA: We did not have any data on that, and it was not considered. But we would encourage you to submit a comment, and we can consider it in the NOPR phase.

MR. BROOKMAN: Do you know approximately how -- is it many states that offer an exemption for large manufacturers?

MR. WHITE: I don't know nationwide. I live in Indiana. I know in Indiana it does, I know in Michigan it does. Those are the two states I've had that most previous work experience in. So that's certainly something to be looked into.

Second question, when you talked about national accounts -- I rescind my question. I've answered it.

MR. BROOKMAN: Okay, thank you. Yes

Frank.

MR. STANONIK: Frank Stanonik, AHRI. I guess -- but I do have a question about national accounts. What exactly are we talking about? I'm not sure I understand what that is.

MS. SINGLA: Alex, would you mind stepping to the microphone.

MR. BROOKMAN: The question is what -- Frank's asking what national accounts is, what it represents in the distribution channel.

MR. LEKOV: Our understanding is that for some larger part is the manufacturer have a direct way of basically allowing the equipment to be purchased and we call this a national account. It's small part of the market, and it's explained in the technical support document.

MR. BROOKMAN: Okay. I'm looking at these comment boxes here. Additional thoughts on the distribution channels, percentage of equipment being distributed through different distribution channels, and whether the share of equipment through each channel varies based on equipment class or equipment capacity. What about that one?

MR. WHITE: This is Chuck White. I have a question then. Would this still be pegged to our 800,000 and three million 800 MBH and 3,000 MBH products, or are we -- that we talked about in engineering. The large was typically based on the three million. The small was --

MS. SINGLA: Right. So we considered the same representative capacities, yes.

MR. WHITE: Okay, because what makes me wonder is up to a threshold, not necessarily guaranteed, but commercial boilers, probably up to that three million maybe four million, probably have a lot of wholesaler presence. But anything in the large over four million, the ten million we talked about, the 25 million, is not going to come through a wholesaler. It's going to come most likely through a manufacturer's representative.

MS. SINGLA: So in our analysis, we actually did assume that the smaller boilers go through a wholesaler, and the larger boilers commonly go through a manufacturer's representative.

MR. WHITE: Okay.

MR. BROOKMAN: Thank you. Do we have any new information in response to Issue No. 7, Proposed Approach to Developing Estimates for Future Commercial Packaged Boiler Retail Prices? Anything new on that horizon? No, okay. Chuck.

MR. WHITE: Well, this is Chuck White, PHCC. I guess I would need a little more definition about what's retail. In my world, I would think that the contractor's selling price would be the retail price that goes to the end user. But --

MS. SINGLA: Yes, so we are considering the retail prices, the consumer price.

MR. WHITE: Okay.

MR. BROOKMAN: So that would include installation?

MS. SINGLA: Not including installation.

MR. BROOKMAN: Not include installation. Okay. Any new data available in any of this? As usual, the Department is searching. Okay. Robert Glass has a comment. Robert, we will unmute you and hopefully we can hear you in the room.

MR. GLASS: Hello, can you hear me?

MR. BROOKMAN: Yes, we can. You sound good.

MR. GLASS: Okay. Yeah, the comment I had was basically that the -- really the wholesaler does not really apply to commercial boilers, even in the smaller sizes, because there are so many permutations and combinations of controls and requirements between low water cutoffs, high and low gas pressure switches, manual reset versus auto reset high limits.

There's so many different things that every particular installation or engineer, or state has requirements for, that those are primarily done through a manufacturer's representative, where they buy -- and many of those are buy-sell rep, where they actually go ahead and purchase the boilers from the manufacturer, and then they sell to the contractor engineer end user, at some price that's reflective of the total work that they have done on the project.

They are not necessarily just supplying the boiler, but maybe providing many pieces of equipment and expertise in regards to the installation and sizing of that equipment. So that the price that is charged is not necessarily just the price of the equipment. Also, the work that goes into getting that and any additional time and effort in that process.

MR. BROOKMAN: Okay, thank you. That's helpful. Frank Myers also has a comment. Frank, we will unmute your phone. Please proceed.

MR. MYERS: Yes, can you hear me?

MR. BROOKMAN: Yes, you sound good.

MR. MYERS: Yes. I was just noting in a previous slide, if I understood it correctly, you were saying that the markup was that represented by publicly traded companies, and if that's the case, then that would not be reflective of the vast number of smaller manufacturers, because the publicly traded companies are generally higher volume and therefore gain substantial economies of scale from the higher volume.

So I would cautious about using that across the board to reflect the markup for smaller manufacturers.

MR. BROOKMAN: And Frank, if you have any information you could supply to the Department in writing, even under a non-disclosure agreement with Navigant, then that would be very helpful.

MR. MYERS: All right, thank you.

MR. BROOKMAN: Thank you. Okay. So additional comments. You see the comment boxes listed there. Anything additional before I move on?

(No response.)

MR. BROOKMAN: Okay.

MS. SINGLA: All right. So we just finished the determination of consumer price. Now we're going to talk about energy use characterization. So the annual energy consumption of a boiler was calculated in order to assess the energy savings as a result of increases in boiler efficiency.

The annual energy consumption is the site energy use of the boiler. The annual energy consumption is the sum of the space heating fill usage, the water heating fill usage and any electrical usage from auxiliary components. We'll go through each of these components in detail.

So the energy use -- our energy use analysis is based on boilers installed in real buildings. The Energy Information Administration or the EIA has a sample of commercial buildings, called CBECS, and a sample of residential buildings called RECS. These two building surveys serve as the representative sample for our energy analysis.

In order to be in an energy analysis at all, a building and other survey must satisfy three criteria. The first is that it must have a boiler, and the boiler must be used for either a main or secondary source of heating in the building.

The second is that the heating fuel of the boiler must either be natural gas or fuel oil, and the third is that the reported space heating energy usage of the building must be greater than zero. So if a building in either our CBEC or REC survey satisfies all three of these criteria, then it goes into the flow chart.

The first thing that we look at is the age of the building. So if the building is old, then there's a chance that the boiler installed in the building will be a steam boiler. Otherwise, we assume that the boiler is hot water.

So the top portion of the chart is for steam boilers, and the lower portion of the chart is for hot water boilers. It is the same methodology for both heating mediums.

So once we consider the heating medium, the next thing we look at is the boiler fuel type. Whether the boiler is gas or oil comes directly from the building survey, from CBEC surveys. Next, we determine the draft type. So we assume a split between mechanical and natural draft, based on ratios in the AHRI database, the AHRI models directory.

Beyond that, we determine the -- based on the input capacity of the boiler, we either put the building into the large boiler equipment class or the small boiler equipment class.

This flow chart gives an overview of how the space heating fuel consumption is determined. So we start with the energy use from the building sample that we just talked about. We assume an efficiency for the existing boiler in that building.

We do this based on the year that the building was built. So we studied the AHRI models databases from 2007 to 2014, and we determined the average efficiency by product class for each year from 2007 to 2014. We looked at the trend in the average efficiency, and we projected that backwards to determine what the average efficiency has been over time.

So then, based on the year that the building was built, we were able to determine or able to assume an efficiency of the existing boiler. We also calculate some adjustment factors, or we apply some adjustment factors based on EIA data.

One factor that we apply is to adjust for the building shell. This is to account for the fact that a building built in the year 2019 will have a better shell efficiency, that is better insulation and better windows than a currently existing building.

We also adjust for heating degree days.

So we take the heating degree days in 2003, which is the year of the CBEC survey, and we normalize it to a ten-year average heating degree days. This is to make the fuel usage more representative over a longer period of time.

So we combine the energy use from the CBEC sample with the existing equipment efficiency and the adjustment factors, and we get the building heating load. Then for each considered efficiency level, that is the proposed rated efficiency, we apply some adjustments to it, which we'll talk about a little bit later.

So we combine then the adjusted thermal efficiency, the building heating load and the input capacity of the boiler, in order to determine the full-load burner operating hours. We then combine the full-load burner thermal operating hours with the input capacity, and we get the space heating fuel usage.

So these are the equations in the space heating fuel analysis. This is everything I just went over. These are just the equations that we used.

The thermal efficiency is the basis for our energy use analysis. There are four equipment classes that are by combustion efficiency rather than thermal efficiency.

For these four equipment classes, we studied the AHRI models directory and determined the relationship between combustion and thermal efficiency. So based on this relationship, for each combustion efficiency we assumed a thermal efficiency.

The efficiency at the considered efficiency level is the rate of thermal efficiency. The rate of thermal efficiency is what is determined for the test procedure. The test procedure occurs in a lab at 100 percent boiler input capacity, with a boiler return water temperature anywhere between 35 and 80 degrees Fahrenheit, and a boiler supply water temperature of 180 degrees.

The actual thermal efficiency experienced in the field, experienced in actual boiler installations varies with climate, with whether the boiler modulates to meet low loads or cycles, and with the system water temperature heats.

So boiler performance at different return water temperatures and different loading conditions was assessed based on manufacturer literature. In this analysis, the annual average field thermal efficiency for each climate zone in each boiler type, that is condensing versus non-condensing, was calculated. The average field thermal efficiency accounts for all of these factors.

MR. WHITE: This is Chuck White. Could you restate those temperatures of the return water and the leaving water?

MS. SINGLA: Yes. The return water temperature has to be between 35 and 80 degrees, and the leading water temperature is 180.

MR. WHITE: Thank you.

MS. SINGLA: So as I mentioned before, the analysis also accounts for fuel consumed for water heating. So we looked at the building surveys, CBECS and RECS, and determined buildings that were part of the same fuel type for both space heating and water heating.

We assume that in half of those buildings, the boiler was used for water heating in addition to space heating. We determined the water heating fuel use as a function of the water heating load, and in adjusted thermal efficiency.

We determined the water heating load as a function of the fuel consumption from the building survey, and an adjusted existing thermal efficiency.

MR. BROOKMAN: We have a comment from Robert Glass, or actually perhaps a question, which is "You note the percentage of hot water versus steam on Slide 54. What about mechanical draft versus natural draft for both steam and hot water boilers? What percentages does DOE estimate? This refers to space-heating boilers. Does this rulemaking cover process boilers that are not providing space heating?"

MS. SINGLA: So to answer the second question first, this rulemaking does not cover process boilers that are not used for space heating. All these boilers must be used for space heating. The first question is the split between mechanical and natural draft is different for whether the boiler is oil or gas and whether it's steam or hot water, and those ratios are based on the AHRI models directory.

MR. BROOKMAN: Okay, thank you.

MS. SINGLA: So as I mentioned earlier, the analysis also accounts for electricity consumption of the boiler. DOE calculates electricity consumption for the circulating pump, draft inducer in the case of mechanical draft equipment, and the igniter.

DOE calculates electricity use for all of these components whenever the boiler burner is on, either for space heating or water heating. For all hours when the boiler burner is not on, DOE accounts for standby power. Standby power is assumed for all mechanical draft equipment, and not for natural draft equipment. DOE also considers the electricity use of a condensate pump for some condensing boilers.

So this chart shows the results of the energy use analysis. This is four of the equipment classes, each efficiency level. We have the annual average fuel use and the annual average electricity use.

DOE seeks comments on a number of issues related to energy use characterization. The first is DOE seeks data on representative annual profiles of return water temperature, supply water temperature and boiler percent loading. DOE seeks data on what return water temperature boilers are tested at, under the test conditions prescribed by the DOE test procedure.

DOE seeks input on data sources that it can use to characterize the variability and the annual energy consumption for commercial boilers. DOE is particularly interested in field monitoring studies and data.

MR. BROOKMAN: Let's pause with those, to try and get comment on 9, 10 and 11. Do we have anything here?

(No response.)

MR. BROOKMAN: No, okay.

MS. SINGLA: DOE requests data about typical boiler-sizing practices. How often are multiple boilers installed instead of single boiler, to meet the building heating load. How are the number of boilers determined for a particular type of installation?

DOE seeks input about how boilers are controlled, particularly in multiple boiler installations. DOE states historical shipment-weighted commercial packaged boiler efficiency data and shipments data by efficiency bins.

DOE is primarily interested in data during the last ten years to capture the impact of the most current technologies on the boiler market.

MR. BROOKMAN: What about typical boiler-sizing practices? We kind of touched on this already. Harvey.

MR. SACHS: This is Harvey Sachs. It seems to me, without any particular expertise in the area, that boiler sizing has two dimensions, and the dimension that's of concern is how the field oversizing of capacity affects efficiency in the field application, and what the oversizing practices are in the field.

I don't think we've seen much on that. In the old days, of course, a way over-sized one would have way over-sized standby losses. We hope that's under somewhat better control now, but nobody ever called his contractor to complain that his boiler was too large. So we expect substantial oversizing for the actual peak draws that we would expect in the facility.

MR. BROOKMAN: Okay, thank you. Frank.

MR. STANONIK: A slightly different point, and we certainly will try and see if we can provide some information here. But I think that one of the things, and maybe it's one that -- actually, I guess, relates to maybe 13 also, but this goes back some time.

But I was really surprised to learn that for certain building types, it is not at all unusual for the building to have a backup boiler, which at least historically was really mostly there if in case something would happen with the first boiler and that particular building, as an example let's say it was a large hotel, could not, you know, could not accept that they didn't have heat.

So they would invest actually in having a backup boiler, which again things have evolved here, I think. But in the past, it was really there just as a backup. So I think there is a really change here that buildings do have multiple boilers. I think more buildings, the progress, if you will, is that now you have multiple boilers that are actually, let's say, commonly controlled.

So in fact they're staging those boilers or else alternating which one is let's say the master boiler or whatever. But I think you still have that situation where you have again, for certain building types, there's a secondary boiler that is not expected to do much except be there in case the first boiler needs repair or fails.

I guess I would say you can't ignore it, you know. Somebody has paid for that second boiler, and isn't going to operate it very much. So it's kind of -- you know again, to me that's hard to understand. But I think you just need to look at the kind of building where that might be the requirement. So in any case, I mean we'll -- we're going to try and see if we can give you a better sense of how much that goes on nowadays, because I think it does matter when you're looking at the energy use of the boiler.

And then as -- I'll just jump to 14. We certainly have had some preliminary discussions with our members, and at this point I think we will be able to give you some data of that nature. I'm not sure of exactly the business that DOE would like, but I think we can help with some of that information.

MR. BROOKMAN: Frank, can you or Chuck, can you address Issue 13, how boilers are controlled in these multiple boiler --

MR. SACHS: Can we get Chuck on the oversizing first.

MR. WHITE: I'll weigh in on all of it for you Harvey, just to be nice. This is Chuck White. Starting with 12, the sizing practices. My favorite phrase is it depends. Once upon a time you stood across the street and held up your hand, and however many fingers covered the house, that's how many sections you needed. Two, three, I can't see the house anymore. I need a four-section boiler. Those things are pretty much long gone.

MR. SACHS: That's a precise measurement there.

MR. WHITE: Yeah, yeah. But I think most contractors in the retrofit world are doing one of two things. Most are doing heat loss calculations. So you're determining the load of the house, but you also have a concept called connected load, and I don't have to lecture the room probably, but boilers aren't furnaces.

Boilers and hot water and steam systems, particularly steam systems, are a different animal in how they operate and perform. So if we don't have enough heat to meet the connected load, particularly in steam, if we don't have the ability to fill the system with steam, it's not going to heat effectively.

So in retrofits especially, it gets to looking into what the system is. Maybe I think I have an 80,000 BTU heat load on the house. But if I have 150,000 BTUs worth of radiators installed, it may not heat properly. There's a lot of what ifs connected with, particularly renovations and retrofits in old systems.

In new installations, the engineering work and the layout is certainly doable. But it's also very important if you're going to use high efficiency products, which we touched on with the return water temperature discussion. If you want to be high efficiency, you need lower return temperatures generally speaking, to be operating in that effective part of the curve.

So it's a comprehensive sizing problem, and whether it's an engineer that does it or a contractor that does it, how that happens, it takes some skill and some thought and some ingenuity. There are certainly people out there that, you know, retrofit situation walk in and you've got a size ten and you need a size ten. If you've got a size 12, you need a size 12, whatever that might be.

But most contractors are looking at the system as a whole. Particularly if you're moving to high efficiency, it's very important to consider those factors. Not to say there isn't oversizing going on, and we can refine our mathematics to multiple decimal points. But at the end of the day, I'm going through a catalogue that has fixed sizes in certain increments, and I'm going to pick something that takes care of the load.

It's very nice to have modulating products that can come down, fire-down to the load you need. But that's not always the case. Moving to 13, multiple boiler controls, there's a variety of ways you can do that.

There's after-market products that you can put in that will connect to existing multiple boilers, give you staging and functions based on outdoor temperature, you know, how many run, how much run time, adjust the water temperature. There's lots of products that will do that.

Many of the new products, new boiler products communicate with each other. So you can use multiple boilers and just connect them together with a cable, and they will talk to each other and decide who ran the most and who's at 100 percent, who needs to be 50 percent and make these adjustments.

So there's a variety of ways you can control multiple boiler installations. There's not a one-size-fits-all answer here, unfortunately. Was that helpful?

MR. BROOKMAN: Okay, thank you. Any additional thoughts on these? Frank.

MR. STANONIK: Frank Stanonik, AHRI. Just picking up on what Chuck just said there, I mean again, I'm not sure this is doable or that even our membership can, you know, can really help with this.

But on 13, I think, you know, it would be, if we could find the information, it would be useful to know today how many commercial boiler installations actually include in the installation essentially a system control panel, if you will, that adds all this sophistication to controlling the boilers and the system.

Because yeah, I mean I know our members are out there selling those control packages, if you will, as well as others as an after market, and it certainly has, I think grown in its use.

MR. WHITE: Well, this is Chuck White again. There is a large industry of building management control that's set aside from the contractor. The contractor may install new boilers, do all the piping, do all of that. But then a control contractor would be a separate person making those connections, integrating it into a building management program.

So there's from very simple to extremely complex ways of doing this, and it's really a matter of who's the customer and what are their needs, and what are their abilities to underwrite this undertaking.

MR. BROOKMAN: Okay, thank you. I guess we don't have any historical shipment-weighted commercial boiler efficiency data or shipment data by efficiency bins at this point? Are you going to work on that one, Frank?

MR. STANONIK: Yes.

MR. BROOKMAN: Okay, okay.

MS. SINGLA: A few additional comments.

DOE requests --

MR. BROOKMAN: Harvey has a comment. Sorry.

MR. SACHS: This Harvey. Just thinking back on the conversation the last 10 or 15 minutes, and the overlap in teasing outs between redundancy and modularity, because I think we're seeing both in the market, of people who need 100 percent backup and are concerned about having a single large boiler, without having a second large boiler, I've also informally and anecdotally heard about lots of other approaches.

One of them is to have ten small boilers that together have 130 percent or 120 percent of the peak load, so that if any one of them goes down, you're still not in trouble.

Those can be, in some systems, dispatched as a single unit with a single interface to BAS. So it's getting to be a very complex world, and I do not have any idea of how this is affecting shipments of any particular capacity unit.

But I think it's important to understand the market. In the redundant case that was brought up very early, one could make a strong case for a very inexpensive minimum efficiency secondary boiler that's just never getting used. It's only there is an insurance policy, and on the other hand, the public policy implications of going down that path and controlling it are just almost impossible to manage.

So I think we need to be very careful with understanding applications in this area.

MR. BROOKMAN: Chuck.

MR. WHITE: This is Chuck White again. I meant to comment on that aspect as well. But redundant boilers, certainly they're being put in, but not as much as previously. The modular aspect, you're exactly right Harvey. If I don't really need 120 or 130 percent, if I put in four units that would give me 100 percent, if one goes down I'm at 75 and the time frame that you are design load is very, very small.

So that 75 percent capacity will probably carry 95 percent of the time, and in the current economic climate and conditions, people are very attuned to not spending an additional 40-50 percent of the heating project to have that redundancy, when we could do it and be safe enough.

And regarding the buying one that's a low efficiency product, that's probably not going to happen. Most -- if you do buy redundant, most people set up a schedule to rotate them, so that you don't have one sitting there hoping it works some day, that we're routinely switching them.

So if something's going to fail on one of them, we'll find out and be able to fix it. It does happen in retrofit-type operations. There's two boilers there now. This one still works. We'll save it as the backup, and then put in other products, newer, higher efficient products.

But what typically I've seen is when people do that, they like their new stuff so much better, they don't rotate the other, and it sits. You might as well tear it out when you started. But the modular aspect really makes a big difference to people, that I can give you 50, you know, steps of

20, 40 percent, to give you coverage for the majority of the time.

MR. BROOKMAN: Okay, thank you.

MR. SACHS: This is Harvey again, and I think it would be worthwhile for the Department, as it's investigating the market, to get in touch with the relevant ASHRAE technical committee and see what design practices are (a), recommended and (b) what, at least anecdotally, these people feel are most commonly used in these larger systems. It may well be that PHCC members have some good input onto that as well.

MR. BROOKMAN: Okay, thank you. Frank.

MR. STANONIK: Frank Stanonik, AHRI. I've got a question, and again just because I've lost track of it. You're still using 2003 CBECS data. Isn't there something going on to develop an updated database for CBECs, and will it be in time for this analysis or too late?

MS. SINGLA: Yeah. So there's a CBECS 2012 that hasn't been fully published yet. Hopefully by the time the NOPR phase comes along, it will be.

But I don't believe we have a publication date for that.

MR. STANONIK: Okay. So let's say that --

MS. SINGLA: So 2003 is the latest version.

MR. STANONIK: Right. So let's say the 2012 final appears magically in a few months here. Will DOE be updating the analysis to use the new data?

MS. SINGLA: As long as it comes in time, then yes.

MR. STANONIK: Okay.

MR. BROOKMAN: Okay. Let's go to 15 and 16.

MS. SINGLA: All right. So DOE requests input about electricity use by commercial boilers. That is in addition to the fuel energy use, and that should be included in the energy use analysis. DOE seeks input what fractions of hot water commercial packaged boilers are used for both space heating and water heating.

MR. BROOKMAN: While you're considering

those requests for comment, Robert Glass has a comment. Robert, we will unmute your phone. Please go ahead.

MR. GLASS: Hello?

MR. BROOKMAN: Yes, you're on.

MR. GLASS: Okay. Yeah. The first comment, I think, had to do with a note that Harvey Sachs had mentioned a little bit ago, talking about the oversizing, and I think the one thing we need to also take into consideration is that the sizing is done based on the design conditions, and as a result it could seem like that you have oversized systems, unless you actually get to those design conditions. I think that was mentioned at the end there.

And then another comment having to do with the types of applications that would have redundant equipment, and they were noted. I mean hospitals, hotels, prisons, colleges. They all provide redundant boilers that Frank Stanonik had talked about. However, it may not be a 100 percent redundancy, but enough to provide a limp-along condition to be able to provide heat until issues could get resolved in other boilers.

So there is redundancy that is there. It is very frequently used, but it is not necessarily a 100 percent redundancy.

MR. BROOKMAN: Okay, thank you. Geoff Halley also has a comment. Geoff, we'll unmute you. Go right ahead. Nothing yet.

(Pause.)

MR. BROOKMAN: Is he unmuted? Yes. Geoff, we think we've unmuted you. Try it. Hmmm. It's not working. Okay. Let's look again at Issue 15 and 16, electricity use by commercial boilers in addition, and what fractions of hot water commercial packaged boilers are used for both space heating and water heating. Frank.

MR. STANONIK: Frank Stanonik, AHRI. I feel bad about this one, because I could have just looked it up before I got here or last week. But I think certainly when you're looking at the electrical consumption and you noted that you do include the circulating pump, the energy used by the circulating pump, I think you absolutely need to look at what again ASHRAE 90.1 specifies today for the requirements for pumps used for hydronic heating systems.

Because even though -- even though those, at least mostly in theory this applies to new buildings, those ASHRAE requirements, when you get into things like system controls and what have you, become more widespread, whether it's a new installation or a changeout, if you will.

But I think I can dig that up and just, you know, provide that in our comments. But I think there has been significant progress in requiring or specifying a more efficient mode of pumps for the circulating pump.

MR. BROOKMAN: What about fractions for hot water space heating and water heating?

MR. STANONIK: Frank Stanonik, AHRI. I think we've answered that one in the framework. We don't have any idea what that is.

MR. BROOKMAN: Chuck.

MR. WHITE: This is Chuck White. I don't really have any good answer for 16, but I can certainly ask and see if we have any information available through our members.

But picking up on what Frank said about the pumps, does DOE consider -- are we talking about the system pump or the boiler pump or both, particularly high efficiency boilers like to use primary/secondary arrangements.

So you have a small, smaller pump for the boiler, and it circulates the water through the boiler. You have a different pump that circulates the system, and in a retrofit situation, you may have had a system pump that also did the boiler. It was one pump, but with the high efficiency adders, we now add these other pumps.

So is that -- when we talk about that, are we talking about the pump that pumps through the boiler, or the pump that delivers to the entire system. Also in some of these systems, you have multiple system pumps.

You might have zone pumping where you could have four, five, six circulators for different wings of the building, and yet another boiler pump that's going to vary greatly, depending on the installation. So when we talk about the pump power, what are we talking about?

MS. SINGLA: So we are talking about the system pump that pumps water to the building, and it is a simplification. Right now we're assuming one pump that pumps water to the building. We didn't -- but we would appreciate any data that you have on number of installations with multiple pumps or different configurations, because right now it is just a simplification of one pump for water.

MR. BROOKMAN: Harvey.

MR. SACHS: This is Harvey. Again, this may get me in trouble, but as I'm thinking about trends that I don't particularly get excited about, in smaller unitary equipment, where the water source is having a pump taking out of the rating. We know there's always a pump associated with that system, but we also know that it is generally a field-selected or building design-selected pump.

And it seems to me that conceptually, there is an important difference between the system pump for commercial boilers that is controlled, to some extent, by 90.1, and any internal pump required for doing that local recirc control, the temperature drop at part load that Chuck I think is referring to, the one before the so-called secondary loop.

So I think that y'all are going to have to be real careful in defining what really is integral to the boiler, as opposed to how to treat that which is integral to the distribution of the heat transfer fluid into the building itself. I don't have any answers.

MR. BROOKMAN: Okay, thank you. Chuck.

MR. WHITE: It's Chuck White again, and in small boilers, it's probably provided with the boiler, though it could very well be. But as the systems get larger, those system circulating pumps are diverse. I mean there's a wide variety of selections, choices. Even for an individual three million BTU boiler, I have lots of possible scenarios of how I might pump it.

I can pick -- I can go to a catalogue and pick a pump that will give me a certain flow of certain pressure. I could probably pick five of them, and they will all have different operating efficiencies. So I appreciate that this is a big concern, and my background in my family business was an engineering approach to everything and what can we do to be the most efficient.

I know firsthand you can pick some pumps that are very insulting to the electric bill. But how you can make -- how you can pull that together to get an average or a single case application, that's going to be complicated, I think.

MR. BROOKMAN: Okay.

MR. SACHS: This is Harvey again, and with respect to Question No. 16, on packaged boilers used for both space heating and water heating, there's an awful lot of activity that DOE's analysis will want to at least be aware of. In 90.1 in the IGCC and elsewhere, to limit applications of recirculating loops, dead legs on recirculating systems because for applications like schools and multi-store commercial, there's a growing knowledge-base that we're pretty inefficient when we just use recirculating loops of high temperature water, to mix it down for a few gallons a day per lavatory.

So there may be an evolution away from these predominantly hot water applications in some types of office buildings. Early awareness of this came from work by Hiller and Dinzey 20 years ago, with the reduction in primary energy of 90 percent by simply turning off the primary loop and substituting a couple of tank resistance water heaters near the lavatories.

MR. BROOKMAN: Go ahead, Frank.

MR. STANONIK: Something that Chuck just mentioned, Frank Stanonik, AHRI, and again, maybe I think this will make things easier. But you know, on this whole issue of the pump energy, again, well first of all we're talking about a regulation that would, at least on the schedule right now, would go into effect the middle of 2019, all right.

And DOE has rulemakings going on to look at the efficiency of commercial industrial pumps, I believe. So I think in the analysis, and again I don't know how the schedules mesh, but the analysis might need to look to what extent the impact of a DOE regulation on commercial industrial pumps might have an effect on pumps being used with and supplied with boilers, commercial boilers.

MR. BROOKMAN: Robert Glass has a comment. Robert, we think you're unmuted.

MR. GLASS: Okay. Yeah. The comment that I had was in regards to the commercial boilers may or may not be included with the boiler pump, because manufacturers' reps or contractors generally have their own pump manufacturer preferences, because there are several that are out there, as well as their particular choice of the type of pumps.

The manufacturer is generally providing the flow and head requirements for each particular boiler, and as long as a pump has been selected to meet those requirements, the manufacturer is generally fine, knowing that the boiler will be operated properly as long as those flow and head requirements are met.

So it's something we have to be very careful about looking at trying to provide any requirements or taking this energy consumption into place, because they are not necessarily provided by the boiler manufacturer.

MR. BROOKMAN: Okay, thank you. Do we have final comments here? We're about to move on.

MS. SINGLA: Now that we have gone over the energy-use characterization, we will next discuss the life cycle cost or LCC analysis. DOE performed an indepth life cycle cost analysis. In this analysis, the economic impact of amended energy standards on the individual consumer were studied.

The LCC is used to determine the total consumer cost over the lifetime of the equipment. The total consumer cost is the sum of the installed cost and the annual operating costs, where the future operating costs are discounted to the year of purchase and summed over the lifetime of the equipment.

The payback period measures the amount of time it takes consumers to recover the purchase price of more energy efficient equipment through reduced operating costs. DOE developed a spreadsheet model which generated a Monte Carlo simulation to perform the analysis. The analysis takes into account that each commercial boiler installation is unique. It calculates the LCC and payback period for a representative sample of buildings.

This flow chart shows the inputs into the life cycle cost and payback period analysis. The two primary inputs into the analysis are the total installed cost and the annual operating expenses. The total installed cost is the sum of the consumer price and installation costs.

We've already talked about the consumer price and the markups and an engineering analysis. We'll talk about installation costs in a few minutes. The annual operating expenses are the sum of the annual energy cost, annual repair costs and annual maintenance costs. We'll talk about the maintenance and repair costs a little while later today.

For annual energy costs, we've already talked about the annual energy use of the boiler. We'll talk about the cost of energy, energy prices a little while later. So the annual operating expenses are summed up over the lifetime of the boiler, the applied discount rate and an energy price trend, and we get the lifetime operating expenses.

We add the total lifetime operating expenses to the total installed cost, in order to get the total life cycle cost. All of these inputs vary by installation and by geographic region, and many of the inputs are not single point values but rather distributions.

The installation cost represents the labor and material cost necessary to install the boiler. DOE calculated installation costs using 2013 RSMeans mechanical-cost data, manufacturer literature and information from experts.

The key components of the installation are the basic installation costs, venting and condensate removal for condensing boilers. The analysis accounted for different installation costs for the following considerations. Gas-fired versus oil-fired boilers, natural draft versus mechanical draft, condensing versus non-condensing, replacement installations versus new construction installations, and any specific venting requirements.

MR. BROOKMAN: Chuck.

MR. WHITE: This is Chuck White. So in your venting information, in the case of retrofits with going to a PVC-vented high efficiency product, leaving the quote-unquote orphaned water heater into a vent, do you allow for vent kits or some means of handling that water heater that's left behind?

MS. SINGLA: We do account for a fraction of orphaned water heaters. I'll talk more about each of these components, including venting, in just a few minutes.

So the basic installation costs apply to both replacement and new construction installations. Common to both replacement and new construction installations are the cost of placing and setting up the boiler, connecting gas piping and connecting water piping. Specifically for replacement situations, we also have an additional cost for removing the old boiler and disposing of it.

MR. BROOKMAN: Frank Stanonik.

MR. STANONIK: All right. So in a -- and

again, I appreciate we're talking about commercial products and, you know, in a replacement situation, it doesn't -- okay. So I have an existing installation and my customer has decided they want to upgrade to a condensing-design boiler.

It doesn't look like in that situation you're considering that there might be additional system costs to in fact, let's say renovate the system, so that in fact it can accommodate a condensing boiler and return the water at a low enough temperature for the product to operate as a condensing boiler.

I guess the question here is, I mean was that a conscious decision to just ignore that, or am I missing something?

MS. SINGLA: So in order to account for this, we didn't actually have any data about the downstream systems that would need to be reconfigured. So instead, we assumed a fraction of condensing boiler installations, a fraction of replacement condensing boiler installations that are installed -- where the water temperatures wouldn't actually be that low. So like the condensing boilers that are operating at higher return water temperatures.

MR. WHITE: Is that --

MR. BROOKMAN: Chuck.

MR. WHITE: Chuck White. Is that a significant fraction, or is your fraction -- the fraction is boilers installed would be condensing versus non-condensing, because in retrofit situations, I would hazard most of them are going to be condensing boilers going in at a fair portion of the time are going to be non-condensing. Maybe I've jumbled up that question.

MS. SINGLA: So I don't have the exact fractions, but for condensing boiler installations, we did assume a fraction based on the year that the building was built. So we actually assume that older buildings have more likelihood of being run, operating at non-condensing temperatures.

MR. BROOKMAN: Frank Myers has a question or pardon me, a comment. "Life cycle costs does not seem to include the accelerated replacement resulting from selection of higher efficiency equipment."

MS. SINGLA: So we'll talk about lifetime in just a few moments. But we do not assume -- sorry, it's about the -- could you repeat it?

MR. BROOKMAN: Yes. Life cycle costs does not seem to include the accelerated replacement resulting from selection of higher efficiency equipment.

MS. SINGLA: Great. So we do -- we'll talk about repair rates in just a minute. But sorry Alex, did you want to address that?

MR. BROOKMAN: Alex Lekov.

MR. LEKOV: I would say that the lifetime is presented as a distribution of lifetimes. So although not explicitly mentioned, this distribution would to a certain extent account for this early replacement that Frank is mentioning.

MR. BROOKMAN: Oh okay, because it's a distribution, yes. Okay.

MS. SINGLA: So all boilers that are installed indoors need to be vented. Non-condensing boilers exhaust high temperature flue gases, which heat the inside of a vent above the dew point, so there is no condensation. If condensation does occur, this could damage the vent or the boiler itself. DOE assumes that in non-condensing installations, Type B vents and stainless steel vents are the most common venting materials used. DOE also assumes that masonry chimneys are used in replacement installations, but are uncommon in new construction.

More efficient, low-temperature condensing boilers condense the water vapor, thus increasing efficiency by rate and heat loss. The condensate is fed to a drain. The flue must be able to withstand the condensation. DOE assumes that certain types of plastic and stainless steel are the most common venting materials for condensing boilers.

DOE assumes that plastic is more common in smaller vents, that is less than six inches in diameter, and that stainless steel is more common in larger vent installations. DOE determines the relationship between vent diameter and input capacity of the boiler, based on boiler manufacturer literature and applies this to the vent-sizing analysis.

Condensate removal is required for all condensing boilers. The excess condensate from the condensing boiler must be deposited to a drain. So for all replacement and new construction installations, we assume the cost of a condensate pipe.

A condensate pump is sometimes required if a drain is not near the boiler and the condensate has to be pumped to a drain. So we that that condensate pump is in about a quarter of all condensing boiler installations. A condensate neutralizer, sometimes the condensate needs to be neutralized before pouring it down it down the drain. So we assume that this is required in about an eighth of all condensing boiler installations, and an additional electrical outlet.

We assume that half of the condensing boiler installations that require a condensing pump or a condensate pump also require an additional electrical outlet.

MR. BROOKMAN: Frank Myers would like to comment. Frank, we think you're unmuted.

MR. MYERS: Yes. This is Frank Myers. I hate to go back. I was trying to get a moment in when we were talking about condensating boilers or higher efficiency boilers requiring system redesign, and there was some comment that a certain percentage of those in a variable might be something that's considered in the analysis.

I think that's completely incorrect. Boilers in commercial buildings are almost always designed in by the engineer, and the water temperatures out and the return water temperatures back to the boiler are a part of that system design.

So if the current system is designed with a traditional, for example, 180 out, 160 degree return, then adding a condensing boiler to that system does nothing. It won't condense. So if you're looking at the cost to upgrade to a higher efficiency product, then you're looking at a total redesign of almost all boiler systems that were previously set for non-condensing. So it's not a small factor; it's a huge factor.

MR. BROOKMAN: Okay. Thanks, Frank.

MR. SACHS: Frank, this is Harvey, and as I said earlier, I want to introduce into this a review paper by Tom Durkin a decade or so from the ASHRAE journal, in which we went through the process and rationale for this kind of major retrofit of high temperature boilers with low temperature condensing systems. He broke out all of the system installation costs.

Now those are a decade old now, but it would seem to me that DOE is going to an enormous amount of effort to interview manufacturers about the costs of the boiler, and yet we're doing pretty high level guesses on all the rest of it, instead of going to the design engineers and asking them for their experience with costing-out and bidding a whole bunch of these actual jobs.

That would seem to be a very inexpensive exercise, and if we have claims that these are very significant system conversion expenses, as my buddy Frank has suggested, I think it's incumbent on us to get that into the analysis.

MR. MYERS: Harvey, I couldn't agree with you more. Getting with the engineering community or at the very least, I'm not familiar with the article that you're speaking to. But someone in the engineering community who has prepared what is required to convert a system that is designed for high return water temperature, utilizing a non-condensing boiler into a system that will utilize a condensing boiler and get any benefit whatsoever from that condensing boiler. I think getting with the engineering community is essential.

MR. BROOKMAN: Okay. Thanks, Frank.

MR. SACHS: Anecdotally, there's also an awful lot of experience with this kind of reengineering of schools in New England, where costs became prohibitive to use non-condensing boilers. We can start with the Vermont Energy Efficiency Community, and there's pretty good case-study load up there I'm pretty sure.

MR. BROOKMAN: Okay.

MS. SINGLA: So DOE requests comments on a number of issues. DOE requests data on the fractions of installations that would entail significant additional installation expenses. DOE seeks input on how often plastic versus stainless steel venting is installed for condensing boilers.

DOE seeks input on how often boilers have direct venting, for both condensing and non-condensing boilers. DOE seeks input on the fraction of stainless steel venting in existing boiler installations by efficiency.

MR. BROOKMAN: Harvey.

MR. SACHS: Please let me respectfully suggest that these are all questions that you really need to seek out input from the engineering community. For example on 24, you're asking for input on the fraction of stainless venting in existing boiler installations by efficiency.

I suspect that that and a number of these other questions also have a component that deals with capacity. I just -- I think you need -- if your hypothesis is that the system costs, as opposed to boiler costs are important, you need to talk to the system designers and the contractors who bid on and go out of business or make a profit, depending on the goodness of their bids.

MR. BROOKMAN: Can we speculate on 21, the fractions of installations that would entail significant additional installation expense?

(Off mic comment.)

MR. BROOKMAN: Okay, Chuck or Frank.

MR. WHITE: Which ends up being me. Chuck White. In particularly smaller projects, probably there's a high percentage of people just change out what's there, and to try to figure out a way to get the system temperature down every day and provide total heat quantity, that would be significant expense and I doubt in many instances that it's done.

The other mitigating factor there is most of these products, the higher efficiency products, have outdoor reset capability. So as it gets colder, we make the water hot; as it gets warmer, we make the water cooler, try to match the water temperature to the load.

So the trade-off is what percentage of the time is it designed? We're not going to be very efficient at that small percentage. The next step down at 90 percent of design, we're probably not very efficient there. But at some point, our percentage of design gets us to a point where we are in that more efficient operation of that boiler.

So I don't have data on times that you go to that significant additional expense, but I could certainly kind of conjecture what that might be. Your Issue 22, I would say probably the plastic vent is going to be a larger percentage in the smaller capacities.

When you get up in the million, two million, four million, the larger high efficiency ones, you're going to start seeing more stainless. But in the smaller product, I think you're going to see probably predominantly plastic for most of it.

How often they have direct venting, I think most people are going to put products in that are the condensing mode. Probably most of the time they do make it direct venting, but I don't have any data to back that up.

Direct vent, if no one understands, is you have a combustion air pipe and an exhaust pipe. So we aren't taking room air, running it through the combustion and ejecting it from the building. And I have no idea on Item 24.

MR. BROOKMAN: Okay. Frank.

MR. STANONIK: I think Harvey had indicated that all of these are in some way related to I think the capacity of the boiler. That's absolutely right, and just using direct venting as in No. 23 as an example, again this rulemaking, I mean you're looking at, you know, fairly small boilers.

But you very quickly get into a situation where again the boiler has been installed in a boiler room. I mean you again, looking at all of the huge range of buildings that get included in this category, this grouping.

You know, you have let's say older buildings, where in fact you had a boiler room, and that room was, for whatever reasons, located some place that in fact probably, rather than direct venting, if you get a big enough boiler, you literally have louvers on the wall to provide air into the room.

And so, you know, there is, I think in each of these cases, probably some -- a better than rule of thumb kind of indication that, you know, if you're in the capacity range of this, then you probably have this happening, and once you get above there, it becomes very rare.

We will try and provide some information on this from wherever our members can determine. But like I said in all of these cases, I think it will be useful for the analysis to perhaps focus on a certain range of capacities, as to whether these issues apply or don't, because again, to me there's no question.

Let's just say we're talking about boilers only over ten million. You could probably forget 22, you could probably forget 23, and forget 24. But in the inverse way, they're probably, you know. Anyhow, so I think that's point made.

MR. SACHS: Okay. I'd like to go back -- this is Harvey again, and I'd like to go back to Chuck's comments on No. 21, which basically is if I design to load with a condensing boiler, there will be design days when I'm likely to have to move up the temperature into the non-condensing range.

But how much time that is I think, and I'm really stating this as a question I'm asking, will depend on the oversizing in the boiler. If I've got twice as large a boiler as I need, and have it pump sized for that flow, I'll push a lot more 140 degree water through there or 120 degree water through there on the design day, and have to -- or the 120 degree water, and have to move into the non-condensing mode a smaller fraction of the time.

So actually having a sense of how oversizing the impacts, oversizing practices impact this question would seem to me to be important. Am I totally off base?

MR. BROOKMAN: Okay. Chuck.

MR. WHITE: This is Chuck White. Oversizing certainly is a factor. It increases your standby losses, etcetera. But the temperature, the design temperature requirements drive the water temperature, and that's based on your emitter conditions.

So how many feet of baseboard do I have, how many square feet of radiant floor, how big are the heating coils in the fan coil unit I have, whatever that might be. So the -- if I can't get the BTUs out of that emitter at a given water temperature, I will have to increase the water temperature.

So if my boiler's not big enough to get that temperature, if I don't have enough heat to raise it up to that level that I need, then yes, I need a larger boiler. But it's not strictly driven as a function of my boiler is too big, and especially if I have a modulating device, then I will get some turndown out of that just naturally.

There was something else I was going to respond to. You've thrown me off of it.

MR. BROOKMAN: Let's move on to 25 and 26.

MS. SINGLA: DOE seeks input on where buildings are typically located within different types of buildings, and where the vents typically terminate. DOE is interested is whether this changes by geographic region or by boiler type.

MR. BROOKMAN: Just pause there. Can we

-- yes, Chuck?

MR. WHITE: I thought of what I was going to say.

MR. BROOKMAN: Okay.

MR. WHITE: This is Chuck White. Would DOE consider creating a survey with some standard questions, that you could send out to contractors, engineers, manufacturers, for some of these kinds of things that you're interested in, that we don't have four or five or six industry groups out there asking what we think you want to ask, that --

And if that needs, you know, some refining or some help crafting those questions, I'm certainly volunteering Harvey to do it.

(Laughter.)

MR. WHITE: But that might get you better answers and better information, more uniform information. Just a suggestion.

MR. BROOKMAN: Okay, thank you.

MR. SACHS: Well, this is Harvey --

MR. GLASS: Robert Glass.

MR. BROOKMAN: Go ahead.

MR. GLASS: This is Robert Glass. I have a question from the Issue 24, one that was talking about the percentage or the fraction of stainless venting used in existing boiler installations. One of the things that I think DOE needs to be cognizant of is that the same boiler installed in a Category 1 vent condition vertical vent, may be able to use the vent-type venting materials.

But if the same boiler is installed with a horizontal vent and it changes the category, then stainless steel venting may be required there. So either a rephrasing of the statement if it's relating to condensing versus non-condensing or just condensing products, DOE needs to be aware that standard installations may still be using stainless steel because of the categorization of the vent under that type of installation.

MR. BROOKMAN: Okay. Harvey.

MR. SACHS: Not getting too far into the weeds, if DOE is thinking survey, I think it has to start with interviews, to find out what the significant questions are.

MR. BROOKMAN: Okay. We're back to 25, input on where boilers are typically located. We started to cover this, and does it change based on geographic region or boiler type? We've kind of touched on this a little bit. Chuck.

MR. WHITE: This is Chuck White. It's going to be all over the place, depending on some places may have basements, some places may have particular boiler rooms. There may be small equipment rooms. I know of some hotel properties that put them on every floor, so you have a high efficiency boiler servicing each floor, kind of a retrofit arrangement that somebody did, but that worked for what they were doing.

They could be at remote boiler rooms. They could vent through sidewalls, they could vent through roofs. They could go up masonry chimneys, stainless e-vent depending on the particular product. So this is -- I don't know that there is a typical for this.

MR. BROOKMAN: You couldn't say for a certain building type with a certain vintage and a certain region, that this would be a typical sort of a --

MR. WHITE: I would say probably for a hospital. Typically, there's going to be a powerhouse, and it's going to be a remote building. For a hotel, it's typically going to be a basement or an equipment room. It could be a penthouse.

Offices, apartment buildings could be similar, either a penthouse type arrangement or a basement or equipment rooms located on the utility side of the building, not at the, you know, next to the front door. But it's one of the versatilities of hot water heat or steam, you're passing the product around in a relatively small pipe.

So I don't need large duct chases. I don't need to dedicate specific areas. So you can move that around to fit the floor plan as a client dictates or wants out of their facility. Everybody wants to maximum rentable space or productive space. So these things tend to be relegated to not front and center.

MR. BROOKMAN: Right. 26.

MS. SINGLA: All right. DOE seeks data on how often common venting occurs in multiple boiler installations, and whether commercial water heaters are commonly vented with commercial boilers.

MR. MYERS: This is Frank Myers. Are you able to hear me?

MR. BROOKMAN: We hear you, Frank.

MR. MYERS: Oh thank you. Common venting is a very sensitive issue. Most, but not all condensing boilers today vent individually. There are some that at the boiler, they might have multiples that they have worked with their certification agency to come up with a multiple venting arrangement.

But if I were in -- and I have looked at a number of condensing boilers in the marketplace, and the most common is a single vent for each boiler. So if you had three boilers, you'd have three vents. If it's non-condensing equipment, they are most commonly vented together.

There is a number -- there are a number of projects going on right now, looking at what is required to common-vent condensing boilers, what safety certification might be required to do that, and there may well be some research that is required, in order to be able to finalize that.

MR. BROOKMAN: Okay, thank you.

MR. MYERS: The second item there are water heaters commonly vented with commercial boilers, in the non-condensing area of commercial buildings, yes they are frequently vented together. But again, if they're condensing boilers and condensing water heaters, not 100 percent but most of them are separately vented.

MR. BROOKMAN: Okay, thank you. And of course for anybody on the call or here in the room, the Department would really appreciate these comments in writing. Any additional thoughts on Issue 26? Frank.

MR. STANONIK: Frank Stanonik, AHRI. I think, and again, as we talked about it in the preceding slide, even this issue of commonly vented commercial water heaters and commercial boilers, there's probably a boiler capacity, boiler size issue that you've quickly moved from it something being usual to something being very rare.

Again, you know, I'm envisioning -- you have a very, very large boiler, and the building's hot water needs may not be anywhere near what its heating needs are, and all of the sudden, the concept of common venting becomes more than problematic, because your common vent size would be potentially so large that when the boiler wasn't firing, you're going run into a vent problem on the water heater, and you know, it's a non-heating season or something.

So again, I think there's a capacity component that again, you go from okay, this happens to well, usually not.

MR. BROOKMAN: Okay. I'm looking ahead in the slides that are forward from here, and there are four or five different segments to be discussed for LCC and payback trade analyses. So I'm going to suggest we take a break now for lunch. It's 12:25. We've made a lot of progress here. We still have a fair amount of rather detailed content to cover.

So I want to make sure we're fresh to do that. 12:25. We'll break for an hour for lunch. I think most of you are familiar with the Forrestal Building. Please wear a badge visible. This room will be watched. It will be secured. You can leave your stuff here, and if you go to the big cafeteria, to run back through the security portal you might need a picture ID.

There's also a Subway shop down on the ground floor, near the coffee shop down there. So see you back here at -- to start at 1:25. Harvey.

MR. SACHS: Would it be out of line to ask -- [not audible]

(Whereupon, at 12:25 p.m., a luncheon recess was taken.)

A F T E R N O O N S E S S I O N

1:33 p.m.

MR. BROOKMAN: Okay. Sorry for the slight delay starting up. We had a little bit of technical difficulty and now we're back, and picking up on Slide 72, I believe.

MS. SINGLA: So next we'll talk about the maintenance and repair costs, which are part of the annual operating costs that are accounted for in the life-cycle cost analysis. The maintenance cost is the routine cost to the consumer of maintaining the equipment. The maintenance frequency assumed is based on RSMeans and CBECS and RECS samples.

DOE assumes that all oil-fired boilers are maintained on a regular basis, and are maintained per the frequency specified in RSMeans. DOE assumes that gas-fired hot water boilers may or may not be maintained regularly.

The CBECS and RECS survey actually indicate whether the owner reports that they maintain their boiler -- or whether they maintain their equipment regularly or not. If the owner indicates that they maintain their equipment regularly, then DOE assumes that the gas-fired hot water boiler will be maintained at the frequency as specified in RSMeans. If the owner indicates that they do not maintain their equipment regularly, then DOE assumes that the maintenance occurs one-third as frequently as specified in RSMeans.

The labor hours and costs are based on the 2013 RSMeans facility maintenance and repair data book. This includes separate labor costs for steam boilers versus hot water boilers, and for small boilers versus large boilers.

The material costs are also based on RSMeans, and we include an additional common state neutralizer cost for condensing boilers. We assume that the maintenance is the same across all efficiency levels, other than the condensate neutral costs and across all equipment classes.

The repair cost is the cost to the consumer of replacing or repairing components in a boiler that has failed. The labor hours and costs are based on the 2013 RSMeans data book, and material costs are based on RSMeans, as well as the engineering analysis. The component failure rate is given in this chart on the slide. We have a mean failure year. We assume a Weibull distribution for the component lifetimes, for each component lifetime. The mean year is what is written in the slide. So we have mean year -- mean failure year and the repair rate.

Also, the analysis assumes that all boilers have a one year warranty on parts and labor, and a ten year warranty on the heat exchanger. So DOE has a number of comments or a number of requests in relationship to maintenance and repair.

So DOE requests comments on frequency and cost of maintenance, major repair issues, repair frequency and repair costs for commercial boilers that meet the minimum energy efficiency standard, as well as for higher efficiency boilers.

DOE seeks input on how often boiler maintenance is performed by on-site maintenance staff versus external contractors, specifically for hot water boilers, resisting boilers and small boilers versus large boilers. DOE seeks input as to how often, in the event of a heat exchanger failure, the heat exchanger alone is replaced, versus the entire boiler being replaced.

DOE is interested in knowing whether this varies with equipment costs or varies with condensing versus non-condensing.

MR. BROOKMAN: Frequency and cost of maintenance. Let's start there. Chuck.

MR. WHITE: This is Chuck White. While I cannot comment on costs, but certainly the steam boiler annual maintenance is on target. Larger hot water boilers probably do have annual service, probably not as much as steam but more than minimal. I think most of them are going to have some annual service to them. I can't comment on the cost issue. The on-site versus the external contractors --

MR. BROOKMAN: Before you move on, is there a difference between minimum efficiency boilers and higher efficiency boilers?

MR. WHITE: I don't really think so, particularly in steam. No matter what -- I'm not exactly sure what a high efficiency steam boiler is anyway, but oh, I probably shouldn't have said that out loud. But compared to high efficiency water, hard to be really high efficiency in steam. But I think they're both going to have service pretty routinely. On site, external, that's going to be a function of the -- really the facility it's in, if they have competent people to do that kind of stuff.

So like hospitals and larger apartment buildings, things like that probably are going to do on-site, unless it's repair of specific problems. I mean if it's routine maintenance, typical stuff probably, the on-site staff's going to do a lot of the typical. But --

MR. BROOKMAN: Would that correlate more with the size of the boiler?

MR. WHITE: Yes the large -- especially the larger is probably going to be more external. But not every time, and the heat exchanger failure, that's really -- that really is directly related to maintenance, particularly in steam boilers. But if you're not maintaining steam boilers, you're probably going to be breaking sections or tubes or what have you.

Whether you change the heat exchanger or whether you change the boiler, bigger boilers you're probably going to repair, change parts; smaller boilers, you'll probably change the unit. But not 100 percent either way.

MR. BROOKMAN: Okay, good. Thank you. Additional thoughts on these questions? Okay.

MS. SINGLA: Another key input into the life cycle cost analysis is the boiler lifetime. DOE defines lifetime is the age when the commercial boiler is retired from service. DOE assumes that the lifetime of a boiler is the same at different efficiency levels, and the same across all equipment classes.

DOE assumes a medium lifetime of 24.8 years, based on its literature review of boiler lifetimes. DOE uses a Weibull distribution, the one pictured here on the slide, to represent the boiler lifetime. In order to derive the parameters for defining this distribution, we derived some of the parameters from the literature review, and derived some from parameters typical of appliances.

You can see all of the sources found on the literature review, as well as details on the methodology in Appendix 8-F. So we're also requesting comments on lifetime. So specifically, DOE requests comments about the methodology used to determine equipment lifetimes for commercial boilers, and DOE seeks data that projects boiler lifetime, particularly for non-condensing versus condensing boilers.

MR. WHITE: This is Chuck White. The 24.8 is kind of an unofficial industry mantra is boilers in 25-year kind of devices. I don't really have a way to weigh in on the condensing versus the non-condensing. One of the condensing technologies, the current condensing technology is 25 years is kind of a stretch for some of those products. So I don't -- I really don't have an opinion on how to quantify that aspect.

MR. BROOKMAN: Okay, Frank.

MR. STANONIK: Frank Stanonik, AHRI. In a lot of those lines, and we've voiced this concern before, the -- I mean the fact is that the use of condensing technology in boilers, even on the commercial side, really hasn't been enough of a field experience to -- I'll say to apply, let's say, the same technique that you might do for non-condensing boilers, because we're probably --

If mean if you were to say okay, they have an average life of 25 years, in fact 25 years ago there were very, very few condensing boilers being installed. So we just don't really have the field experience at this point, I think, to substantiate that the typical lifetime of a non-condensing boiler necessarily translates directly to condensing designs.

And so I think just it needs to -- and again, I don't know that we can get our hands on any data from the field that might show something. But it just needs to kind of be recognized that, you know, if you looked at -- we really just don't have the field experience to have a good fix on it okay, is it different.

MR. BROOKMAN: Okay. Frank Myers, please unmute your phone. Let's hear from you.

MR. MYERS: Okay. Can you hear me now?

MR. BROOKMAN: Yes, yes.

MR. MYERS: Thank you. On the lifetime of equipment, that's usually determined by two factors. One is payback for replacement of equipment due to higher efficiency, and the other is when the cost of maintenance is seen by the owner as exceeding the benefit of maintaining the old equipment. Would they rather spend the money to repair or to replace?

So and to 28, Frank Stanonik is correct. We don't have long years of history to make a definitive statement about whether or not the traditional lifetime of boiler applies to non-condensing.

But early evidence is that the products are more sophisticated, have to deal with corrosive condensate and as a result tend to have shorter lives than the non-condensing counterpart that they might be replacing, assuming the design of the building can accept and utilize such a replacement.

MR. BROOKMAN: Hmm, okay. Thank you. Geoff Halley, please, your turn.

MR. HALLEY: Yes. I think that the 24.8, 25 years is a good number for conventional boilers. A lot of it depends on the actual maintenance that's done on the thing, the day-to-day operational chores, if you like, that the operators have to go through, like blowing water down on steam boilers, so on so forth.

But I think a better number for conventional boilers is probably around 15 years, you know. Like Frank Myers has just said, it looks as though it could be shorter. I've not actually heard comments from manufacturers of convention boilers, but customers are going to be a little bit upset or a lot upset, you know, 15 years down the road from when they buy it and they find out that it's not going to last as long as a conventional boiler.

So I think that possibly we ought to be delineating between condensing boilers and DOE, rather than having across the board 25 years.

MR. BROOKMAN: Okay, thank you.

MR. MYERS: This is Frank Myers, PPI Industries again. Going back, I think it's one slide, talked about the maintenance costs and frequency of repair for condensing versus non-condensing, and also the issue of self-service versus external service.

This is another area where a well-worded survey form could be either physically applied by calling and asking for answers to questions, or sent out to boiler service companies. They do this every day, and would be able to give you answers to both the cost frequency and even help answer some of the questions about the frequency differences between non-condensing and condensing equipment.

MR. BROOKMAN: Okay. Thanks, Frank.

MR. SACHS: This is Harvey, and I'm certainly very naive about these issues. But one of the things we have discussed is that there are multiple materials used in the heat exchangers of these devices, including copper, cast iron, steel and on the condensing side stainless steel.

So it would seem that the issue of the

heat exchanger material is likely to be as relevant as the issue of the condensing versus non-condensing, and if you're going to go to the trouble of doing this sort of survey, which we'd certainly support, we need to make sure covering the variables and have a reasonable chance of making a difference.

MR. BROOKMAN: Okay, thanks.

MR. SACHS: I personally have long-favored the use of unobtanium in the primary heat exchanger.

MR. BROOKMAN: Now we are moving on.

MS. SINGLA: Average monthly energy prices were determined for CBECS and RECS regions based on EIA data. 2012 annual electricity prices were derived from EIA Form 826 data, which includes energy prices by State. Data for natural gas prices were determined from the EIA's natural gas navigator, which includes natural gas prices by State.

2012 average fuel oil prices were collected from EIA's state energy consumption price and expenditure estimates, which includes fuel oil prices by State. For areas with more than one State, the analysis weighs each State's average price by its number of commercial buildings and households.

Marginal prices from a consumer perspective are those prices that consumers pay or save for their last unit of energy used or saved. For utilities, marginal energy costs are the costs experienced by utilities for the last kilo[watt]/hour of energy produced.

A utility's marginal cost can be either higher or lower than its average price. We apply average energy prices to the energy use of the baseline. We apply marginal energy prices to any energy savings in natural gas and electricity. Marginal energy prices were derived from EIA data.

Future energy prices were based on EIA's projections from 2019 to 2040. DOE multiplies the prices described in the previous slide by the forecasts of annual average price changes in EIA's AEO 2014. The figure shown here is the projected commercial National gas price trend.

Because the EIA projection only goes to the year 2040, to estimate the trend after the year 2040 we use the average rate of change from the years

2030 to 2040. This is based on guidelines provided to the Federal Energy Management Program by EIA.

The projected energy price for each of the nine census divisions was applied to each building example, based on the building's location.

The discount rate is another input into the LCC analysis. The discount rate is the rate at which future expenditures and savings are discounted to establish their present value. Discount rates are applied to all annual operating expenses in the LCC analysis, including energy cost, repair costs and maintenance costs.

DOE estimates discount rates separately for commercial and residential end users. For commercial end users, DOE calculates the commercial discount rate as the weighted average cost of capital, using the capital asset pricing model.

Damodaran Online is a widely used source of information about company debt and equity financing for most types of funds. This was the main source of data for the discount rates analysis. You can refer to Appendix 8-G for more details.

So DOE seeks comments about whether its planned approach for estimating discount rates for commercial boilers.

MR. BROOKMAN: And are there other methods or sources that would be more appropriate if you don't like this one. No comment here. No? Chuck.

MR. WHITE: Okay. No comment here.

MS. SINGLA: So DOE recognizes that consumers today are already purchasing equipment that's higher than the standard. DOE recognizes by the year 2019, when this new standard will take effect, there will be even more consumers purchasing equipment that is higher than the standard.

DOE derived efficiency distributions by equipment costs for commercial boilers for the base case, that is for the year 2019. DOE did not have access to sales data describing the actual distribution of efficiencies in the base case or in the current sales today.

So instead, DOE based the estimates of the distribution of efficiencies on the AHRI models database. We looked at the models directories from

2007 to 2014, we determined trends and projected the trends forward to the year 2019.

So DOE requests data to characterize the current distribution of commercial boiler efficiencies in the market. DOE also requests data on efficiency distribution and on the likelihood and degree of improvement in efficiency of commercial boilers in the next five to ten years, as a result of market forces or industry trends.

MR. BROOKMAN: Frank.

MR. STANONIK: Frank Stanonik, AHRI. As I mentioned earlier today, we certainly will try and provide some of the data on distribution of products by efficiency in our comments. As far as the degree of improvement, we will also try and address that, although I'm fairly confident that there will be continued improvement. The condensing boilers in both the residential and commercial side are still having growth.

MR. MYERS: This is Frank Myers, PPI Industries. Both here and previously, you have used the AHRI directory I believe inappropriately, that will likely lead to faulty conclusions. That is the existence of a condensing or the existence of a non-condensing product in that listing has no bearing on how many are sold.

An example would be that when you're looking at atmospheric and mechanical draft, looking at that information, the atmospheric products, because there's a very low cost to maintain them from years ago, when they were entered into the program, there's a likelihood that a manufacturer will maintain those listings until it's not beneficial to them, and then add in a new mechanical draft, which may be where all of their sales are, or almost all of their sales. But they maintain lots of atmospheric listings, because it's easier for them to maintain them.

There's not a link between the sales volume and the number of listings of any particular product type, whether it's atmospheric, mechanical or condensing/non-condensing.

MS. SINGLA: Thank you for your comment. I think hopefully Frank is able to provide data that would help address this.

So this table shows the results of the LCC analysis for one equipment class. This is the gas-fired small hot water mechanical draft boiler. So it's all six efficiency levels considered, including the base case efficiency. The values in parentheses are negative values.

MR. BROOKMAN: Let's just pause here. Geoff Halley, please, you're up.

MR. HALLEY: Hello?

MR. BROOKMAN: Geoff, yes.

MR. HALLEY: Yes. I didn't really have much of a comment actually with this. But I just wonder what a reasonable payback period is at this point in time, because they look awfully high to me, these payback periods, and certainly, you know, at one time not too long ago, you know, if you were beyond two or three years payback, it wasn't an acceptable project.

MR. BROOKMAN: So you're referring to Slide 81, and do you wish to say anything more specific?

MR. HALLEY: No. I just, you know, while you've got negative life-cycle cost as well, you know. Does it make sense to go to these high efficiency boilers from a business point of view?

MR. BROOKMAN: Okay. Okay, thank you. Do you want to just cover the highlights on this slide?

MS. SINGLA: Yes, so that was basically it. These values are average value across all the ones that we did. You can see the complete -- for each equipment class, you can see the complete results in Chapter 8.

MR. BROOKMAN: Frank.

MR. STANONIK: Frank Stanonik, AHRI. Again, I haven't read through all the TSD material. But I'm just curious. On this particular slide, the life-cycle cost for Level 6 is more than the life cycle cost of the baseline unit.

We can see the installed cost as significantly different. The savings is about $1,600 a year. If you ran that backwards I guess 25 years, that would probably -- that probably would cover the difference in installed cost.

My question is what's contributing to the high life-cycle cost that we're not seeing here?

MS. SINGLA: So, I don't know if you low calculation right now, but we include a discount rate also. So that's part of it. But it's, you know, there's no single answer. It's all the inputs that we went over.

MR. STANONIK: Okay, all right. That may explain some good part of it, okay.

MR. BROOKMAN: Additional comments on these LCC and payback period analysis results?

(No response.)

MR. BROOKMAN: Okay.

Shipments and National Impact Analysis

MS. SINGLA: We're ready to move to NIA? All right. So next we'll talk about the shipments and the National Impact Analysis. So we've already talked about the life-cycle cost analysis and all the inputs that go into that.

The next step is to determine the shipments, and then use that together with the outputs of the life-cycle cost analysis, in order to determine the national impact. The purpose of a shipments analysis is to estimate the annual commercial boiler shipments for each equipment cost over the analysis period. The shipments analysis is a necessary input into the National Impact Analysis, as well as the Manufacturer Impact Analysis. The National Impact Analysis or the NIA estimates the national energy savings and national economic impact on consumers from commercial boiler energy conservation standards at different efficiency levels.

The shipments model forecasts the commercial boilers that would be expected to be shipped between 2019 and 2048, both with and without new energy conservation standards. The shipments model starts from a historic base year and calculates retirements and shipments by market segment for each year in the analysis period. This produces the total equipment stock for each year of the analysis period.

The equipment stock efficiency distribution is calculated for the base case and for each standards case for each equipment class. The equipment stock efficiency distribution is used in the National Impact Analysis to estimate the total costs and benefits associated with each efficiency level.

The shipments model considers three different equipment placement channels. Those are new construction, replacements and new owners. The shipments model also accounts for the impact of standards on shipments using price elasticities.

DOE uses multiple data sources in the shipments model. DOE uses historical annual shipments. DOE had historic annual shipments for one year for commercial boilers, that was the year 2007, for which we had -- for which we had commercial boiler shipments disaggregated by fuel type.

In order to expand the historical shipments beyond the year 2007, DOE used residential boiler shipments data. Residential boiler shipments data was available from 1960 to 2013, from data from Appliance magazine, the Gas Appliance Manufacturers Association and the Energy Star program.

So based on the trends seen in the

residential boiler shipments, DOE applied that to the commercial boiler shipments, to the 2007 commercial boiler shipments, and with that, they were able to expand the commercial boiler shipments.

DOE disaggregated between product classes, that is, steam boilers versus hot water boilers, and mechanical draft versus natural draft boilers, based on the AHRI model directories from 2007 to 2014.

Another input into the shipments analysis is the retirement function. The retirement function is based entirely on the lifetime distribution, which we've already discussed.

DOE also calculated shipments to new construction. In order to do this, DOE estimated the market saturation. That is, the number of buildings with boilers installed compared to the total number of buildings. This fraction came directly from CBECS and RECS.

DOE obtained new building starts data and projections from AEO 2014. So using these new building starts projections, along with the market saturations, we were able to determine the shipments to the new construction market. DOE also accounted for product-class switching.

The analysis based a split between natural gas and mechanical draft on trends seen in the AHRI database from 2007 to 2014. The trend that we observed was that the mechanical draft market was increasing, while the natural draft market was decreasing.

DOE assumes that this trend continues beyond the year 2014, and continues throughout the analysis period. DOE observed a similar trend between steam boilers and hot water boilers, where the hot water boiler market is increasing. DOE assumes that this trend also continues throughout the analysis period.

DOE saw a similar trend between large boiler models and small boiler models, where the large boiler model market is decreasing, and the small boiler model market is increasing. DOE similarly assumes that this continues throughout the analysis period.

DOE calculated price elasticity based on the planned shipments and household economic data during the period 1890, or sorry 1980 through 2002. You can see Appendix 9-A for more details. So this chart shows the results of the shipments analysis, both historical and projected. So from the chart, it's obvious that each equipment cost grows and decays at different rates.

So the bottom eight colors are all the natural draft equipment classes. So from this, it's clear that we're showing a decrease in the natural draft market. You can also see that the largest or the single equipment cost with the largest growth is the blue one, the big blue one in the middle, and that's the small mechanical draft hot water gas boiler.

You can see that overall, the shipments are pretty flat and don't have much growth over the analysis period.

Okay. So DOE has several requests for comments. DOE requests inputs on the shipments projection methodology. DOE invites comments about the selection of appropriate economic drivers, and the sources of data for historical shipments and shipments breakdowns for high equipment costs.

DOE seeks historical commercial boiler shipments data which is aggregated by equipment class and efficiency level, if available. DOE seeks input on the potential impact of amended energy standards on commercial boiler shipments.

MR. BROOKMAN: Frank.

MR. STANONIK: Frank Stanonik. A couple of immediate comments. As far as the shipment projection methodology, the slide -- the previous slide you talk about, new construction market -- I'm sorry, maybe it was the one before that -- new construction market saturation projected by new buildings, again I think based on what the trends are, it --

I'll put it this way. I think an attempt should be made to determine the -- how many boilers get installed per each new building. In other words, you know, if the trend is -- to be totally facetious here, if the trend was that in fact new buildings tend to each have on an average three new boilers installed as a module or whatever, then you know, that obviously would make the shipment, that part of the shipment projection very different.

And again, I'm hedging here, because I appreciate the difficulty of getting -- of trying to get some good information. But I think you need to realize that it's possible that in terms of new construction, let's say the boiler shipment -- there should be a boiler shipment multiplier as opposed to one boiler per building. I think that's very possible.

The other thing that is questionable, I question is that your price elasticity there, I'm reading -- and I hope I'm wrong, but I'm reading that that basically you're using essentially data from residential boilers to come up with price elasticity for commercial models.

If that's the case, and again I appreciate maybe that's the only thing you had. But if that's the case, I'm going to say that's really -- that's not great. That's not very useful, I don't think. I mean again, when you get into commercial boilers, I think you're dealing with a whole different pricing structure and relationship between the customer and the seller, whoever that might be.

I'd be real -- I am real leery about taking any kind of residential data on certainly something like price elasticity, and applying it to commercial boilers. Some of the other stuff we said before, you know. We will certainly try and provide some of this shipment information to the extent that our members can provide it.

MR. BROOKMAN: Thank you. Harvey.

MR. SACHS: On that Issue 34, there's just some question about the extrapolation from -- I'm sorry, not on 34, the issue of extrapolating from residential elasticity to this product class. I haven't read the whole TSD. There may be justification for it. It's intuitively a little bit perplexing to me.

MR. LEKOV: So -- Alex Lekov, LBNL. We believe the analysis need to reflect the fact that there is some impact on the shipments, as a result of increased cost of the highest efficiency level. This is the closest that we have to set of basically relationship.

We realize that, and this is the type of comment you guys have been commenting several times. But that's the information that's available right now. If you could comment on it and help to enhance it, that would be great. Thank you.

MR. BROOKMAN: Okay.

MR. SACHS: I very much appreciate the quandary you're in and I'm just a little bit afraid that downstream, when this gets turned over to the economists, who can be very literal people, they will try to look at $50 differences in life cycle costs by efficiency level, and think those numbers are real.

If we don't have a good metaphor, much less a good model for what elasticity is or so many of these other parameters, I'm just concerned about how we make it clear to those who will use these analyses where the sensitivities are and where the uncertainties are.

That's the more general point, and I know you're even more sensitive to that than I am, and have much better tools than I do for addressing it.

MR. BROOKMAN: Do we have any additional comments on this series of requests? Okay.

MS. SINGLA: The purpose of the National Impact Analysis is to estimate the national impacts of energy conservation standards for commercial boilers shipped between 2019 and 2048. The impacts on the national energy savings or the NES and the net present value or the NPV were studied in particular.

The NES is the primary energy savings. It is the difference between two projections. It is the base-case energy use without new standards projections, and the standards case, that is with new standards-case projection.

The NPV is the difference between the present value of energy cost savings, and the present value of total installed-cost increase. The methodology used to calculate the NES and NPV looks at each equipment class at each standards case.

For each equipment class in each standards case, the per unit cost increase and the per unit energy savings due to the standards were calculated.

The number of units or the stock were also calculated, and the energy savings for each year were calculated from 2019 to 2048. These two parameters were combined in order to determine the NES and the NPV.

We'll go over the inputs into the calculations. So as I stated before, the national energy savings is the difference in annual energy savings between the base case and each standards case summed over the analysis period.

The inputs into the NES calculation are the annual energy consumption per unit, the shipments, the equipment stock, the national annual energy consumption, the rebound effect, site to source conversation factor and the full-fuel-cycle factor.

The net present value is the difference between the present value of energy cost savings and the present value of total installed cost increase. The present value of total installed cost increase is the difference in installed cost between the base case and each standards case, discounted to the present and summed over the analysis period.

The present value of energy cost savings is the difference between operating cost savings between the base case and each standards case from 2019 to the time when the last unit installed in 2048 is retired.

The inputs into the NPV calculation are the total installed cost per unit, the annual per unit savings and operating cost, the shipments, the equipment stock, the total annual increases in installed cost, the total annual operating cost and the discount factor.

A key component of the NIA is the efficiency of boilers projected over time to the base case, that is without new standards, and for each of the standards case that is with potential new standards. For each equipment cost, DOE develops a distribution of efficiencies in the base case for the year 2019.

In each standards case, DOE assumes a roll-up scenario to establish the efficiency distribution for 2019. Equipment efficiencies in the base case that do not meet the standards case under consideration would roll up to meet the new standard level.

All efficiency shares in the base case that are already above the standard under consideration would not be affected. DOE projected efficiency trends after the year 2019 as well. After 2019, DOE assumes that the share of market -- that the market share of condensing boilers will increase linearly.

Within condensing boilers, the efficiency distribution remains at the same proportions as in 2019. The efficiency distribution of non-condensing boilers remains the same after 2019, even though the overall market share of non-condensing boilers decreases.

So this chart shows the overall projected growth of the condensing boiler market. This is based on the AHRI Models Directory from 2007 to 2014. We simply just extrapolated it to the year 2049. The condensing market share only applies to four equipment classes. Those are the hot water and mechanical draft equipment classes.

MR. BROOKMAN: Frank.

MR. STANONIK: Before you leave that chart.

MS. SINGLA: Yes.

MR. STANONIK: Frank Stanonik, AHRI. Okay. So we've had a bit of a discussion earlier, that in fact the actual market availability of condensing oil boilers of any size is extremely small, I think, and now how did you get --

So in 2019, you're showing, you know, I would say roughly something on the order of eight or nine percent for a small oil and 18-19 percent for large oil. How did you get to that number from where we are today?

MS. SINGLA: So this was based on trends in the AHRI Models Directory from 2007 to 2014. So we looked at the growth during that period and projected it forward. We assumed a linear growth.

MR. STANONIK: Okay. Then I'm going to -- and again, I will research this, but I'm going to venture that whatever trend you saw for the oil condensing products, I would say is not a big enough sample to say it's a trend at this point.

And again, I'll go back and check. I'm not, you know, I'm not going to profess that I'm reviewing the status of oil condensing boilers on anything like a regular basis. But to my understanding, those are still pretty rare products.

MS. SINGLA: Yeah. We appreciate your comment. We'll take that into consideration.

In 2011, DOE announced the use of a full-fuel cycle or FFC metric in the cost-benefit analysis. The methodology is based on the calculation of a full-fuel-cycle multiplier, or a conversion factor, for each of the primary fuels used by the product.

For this preliminary analysis, DOE calculated FFC energy savings using a methodology based on the National Energy Modeling System or NEMS. This is described in detail in Appendix 10-B.

The primary NES and FFC energy savings for the considered efficiency levels are reported in full in Chapter 10.

So this is the table of the Primary National Energy Savings. There was also in quads, and the results from other states for multiple equipment classes for each considered efficiency level.

So the next few tables, the new few slides are just results tables. So this is the -- the next slide is the full-fuel-cycle national energy savings results, with again the results in quads.

The next table is the Net Present Value results, with a discount rate of three-percent applied. So note that the negative values are indicated by parentheses. And the last results table is the Net Present Value results, discounted to seven-percent.

MR. BROOKMAN: Comments, questions on any of these foregoing tables?

(No response.)

MR. BROOKMAN: We have a question from Jeff Kleiss. Jeff asks "Is the total annual increase in installed cost inflation, or does it have a broader scope?"

MS. SINGLA: The total annual increase is --

MR. BROOKMAN: In installed cost inflation, or does it have a broader scope?

MS. SINGLA: Based on differences between different equipment classes?

MR. BROOKMAN: I'm not sure. Jeff, can you unmute your phone?

MR. KLEISS: Yeah. This is Jeff Kleiss from Lochinvar, and this is going back to the Slide 91, where you're going through the Net Present Value, and it's the assumption for total annual increase in installed cost, the increase attributable to standard, calculated by vintage.

I'm just wondering, is that -- are you just saying that that's the cost increase of installed appliances based on inflation, or are there other factors that are influencing that --

MS. SINGLA: Yeah. This is just based on the different efficiency levels. So this right here is actually we take the efficiency weighted total installed increase. So it's the shipment's weighted efficiency total installed increase. Alex, do you want to clarify that?

MR. LEKOV: If I understand -- Alex Lekov, LBNL. If I understand his question, in essence, as she just said, we're accounting for the increased cost of the equipment and the installation cost over the years. It's not inflation rate.

MR. BROOKMAN: Okay.

MR. KLEISS: Okay. So there's no consideration for, as years ago on, that there might be inflation and that the cost -- the initial installed cost of appliances is going to go up with inflation?

MR. LEKOV: This is accounted -- Alex Lekov, LBNL. This is accounted in the discount rate.

MR. KLEISS: Okay. Thank you.

MR. BROOKMAN: So four tables of a lot of data. Any comments or questions about all of those? Frank.

MR. STANONIK: Frank Stanonik. I think I know the answer. I just want to make sure I'm remembering right. So on your savings here, as an example, just in the first row, the savings at Efficiency Level 3, that is the total savings compared to the baseline?

MS. SINGLA: Correct.

MR. STANONIK: So each one of those is that level compared to the baseline. They're not additive in other words?

MS. SINGLA: Correct. Each one compared to the baseline.

MR. BROOKMAN: Okay. We're going to move on to Preliminary Manufacturer Analysis.

MR. MYERS: This is Frank Myers. I thought we're going to a list of questions. So I was holding my comment. But I think it's probably appropriate to make it now.

MR. BROOKMAN: Let's do it. Let's back up to wherever we need to back up to.

MR. MYERS: You can go back to the previous slide, although it appears it applies to this section, and that is there appears to me to be a fundamental flaw in the analysis. Not in the details, but in the concept.

It appears, and correct me if I'm wrong, that this analysis is largely based on if you increase the boiler efficiency, there will be a resulting savings, and where you cannot get savings if you don't have the efficiency, having the efficiency does not mean that you're going to have energy savings, and therefore any payback.

If for example, the building stock is designed -- the boiler system and the building stock is designed to have a return water temperature of 130 degrees or higher, there will be no, zero, nada savings from the application of a condensing boiler of any efficiency, because the boiler cannot condense.

So to think that requiring a boiler to be more efficient is therefore going to result in more energy savings is incorrect. In fact, if your return water temperature, the building is not designed for return water temperature of 100 degrees or below, you're only going to have a tiny amount of savings. Now if there are 100 degrees or below yes, you can get good savings from a condensing product.

And it's my observation -- now this is anecdotal, based on my experience, that the vast majority of building stock in the U.S. today has a return water temperature of between 140 and 160 degrees. And in any of those buildings, if you apply a condensing appliance, there will be zero additional savings.

MR. SACHS: Frank, this is Harvey, and I much appreciate the concern, and I think this loops back to the conversation we were having this morning about Tom Durken's published experience with conversion of high temperature systems in schools to low temperature systems in the same buildings, where he reported savings up into, as I recall, 70 percent or so as the high end on steamed buildings he converted, and this included all of the retrofit costs, down into the 40 percent range for some decent hot-water systems.

So it may be that there are large classes of buildings for which this is not feasible, but I think that the assertion that it's almost never feasible because of the designed-in temperatures, contradicts some field experience that I will introduce into the record, so it can be criticized and reviewed.

MR. MYERS: Excellent.

MR. BROOKMAN: Okay. Thank you, Frank.

MR. MYERS: Thank you.

MR. BROOKMAN: Let's press on. Yes, Alex Lekov.

MR. LEKOV: Alex Lekov, LBNL. Just for the record, in fact Frank, DOE's analysis account for the fact that the fraction of installation of condensing boilers were not going to operate in the condensing conditions. So this loss of efficiency is accounted in the analysis. Thank you.

MR. BROOKMAN: Okay, thank you.

MR. MYERS: This is Frank Myers again. Do you -- does the record include the percentage that you are taking that action on? My sense is that it's the vast majority. So I'm curious as to what percentage was selected.

MR. LEKOV: But DOE's life-cycle-cost analysis spreadsheet and the technical support document in Chapter 7 account this information. Of course, you could take the fractions and approach that is described there, and provide comments that could improve DOE's analysis for the next phase. Thank you.

MR. MYERS: Thank you. I'll look at Chapter 7.

MR. BROOKMAN: Okay, thanks.

MR. GLASS: This is Robert Glass with Raypak.

MR. BROOKMAN: Yes.

MR. GLASS: Just to carry on, one of the things said earlier this morning was that there was changing out the distribution heat transfer surface was not taken into consideration in costs or anything else, but that there was some portion that was taken, realizing that condensing products would not be operating in the condensing zone, and that that was taken into account.

But if, as Frank had mentioned, if the final distribution heat condenser surface is not providing it in any type of a retrofit standpoint, then I also stand by what Frank was saying, is that you're not going to have the savings that is being projected.

That even backs up what Harvey was saying, from the standpoint of if a building was retrofitted and completely retrofitted, which means therefore the costs associated with the distribution and the end heat transfer, that needs to be accounted for if these savings that are being projected are going to be realized. Otherwise, what's being projected there will not be realized.

MR. BROOKMAN: Okay. Do we have additional comments here before we move onto the preliminary MIA? Okay. We're moving on.

Preliminary Manufacturer Impact Analysis

MR. ALLEN: Hi. My name's Andrew Allen and I work for Navigant, and I will be presenting the preliminary Manufacturer Impact Analysis. So the Manufacturer Impact Analysis takes into account inputs from the Market and Tech Assessment, as well as the Engineering Analysis and the Shipments Analysis.

The purpose of the MIA is to identify

potential impacts for amended energy conservation standards on manufacturers of commercial packaged boilers. The analysis is conducted in three phases. In the first phase, DOE creates an industry profile to characterize the industry, that identifies important issues that require consideration.

This is primarily what I will be focusing on today, as this is a part of the MIA that DOE conducts in the preliminary analysis stage of the rulemaking process. The bulk of the quantitative analysis is on the second and third phases of the MIA, which take place during the NOPR stage of the rulemaking process.

In the second phase, DOE prepares an industry cash flow model and an interview questionnaire to guide subsequent discussions with manufacturers. And in the third phase, DOE interviews manufacturers and assesses the impacts of standards, both quantitatively using the government regulatory impact model and qualitatively, taking into consideration potential impacts of standards on industry competition, manufacturing capacity, direct employment and regulatory burden.

So as I mentioned, in the preliminary analysis stage of rulemakings, the MIA focuses on identifying key issues that require consideration in the analysis going forward. DOE primarily identifies these issues through preliminary interviews with manufacturers. So the first issue that DOE identified is that amended standards and an altered test procedure could require commercial packaged boiler manufacturers to retest all of their models, which could strain laboratory and engineering resources and be financially burdensome.

Manufacturers stated that testing is particularly challenging for commercial packaged boilers, because of the large size of most equipment, and the fact that many commercial packaged boilers are custom manufactured.

The second issue DOE identified is that not many American manufacturers produce condensing heat exchangers. Therefore, any standard necessitating condensing technology would require manufacturers to either continue to source heat exchangers from overseas, or make investments in product development and capital equipment to create their own production capacity.

And so the last key issue DOE identified is that DOE recognizes amended standards could differentially impact small businesses. DOE has preliminarily identified 21 small business manufacturers of commercial packaged boilers, and manufacturers stated that these companies may have fewer engineering, testing and capital resources to adapt to standards, compared to other competitors.

In the NOPR stage, DOE will conduct a Regulatory Flexibility Analysis that examines the potential impacts on small entities of amended standards.

So this brings us to issues on which DOE is seeking comment. In Issue 31, DOE is requesting comments and information on small business manufacturers, and any information that can help inform the regulatory flexibility analysis.

In Issue 32, more generally, DOE is requesting comments on any additional subgroups that warrant analysis, that may have different cost structures or operate within different regulatory frameworks from the rest of the industry.

And finally in Issue 33, DOE is requesting comment on its overall identification of key issues for this rulemaking, and is requesting any additional data or information that will assist it in evaluating the potential impact of amended standards on manufacturers.

MR. SACHS: This is Harvey, and I'd like to return to your first item, testing burden. The amended standards and an altered test procedure could require CPB manufacturers to retest all models which could strain lab resources and result in added financial burden.

These are issues which have been addressed respectively in the 2013 Negotiated Rulemaking, which included this class of equipment, and in the recent residential hot water heater or water heater standards rulemaking, which involved a very major shift in the paradigm for classifying and rating residential water heaters.

On the first issue, there was widespread acceptance, which certainly will have some burdens differentially across manufacturers, of the concept for off-setting, to the extent possible, physical testing in the lab with simulations such as the AEDMs. If we're going to look at this, we need to look at what can be done, what cannot be done with AEDMs.

With respect to the second issue, by law DOE was committed to developing the translation engine, to allow for existing products to be given ratings with the new rating method, based on algebraic conversions. We recognize, all of us I think, that this will not be perfect, but we think that there will be minimum disruption in terms of either disqualifying or mis-rating equipment.

It's a one-time process, and it depends upon this proceeding going all the way through without or getting a new test method. So I respectfully suggest that this requires using the recent history of DOE rulemakings to think about what it actually means.

MR. BROOKMAN: Okay. Now you see the

three comment boxes. Additional thoughts on these? Subgroups, for example, small businesses and others.

MR. SACHS: I want to say one other thing on that. This is Harvey. The issue of testing burden on small business is a real one. My father-in-law was a small manufacturer and I'm sensitive to this. The biggest contribution we could make to helping small business survive and thrive would be development of standardized simulation engines, open source that manufacturers could use, rather than each one having to develop its own proprietary information or proprietary model.

It need not be a requirement to use the DOE model. Others could be validated. But DOE does have research resources, it does have standards resources, and if we're serious about small business taking your observation of burden and converting that to opportunity for more sophisticated design, it would seem to be well worth doing. End of rant.

MR. BROOKMAN: Yeah, thank you. Any additional comments on these three?

MR. SACHS: Jim Raba is prescient on

that. This is Harvey again. DOE's heat pump model has been very widely used, I'm told, by multiple air conditioner and heat pump manufacturers. This was a model developed at Oak Ridge. I don't care where it's developed, and it's been in use for a couple of decades now, as something of an industry resource that's open to anyone.

There's no reason we can't do this much more widely, and I'm quite confident that the manufacturers will discover the defects in any models you develop leading to iterative improvement, just like all other software.

MR. BROOKMAN: Okay. No additional comments here?

(No responses.)

MR. BROOKMAN: Not at this time, okay. Then to Next Steps.

Next Steps

MS. SINGLA: So the presentations that you have heard today, including the engineering analysis, the life cycle costs, the National Impact Analysis, those are all preliminary analyses. So in the next phase, in the Notice of Proposed Rulemaking or the NOPR, we will revise all of those preliminary analyses.

In addition to that, DOE will also perform a series of new analyses. The new analyses that DOE will perform in the NOPR phase include the Consumer Subgroup Analysis, the Manufacturer Impact Analysis and Emission Impact Analysis, Utility Impact Analysis, Indirect Employment Analysis and the Regulatory Impact Analysis.

In the preliminary analysis phase, we developed results from multiple efficiency levels for each equipment class. In the NOPR analysis, efficiency levels from each equipment class are grouped together to create trial standard levels or TSLs. The TSLs represent potential new standards.

Each TSL consists of a set of efficiency levels covering all product classes, and may vary between product classes. The NOPR analysis assesses impacts for TSLs, not for efficiency levels. DOE applies the methodology to assemble the TSLs.

Some possible criteria that could be used to determine the TSLs include most energy efficient level, efficiency level with the lowest life-cycle cost, efficiency level with a payback period of three years or less, efficiency levels with noteworthy technologies, and efficiency levels that fill in large gaps.

MR. BROOKMAN: So DOE requests feedback on the criteria that it should use for basing this selection of the TSLs. Thoughts on this?

MR. STANONIK: Frank Stanonik, AHRI. A kind of immediate comment, and admittedly a bit of a generalization. But I think because we're talking commercial boilers and the fact that it's a very mature product, I think that your selection of trial standard levels should have a significant basis of, in fact, models that are available on the market today.

I think in most -- I'm trying to remember what I saw much earlier on one of the slides. I think, you know, most of the levels being discussed, there are probably one or two or three models available at those levels. If not, then maybe it's not a level to look at.

But I think there should be, in this case, significant correlation between models available on the market today and the trial standard levels you look at, excluding max tech.

MR. BROOKMAN: Okay. Thanks, Frank.

MS. SINGLA: So one of the additional analyses that DOE will conduct in another phase is the consumer subgroup analysis. The purpose of the consumer subgroup analysis is to analyze the economic impacts of standards on commercial consumers, including subgroups who may be disproportionately impacted compared with the general use population.

DOE determines the consumer subgroups impacted by modifying the SEC analysis to examine the impacts for defining subgroups. So DOE requests any input as to which consumer subgroups, if any, it should consider when developing standards for commercial buildings.

(No response.)

MS. SINGLA: So we'll talk about the remaining additional analysis that DOE will perform in the NOPR phase. In the NOPR phase, DOE will perform an emissions impact analysis. The purpose of the analysis is to estimate the emissions impacts from amended energy conservation standards.

DOE uses the full fuel cycle energy savings, which were determined in the NIA, together with the emissions factors from AEO, in order to estimate the emissions reduction as a result of savings, I'm sorry, as a result of standards.

DOE estimates the reduction in common sector, common site combustion emissions of carbon dioxide, nitrogen oxides, sulfur dioxide, mercury, methane, and nitrous oxide. DOE considers the estimated mandatory benefits that could be the result of reduced emissions of CO2 from the energy standards.

To estimate benefits from CO2, benefits plans to use the social costs of carbon values, which were developed by an inter-agency process. So DOE requests any information or requests comments about emissions and also an emission monetization analysis, and you can see the specific questions on the slide.

MR. BROOKMAN: And particularly if there

are any other approaches that DOE should consider.

MS. SINGLA: In the NOPR, DOE will perform a utility impact analysis. The purpose of this analysis is to assess the overall impacts on domestic energy supplies that would result from the standard. The utility impact analysis is performed by taking the national energy savings results from the NIA and applying them in the National Energy Modeling System or NEMS.

The output of NEMS includes the change in energy sales and prices by region, the mix of energy generation and the change in new electricity capacity generation. The utility impact analysis reports the change in new generation capacity. DOE seeks input about its plans to use NEMS to conduct the utility impact analysis.

(No response.)

MS. SINGLA: Another analysis that DOE will perform in the NOPR phase in the indirect employment analysis. The direct employment analysis was already discussed a little while earlier in the manufacturers impact analysis. Here, we are talking about the indirect employment analysis.

The purpose of this analysis is to report the net jobs created or eliminated nationally as a consequence of new energy conservation standards. The impact analysis uses the IMSET tool, which is a spreadsheet model of the U.S. economy that focuses on the sectors most relevant to building energy use.

Changes in product and energy expenditures are taken from the MIA. The outputs of this analysis is the change in employment by sector as a consequence of new standards. DOE requests comments about its planned approach for assessing national indirect employment impacts.

(No response.)

MS. SINGLA: The final analysis that DOE will perform in the NOPR phase is the regulatory impact analysis. The purpose of this analysis is to investigate the national impacts due to non-regulatory alternatives, compared with mandatory energy conservation standards.

The non-regulatory alternatives that may be considered include no new regulatory action, early replacement, prescriptive standards, consumer tax credits, manufacturer tax credits, consumer rebates, voluntary efficiency targets and bulk government procurement.

The regulatory impact analysis was performed by modifying the NIA spreadsheet to consider non-regulatory scenarios. The non-regulatory scenarios increase overall plant efficiency modeled by modifying the base case efficiency trend.

The NPV is calculated by non-regulatory alternatives, in the same way as for the adopted standard. The output of this analysis is the national energy savings and net present value of the non-regulatory alternatives.

MR. BROOKMAN: Jeff Kleiss wishes to make a comment or ask a question. Jeff, please go ahead.

MR. KLEISS: Actually, I realize that the context was wrong, and I don't have anything to add.

MR. BROOKMAN: Okay, thank you. So regulatory impact analysis. There you see the description. Questions and comments on what's presented here? Yes, Frank Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. I guess I'm trying to make sure I understand this process, because actually this last slide puzzled me a little bit. So going back to the schedule in, I think it's roughly June or July, officially DOE is supposed to determine whether they are going to -- whether a change is appropriate in the standards or not.

And, maybe I'm getting residential and commercial mixed up, and my recollection is that if they decide a change is required, they issue a NOPR at that time. And why are we talking about DOE issuing a NOPR? So I'm really a little bit -- I'm no understanding why, and I appreciate it. But why would they be looking at non-regulatory alternatives, when it seems to me there's at least, if not a decision, a strong leaning towards having a next, you know, a next level of new standards? I'm missing something, I think.

(Off mic comment.)

MR. STAS: Eric Stas, DOE. Well, you

know, if look back in the regulatory analyses which follow any of these rulemakings, this is one of the requirements. I think it's under Executive Order 12866, that there has to be an analysis of non-regulatory alternatives.

That goes into the RIA document, which I think is put in the docket along with the TSD. So this is the very standard theme print that you actually see all the time. So this is nothing new. It's just part of the normal, the normal process.

And you know, one of the things that you have to look at is no action, but clearly EPCA is directing us to take action to analyze these things, and to do no action only if it's a no standard standard kind of situation, which sometimes happens but isn't typically the case.

MR. STANONIK: But so this part of the analysis will be in the NOPR package?

MR. STAS: Yes. It's typically there every time.

MR. BROOKMAN: Final comments on this series of analyses that will occur downstream in the

NOPR phase? All right, okay. So then now, as we promised first thing this morning, is another opportunity for comment. Anybody that wishes to make comments here as we move towards closure, issues that you wish to bring to the floor that haven't been covered sufficiently. Concluding remarks.

MR. MYERS: This is Frank Myers. Could you roll back to the previous slide please?

MR. BROOKMAN: 115?

MR. MYERS: Yes.

MR. BROOKMAN: Uh-huh.

MR. MYERS: Something that -- this might be statutory, and if so, I apologize, in terms of the things that may be considered. But one non-regulatory alternative that might be considered is to look at ASHRAE 90.1 and create some kind of requirement that new buildings or renovated buildings have to put in systems that can utilize condensing equipment.

There's lots of condensing equipment out right now and the biggest holdback from more of it being applied is not a regulation saying you have to have it. It's that wed like to have more buildings that can use it.

So that might be something to look at as a non-regulatory alternative, would be some form of requirement, based on positive payback, that might well be seen to for new buildings, and potentially for modified buildings, to require them to have low return water temperatures so the benefit of condensing boilers can be enjoyed.

That would tremendously increase the application of condensing equipment.

MR. BROOKMAN: Okay, thank you.

MR. SACHS: This is Harvey. Of course Frank, that is a regulatory but non-standards approach, in that the 90.1 would be adopted into code by the jurisdictions authorities.

MR. MYERS: True enough.

MR. SACHS: Pardon me?

MR. MYERS: True enough. I say you're absolutely correct. I was thinking about a DOE efficiency regulation. This would be an alternative to that. But it is in fact quasi-regulatory.

MR. SACHS: You would certainly find the advocates strongly supportive of that, and working with y'all on anything we could do. Again, Durkin has a small sample of 20 schools that he published, ten steam, ten high-temperature hot water.

But minimum savings were still somewhere in the range of 40 percent for doing those system changeouts, and that's very, very large in the context of what we can achieve with standards alone.

MR. BROOKMAN: Thank you. Jeff Kleiss, unmute your phone. Let's hear from you.

MR. KLEISS: Alright, two things. One, I wanted to say thanks to DOE for the exclusion of looking at standby electrical power consumption. I think that's very reasonable, and considering the vast majority of the power consumption that's being used on these products. I appreciate that.

The other thing is when you're -- I overlooked stating this before. When you're doing your cost analysis for products, as -- if there is any consideration of altogether eliminating condensing appliances, there are --

Because so many of the heat exchangers for condensing appliances are purchased, particularly from overseas, that it will affect many manufacturers, the overhead structure that they have, and increase the cost of all their remaining products, because there's going to be a lot of overhead and equipment that has been used to produce non-condensing heat exchangers, that will now become idle, and that cost will have to be absorbed in the remaining products.

MR. BROOKMAN: Okay, Jeff. Thank you. Closing remarks, additional final comments?

MR. GLASS: This is Robert Glass with Raypak. One of the concerns that I again want to go ahead and mention it here is still related to what is being projected as the estimated lifetime for condensing boilers.

I don't know if it's possible to go through the process, but I've heard there were some comments and feedback from the field in regards to a 15-year being more representative of condensing products. I don't know if it's possible to also do some of these analyses using 15 years.

So that you could say that okay, if it was between 15 or it was between 25 or something in there, you'd have an opportunity to see really what is realistic, what is the payback, what is the life-cycle cost associated with using condensing products.

I think it would be very eye-opening, and I think that just leaving it at the 24.8 that's currently in there is going to be adversely affecting some of the decisions that are made, because in reality, we don't know what it is.

But I think manufacturers that produce condensing products all feel that the life of the condensing product is going to be substantially shorter than the 24.8 years that's been identified today.

MR. BROOKMAN: Alex Lekov.

MR. LEKOV: Alex Lekov, LBNL. So in regards to this question about the differences in the lifetime between condensing and non-condensing equipment, DOE will consider any data that could be provided. At a minimum, DOE will perform scenarios based on their proposal of it, which will show the economic results as an outcome of different lifetimes.

MR. GLASS: Well, one of the things that goes along to support that is that there is currently no requirements for any annual maintenance on boilers. Where in Europe, particularly in the UK, there are requirements for annual maintenance of product before the gas company will even turn on the boiler in the wintertime.

If that were something that somehow were legislated into place, then I think that would enhance the lifetime of condensing products. But without that requirement, the lifetime of condensing products is going to be substantially less than that 24.8 that's been presented.

MR. BROOKMAN: Okay, thank you.

MR. SACHS: This is Harvey, and I certainly second the spirit of Mr. Glass' remarks, that we should be looking at international experience, not only with respect to maintenance,

maintenance contracts, and perhaps better estimates of equipment life, but also in terms of incremental costs, where condensing boilers are a much larger fraction of the market.

This is a mature product class. We do find -- well, we have often saluted industry on its incredible ingenuity in finding ways to ring-out costs as competition increases, and I think we have stated for years that looking at international comparisons is important, and would encourage the Department in that direction.

MR. BROOKMAN: Okay. Frank.

MR. STANONIK: Frank Stanonik, AHRI. Not, because I think I guess then we're kind of winding down here. So I'm going to admittedly belabor a point, because to us, it is important, and that is that as this thing goes forward, we certainly strongly believe that we need to have the test procedure finalized, and the determination about natural draft boilers finalized before this rulemaking on the standards gets too far ahead of those.

I think as we talked about, and it certainly seems to me those things need to be -- ideally would be known to all as final or close to final before we see the NOPR on this. That would be thus very important to properly addressing and responding to the NOPR on the standard.

MR. SACHS: Frank, you hit one of my hot buttons. This is Harvey, and I've worked on standards committees at ASHRAE, I've worked on standards committees at AHRI. In this particular area, we have had a need that has been recognized for two decades, for a vision cycle today which the AHRI side, which you said is not going to give us things that we've long identified as needed.

I don't know whether I'm going to pull out the two remaining hairs on my head, or make an exception to my usual stance, and say that DOE may have to intervene to get something in a timely manner, that ASHRAE and AHRI have simply been unable to move the ball.

MR. STANONIK: Frank Stanonik. Harvey, I appreciate your comments, and obviously we have perhaps different thoughts on what the test procedure at this stage should contain. But I think the key point of my comment is when you get to trying to really addressing this next level of standard, we need to know what the test procedure will be, and whether it's Harvey's version or Frank's version, we need to know.

MR. SACHS: Do we have a deal for you.

(Laughter.)

MR. BROOKMAN: Okay. Then I think we will address the next slide. So for my part, I thank all of you. We had a very productive day, and I'll turn it back to Jim Raba.

MR. RABA: We conclude today's public meeting with expressed appreciation from the U.S. Department of Energy, it's for your participation, both here live and the webinar. Thank you very much. A very productive meeting, thank you. Very productive, and informative.

We also thank our presenters, Rohit, Rupam and Andrew, our facilitator Doug Brookman, and technical crew backstage, Emily this morning and now Alex this afternoon. Thank you very much. You made this technically possible.

We look forward then to receiving your written comments. Heard many comments here. I'd like to see them in writing please and with data and information most of all, and safe travels all. Thank you very much.

(Whereupon, at 3:02 p.m., the meeting was concluded.)

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