UNITED STATES OF AMERICA

DEPARTMENT OF ENERGY

PRELIMINARY ANALYSIS PUBLIC MEETING ON

RESIDENTIAL FURNACE FANS ENERGY CONSERVATION STANDARDS

U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585
Room 8E-089 Review Center

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AGENDA

PROCEEDINGS

MR. BROOKMAN: Let's get started. Good morning everyone and welcome. This is the U.S. Department of Energy's Preliminary Analysis Public Meeting on Residential Furnace Fans Energy Conservation Standards.

Today is Friday, July 27, 2012 at the U.S. Department of Energy here in the Forrestal Building. My name is Doug Brookman from Public Solutions in Baltimore.

We're going to start off this morning with welcoming remarks from Mohammed Khan.

(Discussion about problems with microphone.)

Okay. I'll speak loudly. We are going to start with welcoming remarks from Mohammed Khan, Department of Energy.

Welcoming Remarks

MR. KHAN: Good morning. Mohammed Khan, Department of Energy. First, I want to thank you for participating today. As you'll find out, we have a lot of material to cover and we're going to be appealing to you for your comments and input on this material. We were here just over a month ago, having a meeting on the related rulemaking that we're doing, which is the test procedure for furnace fans, and I think I see a lot of you here again today, and that's great. And what I said at that meeting was of your comments are very important, but also explained that this rulemaking is unique really for two reasons. One, it's a first time that we're developing a standard and test procedure for furnace fans. The other reason is that it's a product that is already a part of – or is a component of a product that we already cover. So that's basically unchartered grounds, in a sense, but we look forward to your input today and I look forward to a great discussion.

MR. BROOKMAN: Thank you. Let's start with introductions. I'll start over here to my left, please. Say your name and organizational affiliation, and you can get used to turning the microphones both on and off. If we leave them on, then we get feedback in the system, please.

Introductions

MR. BOTELER: Rob Boteler. I work for Nidec Motor Corporation in St. Louis and I chair the energy committee for NEMA, the National Electrical Manufacturers Association.

MR. BROOKMAN: Thank you.

MR. LIN: Paul Lin, with Regal Beloit manufacturer of electric motors.

MR. BOESENBERG: Alex Boesenberg, National Electrical Manufacturers Association, regulations.

MR. MESSMER: Craig Messmer, with Unico, Incorporated in St. Louis.

MR. WAGNER: Greg Wagner, with Morrison Products.

MS. JAKOBS: Diane Jakobs, with Rheem Manufacturing.

MR. ROY: My name is Aniruddh Roy, Air Conditioning, Heating, and Refrigeration Institute.

MR. CHRISTIANSEN: Adam Christiansen with the Appliance Standards Awareness Project.

MR. WILLIAMS: Ted Williams, American Gas Association.

MR. JAMES: Brian James, Southern California Edison.

MR. WINNINGHAM: Dave Winningham, Allied Air, and Lennox.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute.

MR. ECKMAN: Tom Eckman, Northwest Power and Conservation Council.

MR. KIDO: Michael Kido, Department of

Energy, Office of General Council.

MR. KHAN: Mohammed Khan, DOE.

MR. BROOKMAN: Please. Stand up.

MR. WESTPHALEN: Detlef Westphalen, Navigant Consulting.

MR. JASINSKI: Sam Jasinski, Navigant Consulting.

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

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

(Several inaudible introductions.)

MS. MAUER: Joanna Mauer, Appliance Standards Awareness Project.

MR. RANSOM: McDermott Will and Emery.

MR. BROOKMAN: And let me just note for the record that those of you that didn't speak into a microphone, we didn't get all your names on the record, but most of you have -- hopefully all of you registered so we know who's here.

One thing we have been doing recently is we've been asking those who have been joining us via the web to read their names so we know who is joining us via the web. Can you do that, and their organizational affiliations are also there, that would be a good thing. They're not, just names. Okay.

WEBMASTER: So we've got Anush Mystery (ph), Dan Williams, Jim Vershaw, John Hunley, Linda Wilson, Rachelle Cox, Terry Small, Tom Chase, and that's it.

MR. BROOKMAN: Thanks to those of you that are joining us via the web.

Agenda Review

MR. BROOKMAN: All of you received a packet of information as you came and registered this morning. Please take a peek at that, particularly the agenda, that's where I'm starting with a brief review.

Following this agenda review we're going to have an overview presentation, the purpose of the public meeting, regulatory authority and rulemaking from Mohammed. Following that, those introductory remarks, there's an opportunity for anybody who wishes to do so to make opening statements, summary statements surrounding the issues that are of concern to you today.

And then from there we'll launch straight into the more detailed comment that's in this Power Point packet that all of you received. Market and technology assessment and screening analysis.

We'll take a break mid-morning, round about 10:45 or so. Following that, engineering analysis, following that, markups, energy use characterization and LCC and payback period analysis.

We'll take lunch round Around about 12:30 or so. Immediately following lunch, or whenever we get there, LCC and payback period analysis continued, then national impact analysis. We'll take a break mid-afternoon, preliminary manufacturer impact analysis, next steps in the late afternoon, 3:30 or so, and then finally, closing remarks, another opportunity for anybody who wants to, to make additional comments or statements. So two opportunities for open ended comment. We do hope, however, that the bulk of the commentary will be focused in on the content that's being presented because that will keep it organized for us.

I'd ask for your consideration, if you would, please. Many of you have attended these meetings previously. Please speak one at a time. Please say your name for the record each time you speak. I'm going to be cuing individuals by name as best I can. I also wish to encourage follow on comments, sometimes the back and forth is very useful for the Department as they're trying to consider this information.

If you keep the focus here, turn your cell phones on silent mode, limit the sidebar conversations. You will need to turn these microphones on and off please. We do have many web participants joining us. If those of you joining us via the web, if you would keep your telephones on mute, it will limit the amount of feedback we receive here in the room, and if you raise your hand, then we will find a way to fit you into the conversation as best we can that's going on here. So please feel free to join us and be proactive.

And then finally, as there are 100-and however many slides here, a lot of slides, I would ask for your consideration, please try to be concise today, share the air time. There's a lot to cover. We're going to do it very efficiently, I know we will, and so that's the task for the day. Questions and comments on any of this?

Okay, so then, we're going to start off then, Mohammed Khan. And Mohammed, I've been asked, please use the Lavaliere microphone, as the other one provides feedback. You want to hit the microphone and introduce yourself, name and organizational affiliation.

MS. DAKEN: Abigail Daken, US EPA, Energy Star Program.

MR. BROOKMAN: Thank you.

Purpose of Public Meeting, Overview

MR. KHAN: Good morning everyone. Thank you for participating in today's meeting on the U.S. Department of Energy's preliminary analysis on energy conservation standards for residential furnace fans. My name's Mohammed Khan and I'm the project manager for this rulemaking activity.

Today's meeting serves multiple purposes. Mainly, our goal is to have a two-way discussion. We want to convey the key points and concepts associated with this rulemaking, as well as to hear and listen to your thoughts and potential concerns.

- So first the Department wants to present its methodologies and characterize its analysis to date.
- Second, DOE wants to discuss specific issues and invites comment from all participants at today's meeting, on the methodologies, assumptions and data sources used in the preliminary analyses.
- The last thing we want to describe the downstream analyses and next steps in the rulemaking process.

But as Doug mentioned, if anyone has an opening statement they want to make, we can allow that.

MR. BROOKMAN: So let's have opening statements. We'll hear from Diane first. Please get that microphone close to you.

Introductory Statements

MS. JAKOBS: I don't know, I'm just assuming that Sam did a lot of this work, and I just want to compliment him on the breadth of it. It's really intimidating, all the detail. And just – I tried to go through it. I've got all my post it notes and things, and just in general, I think some of the costing – I checked with our procurement people and we might be using some of your numbers in our negotiations with Nidec and Regal Beloit, I think. It looks like you got a better deal than we do. And you used, it seems, like from ASHRAE 103 E-sub-AE, so I was kind of on familiar ground with that in some of your analysis, so that was good.

We did – you were asking us for data, and I'm on -- AHRI, we have been trying to collect data and just in our lab only, it was like Friday and Monday we got FER data for three samples and it looks like your numbers are a little low compared to mine.

So just in general, I think there's a lot of good engineering work and certainly some economic analysis that I think I can learn a lot from, but I was very impressed. Thank you.

MR. BROOKMAN: Thank you, Diane. Thank you. Other comments here at the outset. Your name, please.

MR. ROY: Aniruddh Roy, Air Conditioning, Heating, and Refrigeration Institute. We'd like to make one comment with respect to the timing of today's meeting. The test procedure has not been finalized yet and comments or the deadline for providing comments on the test procedure is July 30th. And so we just wanted to comment on the timing of the energy conservation standards meeting. Because I think a bunch of the stakeholders are going to be submitting comments, or expected to provide something to DOE by July 30th, and so we feel that the timing of this meeting is inappropriate, especially given the fact that that analysis takes into account the FER metric which hasn't been – at least the test procedure hasn't been finalized yet.

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

MR. CHRISTIANSEN: This is Adam from ASAP. I've got some prepared comments that I'd like to submit for the record. So the Appliance Standards

Awareness Project leads a broad-based coalition effort that works to advance standards which deliver large energy savings, monetary savings, as well as environmental benefits. Thank you for the opportunity to participate in today's workshop. We very much appreciate the significant work of DOE and its contractors to advance this important docket.

Standards for residential furnace fans have potential to deliver large benefits. Per DOE's analysis in the PTSD we're going to discuss today, the energy savings from these products could be as high as 1.67 quads of primary energy. The national economic benefits of a strong, but reasonable standard could total between $3.8 and $10.7 billion dollars over the life of the standard.

In general, we think the approach DOE has taken in this docket is reasonable. We are pleased to see that DOE has taken steps to address the complicated aerodynamics in cabinets. As DOE has noted these effects influence ultimate energy consumption of furnace fans. We're also very supportive of an energy standard being developed on a rating method that includes measurements from multiple operating points. Single point rating methods are simply not adequate to capture the complicated operation of a furnace fan in a meaningful way.

One area of concern for us that I'd like to highlight is the issue of the scope of coverage. DOE has excluded split system central air conditioning and heat pump blower coil units and single package central air conditioning heat pump units in the preliminary analysis. These products represent about 37 percent of products that contain furnace fans. It is unclear to us that the SEER and HSPF ratings fully capture the furnace fans. We think DOE should consider including in this rulemaking, air handlers that are part of a blower coil and single package central AC and heat pump systems. And we hope today's hearing will offer an opportunity to discuss the issue.

Again, we look forward to participating in the hearing and engaging with DOE and other stakeholders in this rulemaking process and we're looking forward to the discussion today.

MR. BROOKMAN: Thank you. I'm going to ask each of you to speak up. Hey, Greg, are you hearing okay back there now? Is it getting any better? Crackling. Yeah, we've got a guy working on it. We'll see if we can improve that. There's also a fair amount of feedback up here in the front, I don't know whether everybody can hear that or not, but we'll be working on it.

Karim, did you have a comment here at the outset? Get to the microphone, please.

MR. AMRANE: Karim Amrane, AHRI. I just wanted to restate a little bit this issue of the timing here. I think DOE has a process rule that basically lay out how things have to be done. They have to be done, and test procedures must come before energy efficiency standard. And here we are doing two things at the same time. DOE has spent a lot of time doing this analysis based on this metric that may or may not be what was going to end up being as test procedures. So again, either we are wasting our time today or DOE has already decided that that's going to be the metric. So I would like to understand why DOE is doing two things at the same time. I would like an answer from DOE, maybe legal counsel as well.

MR. BROOKMAN: Do you want to do that now? I'm looking at Michael Kido.

MR. KIDO: The timing for this particular activity, just to emphasize, we're at a preliminary stage right now. There's no proposal right now with respect to the standards. My understanding is that with respect to the analysis that we've got right now, because it's preliminary, it is based on the procedure that has been proposed earlier. So this is an attempt to try to get some feedback with respect to the overall approach that the Agency is considering.

If there's a need for additional time to analyze what it is that the Agency is considering as part of today's meeting, we can consider possibly looking at providing a longer comment period. That's something that we could look at. But I think the way that you should view this particular meeting, it's one that's purely preliminary in nature.

MR. BROOKMAN: Okay. Thank you. Other comments here at the outset? Alex, please.

MR. BOESENBERG: Alex Boesenberg, National Electrical Manufacturers Association. I want to thank the Department for welcoming us here today and … a month without a public meeting is … (Problem with microphone.) So we weren't sure if we needed to come. In fact, it was sort of a hunch to attend. We knew there were motors that drove fans, so we thought we'd show up, and the number of people who have said, oh, boy, we're glad you're here, makes us glad we came.

My members will be listening from a motor standpoint. I'm going to be listening from a slightly larger systems standpoint as Mr. Khan already alluded to, the fan itself is not only a component of a previously regulated product, but also there's a fan in the housing of the motor that drives it and other effects. And I'm going to be watching for how the system is discussed because of the precedent that that sets for some of the rulemakings we have where it's pretty hard to divorce the individual components. So I'm very interested in seeing how the Department approaches that and what that bodes for some of our other rulemakings that involve composite systems. Thank you.

MR. BROOKMAN: Thank you. Yes, it is Craig, right?

MR. MESSMER: Craig Messmer. I want to let everybody rest assured that I will not be talking about small duct high velocity at this meeting, since it is excluded, thank you very much. But I will keep my comments to the topics, and the technical support document weighs about six and a half pounds, so you get an A-plus on the report. Thank you.

MR. BROOKMAN: Okay. Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, thank you. I thought the Department did a good job with the technical support document. We will have comments, but I think there's some really bigger issues for the Department in terms of not just furnaces and air conditioners, but also other products where they're looking at components. For example, the DOE has rules on battery chargers now. Well, battery chargers are components of dozens and dozens of products, and so it's always interesting, you look at the component, you make it more efficient, but what are you doing to the whole product? Is it making the whole product more efficient or are there laws of unintended consequences where the product can be – you're not changing the efficiency of the whole product, or even worse, you're actually increasing the energy usage of the whole product.

And I think going forward, there is possibly going to be a resource issue. You have a furnace fan rulemaking, you have an air conditioner heat pump rulemaking, you have a furnace rulemaking, and do you do them all together? Do you do them separately? You know, three separate tracks? You're kind of talking about energy use for heating and cooling.

So I think going forward, this component versus system is going to be a bigger issue, not just in terms of energy, but in terms of resources of DOE and stakeholders. Thank you.

MR. BROOKMAN: Thank you. Steve was speaking clearly. Greg, was that better or the same?

MR. WAGNER: The same.

MR. BROOKMAN: Okay.

MR. WAGNER: Actually, that microphone is very clear.

MR. BROOKMAN: Okay. We're still working on it. Yes, please, Dave.

MR. WINNINGHAM: Dave Winningham, Allied Air. First of all, I'd like to thank the Department for the detail of the work that went into this. A couple of key issues, I think, that the Department needs to consider.

The increasing burden that this and other metrics are placing on the HVAC manufacturers is increasing. As this proliferation of metrics increase, these costs are going to be passed along to the consumer. The net result of this could potentially be a reduction in the affordability of the products within this industry. I think we've seen some of that as we went from 10 SEER to 13 SEER.

While the energy conservation side of this is very important, we need to look at ways that we can reduce the burden of this and other metrics. The test procedure that has been proposed is a completely separate set up, completely separate test procedure than the AFUE test procedure that is applied to the majority of the products that this is referenced to.

I would ask – and we will make comments in regard to the test procedure – that the Department look at ways that the data needed for these metrics be aligned with other test procedures and test setups.

I would also like to comment and second Diane's findings that some of the assumptions going into – in regard to the cost differential of the components, as well as the performance of the products, needs to be reviewed thoroughly. I would agree that we could use some help negotiating our motor prices, because they don't align with the Department's assumptions.

MR. BROOKMAN: Okay. Thank you. Greg. Thank you for getting that close.

MR. WAGNER: Greg Wagner, Morrison Products. I want to echo the gentleman's sentiments from the Edison Electric Institute. The combined rulemaking process of all the various standards that go into the various appliances creates a huge burden to comply with each one of these regulations. In addition to that, appliances being regulated as components versus being regulated as systems can lead to sub-optimal systems, rather than optimal overall energy use.

In this case we're looking at electrical energy versus performance of the appliance in the furnace case. Consumers are going to be looking at two different numbers, and they're going to have to make a decision on which number is more important, the electrical or the furnace performance. So the question is going to be, how do they evaluate and how do they make choices based upon these two different numbers. So combining standards to where it reduces the regulatory burden is good. It also helps the consumer in making the appropriate choice for energy efficient designs.

MR. BROOKMAN: Okay. Other comments here at the outset? We have one individual, Terrell Small has raised his hand. Terrell, unmute your phone and hopefully as you speak, you should come here into this room.

MR. SMALL: Doug, can you hear me?

MR. BROOKMAN: Yes, we can hear you but speak up.

MR. SMALL: Yes, Doug. First, I'm sorry that I'm not up there. This is Terry Small with Mortex, and I'm sorry I'm not up there with you guys. I want to thank Mohammed and his team at DOE for all the hard work that went into this, including Sam and his team, and of course you, Doug, for moderating it.

We're a small manufacturer that builds products in some of the niche markets that would be impacted by this. Some of the slices of the pie chart in the summary, the very thin ones, are where we are. And this is going to be a big burden on us, and of course our customers who will ultimately have to pass the cost of doing all this through to, particularly in this weak economy. We build to order, very low quantities. Some models that we offer are never built during the year, so the burden of having to test something that you're not selling is going to be particularly bad. I would highly recommend that AEDM be allowed that perhaps would lessen some of the testing burden.

We also disagree with some of the production cost. We pay a lot more for our motors than is basically described in some of the economic analysis, so that in my mind, calls into question some of the initial economic analysis that was done.

And finally, I agree with Diane and the group that the values, what are called baseline values, look like to me that they may have been generated from published data, you know, which is maybe not the best way to generate that stuff. The published data is based on ASHRAE 103, and whereas the test NOPR that DOE is proposing is amped (ph) at 210. I think that table is just completely premature. We're thinking that some of our values will be above those values that are in that table.

But anyway, thank you for allowing us to participate in this.

MR. BROOKMAN: Yes, thank you. Terry, and to all of you via the webinar, the Department does wish to make this accessible to you, so if you wish to speak, raise your hand and we'll fit you in. Final comments here at the outset before we move on. Okay, then to Mohammed.

Overview

MR. KHAN: First, let me thank everyone for those really good comments. I think it is on, let me just speak up. Again, let me just first thank everybody for those very good comments. Those were comments that – those are the kinds of comments that we're looking for. Let me also add that with those comments, I'd like to get written comments and certainly any kind of data or information that you might have to support some of the assertions that I just heard. And, for example, the gentleman here to my left mentioned that in trying to bolster the performance of the fan and motor assembly, it could have some unintended consequences, such as reducing the overall furnace performance, and there's a risk of a consumer having to trade off one for the other. I think what I'd be interested in knowing is how far can we actually push that motor performance – fan assembly performance before there actually is a decline in the entire system? So if there's any kind of data, modeling, or information that you have on that, that would be great. So with that, I'm going to resume my presentation.

Comments. Comments are central to the success of this rulemaking. All participants are encouraged to submit summary comments and raise any additional issue relevant to the rule. As indicated in the Federal Register notice which was published on July 10th, the close of the comment period is September 10th.

Let me also point out here on this slide, the sample call-out box. We will use these throughout our presentation to identify certain issues the Department seeks detailed information on. For reference, please note that the numbering of the issue boxes correspond to the issues listed in the executive summary of the technical support document.

Again, because your feedback is very

important, I want to make sure everyone is clear on how to submit comments. This slide provides the postal, courier, and e-mail addresses which are appropriate for submitting your comments. Please include the information here at the top so that your comment is properly identified and catalogued. While not provided on this slide, you may also submit comments via www.regulations.gov. Regulations.gov is a new, on-line tool for submitting comments on all federal government proposed rules. Let me also point out again that the comment period closes on September 10th.

Meeting Overview

This slide outlines the agenda for today's meeting. Following my introduction and overview, we will discuss all of the preliminary analyses including the market and technology and screening analysis, engineering analysis, and all other analyses presented here before we describe the next steps.

So what's driving this effort? The Energy Policy and Conservation Act, as amended by the Energy Policy Act of 2005, charges DOE to establish applicable energy conservation standards or energy use standards for electricity use for the purposes of circulating air through ductwork. After being amended in 2007 by the Energy Independence and Security Act, EPCA requires DOE to address standby mode and off mode energy use in its standards that are adopted after July 2010. EISA 2007 also says that the energy use associated with standby mode and off mode must be integrated into the energy conservation standard unless existing standards already account for standby mode and off mode, or integration is not technically feasible. If integration is not technically feasible, EPCA requires separate standards for standby mode and off mode energy use.

This slide summarizes the Department's activities for furnace fans to date. As I said at the outset of our meeting, DOE currently does not have a test procedure or standard for furnace fans, but has made significant progress. For the test procedure which DOE is developing in parallel to the standards rulemaking, DOE published a Notice of Proposed Rulemaking on May 15, 2012, and on June 15 it held a public meeting. The comment period for the test procedure NOPR remains open until July 30th. I encourage all of you to submit comments on the test procedure NOPR, so please appreciate that there are only three days left to do so.

The energy conservation standard effort was initiated on June 3, 2010 when the Department published its framework document for its standards rulemaking. DOE then solicited and heard comments regarding the framework document at its June 18, 2010 public meeting.

And today we're holding our public meeting for the preliminary technical support document which DOE published a notice for just over two weeks ago on July 10th. I'd like to remind you that the comment period for this phase of the rulemaking closes on September 10th.

One last point on this slide, DOE's preliminary analyses also was conducted using the test procedure proposed in the NOPR. And again, comment period for that ends July 30th.

DOE proposed a performance metric for furnace fans that provides a measure for annual electricity consumption, normalized by annual operating hours and air flow. The FER equation reflects cooling, heating, and constant circulation operating times. Integrated fan efficiency rating or IFER modifies FER to account for standby mode and off mode operation, and is applicable to hydronic air handlers.

In deciding whether a new or amended

standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. DOE is directed by EPCA to consider seven factors in making this determination. This slide lists the seven factors as well as the corresponding analyses that DOE performs. Throughout the day we will be describing the analyses in detail to make the relevance and relationships between each analysis and the seven EPCA factors.

This slide depicts the rulemaking stages and shows the sequence and relationships between the various analyses the Department conducts. DOE is currently in the preliminary activities phase wherein it conducts the sets of analyses shown here. What’s important to recognize here is that the results or outputs of the proceeding analyses are inputs to the downstream analyses. Because of this relationship, it’s important for the Department to receive your input on its methodologies and any relevant data to help insure accuracy and completeness.

Now just in case you haven’t already fully read each page of the Federal Register notice, and the 17 chapters and the 17 appendices of the technical support document, we prepared this slide to point out the key documents that describe the preliminary analysis activities.

- First is the executive summary that provides an overview of the preliminary activities in the TSD, summarizes key analysis results and lists the issues that the Department seeks your comment on.
- Chapter two of the preliminary TSD provides a review of analyses and a discussion of the comments DOE received from interested parties on the framework document, including DOE's interpretations and responses.
- And finally, the Federal Register notice itself, which discusses in a broader sense, the rulemaking process, the preliminary activities analyses, and where to find the relevant documents on the DOE web page.

This concludes my portion of the presentation and we'll proceed with the market and technology assessment and screening analysis portion.

MR. BROOKMAN: Next we're going to hear from Sam Jasinski.

Market and Technology Assessment and Screening Analysis

MR. JASINSKI: Thank you, Mohammed. My name is Sam Jasinski from Navigant Consulting. I'm going to start by providing or giving a discussion about the market and technology assessment with a lead into the screening analysis. As Mohammed showed you, we provided these roadmaps to just to kind of show you how each analysis fits into the broader scope of the rulemaking process.

The market and technology assessment has two essential parts, the market assessment and the technology assessment. The purpose of the market assessment is to provide a quantified and qualified characterization of the furnace fan, and in this case, residential HVAC market. As Mohammed described, the earlier – Mohammed described the statutory language that's driving this rulemaking. DOE has interpreted that language to provide a tentative definition for furnace fan. Furnace fan means any electrically powered device used in a residential heating, ventilation, air conditioning product for the purpose of circulating air through the ductwork.

DOE realizes that a significant number of products may fit this broad interpretation of the statutory language and the resulting definition. So this graphic here tries to provide a summary of HVAC products or key HVAC products that contain a furnace fan, include a furnace fan, according to this definition. I don’t know how easy that is for everyone to see, but essentially the HVAC system here is simply applied to indoor and outdoor units. And the boxes in red indicate the components of HVAC systems that contain a furnace fan according to that definition.

On the left you can see a lone outdoor unit, it says weatherized and packaged unit. That’s essentially an entire HVAC system in itself. And to the right, leading out from the condensing unit – can you read this graphic? Each path represents a unique system. So for instance, a condensing unit can be paired with a coil only unit, and then a coil only unit can be paired with an electric furnace and modular blower. So that particular path would represent one variation of an HVAC system, and so forth.

As I mentioned, DOE realizes that a significant number of HVAC products contain a furnace fan according to that definition. The provisional scope of coverage includes furnace fans that are integrated in 63 percent of furnaces, air conditioners, and air handling units that include furnace fans.

In this pie chart here, provides a market share according to the same products that were shown in the previous graphic by shipments. The products to the left that are in black are those that are excluded, are not considered in this rulemaking, and those include single package central air conditioners and heat pumps, as well as split central air conditioners and heat pump or coil units. The remainder of the – yes.

MR. BROOKMAN: Let’s – Diane first. Go ahead.

MS. JAKOBS: Okay. Would you mind just going back a slide? So when you talk about coil only unit, I was trying – are you referring to like coil only ratings that we do?

MR. JASINSKI: Here this is just a representation of the product. So that would be the coil only component of a larger HVAC system.

MS. JAKOBS: Well, what’s a coil only unit?

MR. JASINSKI: That’s the – what you’re referring to, that would be something – it’s not the coil only rating, it’s a coil that would be paired with a furnace, or with a modular blower. It’s essentially just the – it’s a coil that would be paired with a condensing unit.

MS. JAKOBS: Oh, okay. So you're talking about the coil only, so the homeowner buys it as a component and then it's matched with –

MR. JASINSKI: Yes.

MS. JAKOBS: Okay. Thank you.

MR. JASINSKI: Anybody else?

MR. BROOKMAN: Dave and then Abigail.

MR. WINNINGHAM: Yes, it appears as if you have a conflict in between your information. You show the indoor unit as a blower coil unit being covered in this slide. In the next slide, you show it not. And then in the introduction, 1.2 Excluded products, it specifically calls that, you know, "Excluded products, other products that incorporate furnace fans such as central air conditioning, CAC floor coil units.

MR. JASINSKI: So it might be a little bit easier if these graphics were on the same slide, but the intent here is to show that DOE's broad interpretation of the language would mean that – for this slide, the red only means that it would meet that definition. So according to the definition the blower coil only unit – I'm sorry, the blower coil unit contains a furnace fan according to that definition. However, for the preliminary scope of coverage of this rulemaking, that's being excluded. So it is a furnace fan, but it's not being considered in this rulemaking.

MR. WINNINGHAM: Okay. Thank you.

MR. BROOKMAN: Okay. Abigail.

MS. DAKEN: That was in fact my question. So I'm going to follow up with another one instead, which is, I assume you're going to get into why you are not considering these later on in the presentation?

MR. JASINSKI: Yes – well, I'm not sure that it's explicitly stated in the presentation. We provide details about the scope of coverage in chapter two as well as chapter three of the TSD.

MR. BROOKMAN: Joanna.

MS. MAUER: Joanna Mauer. So we recognize that fan energy is captured to some extent in the test procedures for central air conditioners and heat pumps. Our concern is that the external static pressures that are assumed in the test procedures for central AC and heat pumps are unrealistically low, point one to point two. DOE's analysis of field data for the furnace fan test procedure rulemaking has shown that external static pressures in the field are more like point seven – sorry, point five to point seven, in that range. So clearly there's a significant difference. And we're concerned that the central AC and heat pump test procedures don't accurately reflect fan energy consumption in the field, and this can also result in air handlers not being able to provide sufficient air flow in the field, which can affect both comfort and heating and cooling efficiency.

Now, we've heard from manufacturers that changing the external static pressure values in the central AC and heat pump test procedures would represent a significant burden because they'd have to re-rate all of their products. And we understand that concern, and we think a way around this is to include furnace fans that are part of blower coil and single package central AC and heat pump products in the furnace fan rulemaking. And the SEER and HSPF ratings could be left alone.

MR. BROOKMAN: Thank you. Charlie Stephens.

MR. STEPHENS: Charlie Stephens. We have some additional concern that these products that are indoor units for AC and heat pump systems are also sold separately. I know, I've installed or overseen the installation of a number of them myself, so I know it happens. And I also am someone who specifies these things and I have to specify them typically by model number, or several model numbers because there's no other metric to use for these things when they are sold separately as part of – when they're not part of a split system. I can't specify them by HSPF or SEER, you know, I'm only specifying an air handler. So it gets a little difficult at times to tell a contractor who doesn't sell this brand but sells somebody else's brand, exactly what it is you're specifying because there is no metric for these things. There is no rating for these things, and some contractors, quite frankly, don't understand the importance of what the specification is.

So these things are sold fairly commonly as air handlers for houses out where I live, and I think they need – we're very concerned that they need some sort of a separate rating, regardless of the fact that they are often found as an indoor unit in a split system. So we would like to see the Department include those in some way. We would also like to have them included in a way that isn't overly burdensome to test in addition to the other testing, so some consistencies would be nice. But in the meantime, we feel strongly that they should be included in this rulemaking.

MR. BROOKMAN: Other comments here before –

Diane.

MS. JAKOBS: I'm not sure I followed which thing Charlie was talking about.

MR. BROOKMAN: Diane, you've got to get close to that microphone, please.

MS. JAKOBS: I'm sorry. I didn't know which thing –

MR. STEPHENS: (off mic) The box that has black – not considered in this rulemaking.

MS. JAKOBS: So an air handler that would be matched with that heat pump. Okay.

MR. BROOKMAN: Okay. Terry Small has his hand up. Terry, speak, please.

MR. SMALL: Yes, Terry Small with Mortex. Sam, I'm wondering, are you excluding, for instance, these type products that would be used in multifamily, perhaps considered commercial fan coils? They may have, particularly in the hydronic, you know, they may have a hot water source that's a boiler or a big hot water heater, may have a chiller attached. Is all of that type product excluded from this?

MR. JASINSKI: The scope of coverage of this rulemaking is limited to residential products, so this was an issue that was brought up during the test procedure public meeting also. We're asking for manufacturers, especially of hydronic air handlers because they're somewhat of an emerging product, to provide information about how they are used, so that we can consider factors like when they're used in multifamily homes, to be sure that we keep the scope of coverage limited to residential products.

MR. SMALL: Well, you know that it's been traditional that fan coils or ceiling mount units or wall mount units have been used in the larger multifamily apartment buildings, et cetera. So I think you need to be pretty specific. Of course, I guess you're asking for comments, but I mean there's a gray area here that is not well laid out in the way you described it here.

MR. BROOKMAN: Okay. Thank you. Final comments before we move on? Okay.

MR. JASINSKI: So, with that identified in the scope of coverage, DOE has identified nine key product classes that represent most of the energy use associated with furnace fans considered in this analysis, because they are associated with the products that have the highest number of shipments. And because these are pretty important, I will go through the labor of reading through each one of those.

MR. BROOKMAN: Sam?

MR. JASINSKI: Yes.

MR. BROOKMAN: Hold on a second, if you would please. Jim Vershaw has his hand up. Jim, does your comment relate to the previous slides?

MR. VERSHAW: Yes.

MR. BROOKMAN: Speak up.

MR. VERSHAW: This discussion about whether or not fan coil units and other things should be included in the standard points out the issue when you try to put standards around components of systems. The gentleman who was concerned about an air handler for special installations not having ratings, which really should be a system rating. This is going to create over and over and over, issues on how to regulate components of systems when we ought to look at the system level performance of these things. In particular with heat pumps and air conditioners in which blower coils are always part of the performance and the standard set at the certain external static pressure, we do that. If you start putting another standard on top of that – a consumer who only buys an air conditioning system or heater once or twice in his lifetime, will be totally confused as to what's going on and it will all be lost – all this effort will be lost on the consumer. It's important that we start thinking about this in terms of systems. Thank you.

MR. BROOKMAN: Thanks, Jim. Okay.

MR. VERSHAW: Oh, and one more thing. The gentleman who's speaking right now – his voice is fading in and out and I'm having a hard time picking up everything he's saying.

MR. BROOKMAN: Thanks – we're working on it. We're having trouble with the audio today. We're going to ask him to speak loudly. So thanks for flagging that. Back to Sam.

MR. JASINSKI: Thank you. I'll pick up where I left off. I want to read through the nine key product classes.

1. Non-weatherized, non-condensing gas furnace fans
2. Non-weatherized, condensing gas furnace fans
3. Weatherized gas furnace fans
4. Non-weatherized oil, non-condensing furnace fans
5. Non-weatherized electric furnace and modular boiler fans
6. Heating and cooling hydronic air handler fans
7. Manufactured home non-weatherized gas non-condensing furnace fans
8. Manufactured home non-weatherized gas condensing furnace fans

9. And lastly, manufactured home electric furnaces and modular boiler fans.

Important to note here is that DOE differentiated these product classes by application and internal structure that impacted air flow and furnace fan performance.

DOE also identified 12 additional product classes that represent significantly fewer shipments and significantly less energy use for the preliminary analysis. DOE grouped each non-key product class with a key product class to which it is closely related in internal structure and fan performance related – I'm sorry, application and fan performance related internal structure, which as I mentioned, are the primary criteria for differentiating between the key product classes.

I'm going to toggle between the next slide and back to this one because I think it will provide a snapshot of what I mean here.

As I mentioned, here are the groupings. You can see on the left, the column on the left is the key product classes for this rulemaking, and then to the right you can see the proposed additional product classes that I'm speaking about that have the fewer shipments and significantly less – contribute – I'm sorry, significantly less energy use than the primary product classes, and this shows the groupings. I won't read through the 12 additional product classes, but that just provides a graphic for what I mean as to the method that is being used.

DOE assigned the baseline FER or IFER and analysis results of each key product class to the non-key product classes with which it is grouped. And if DOE continues with this approach in the NOPR, it would result in proposed efficiency levels for each additional product class that is equivalent to the proposed efficiency level with the key product class with which it is paired.

So as an example, I'll use the top one, if DOE continues with this approach, the baseline and analysis results for weatherized gas furnace fans would be assigned to weatherized non-condensing oil furnace fans, and the result would be that in the Notice of Proposed Rulemaking whatever efficiency level trials standard level was proposed for the weatherized gas furnace fan would also be proposed for weatherized, non-condensing oil furnace fans.

Anybody has any questions?

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, Edison

Electric Institute. So is this another situation where the products on the left are being used as a proxy – the results are going to be proxy for the products on the right side of the table?

MR. JASINSKI: Yes.

MR. ROSENSTOCK: So, eventually, from the previous slide there's nine product classes, and then with this there might be 21 product classes with the final rule. Is that –

MR. JASINSKI: Yes.

MR. ROSENSTOCK: Okay. Just to give –

MR. JASINSKI: Yes, and a clarification – there's only three key product classes shown here because all the 12 additional product classes are grouped with them. The six remaining key product classes don't have any additional product classes.

MR. BROOKMAN: So if would be nine plus three?

MR. JASINSKI: No, it would be the nine plus the 12 that are shown here, so 21.

MR. BROOKMAN: Okay. Joanna.

MS. MAUER: Joanna Mauer. I just want to make sure I understand. Are you saying that the same FER values would be used for the other product classes? The same values?

MR. JASINSKI: Yes.

MS. MAUER: So I guess what's the benefit of having the separate product classes as opposed to combining them into one?

MR. JASINSKI: Well, as I'll get to in the next slide, this is an issue that DOE is requesting comment on. Essentially because the products that make up the additional product classes have so few shipments, there's not a lot of data readily available to perform a detailed analysis to the level that is possible for the key product classes. So a little early, I'll ask that manufacturers and other interested parties provide comment on, and data, about shipments, the prevalence and also performance-related data for the 12 additional product classes.

MR. BROOKMAN: Diane. Close. Get that microphone close.

MS. JAKOBS: Close, okay. Just from your own FER values, it seems like the manufactured homes units, they were much lower, and we don't build those, but I don't know if there's something special about those where they should be a key product class.

MR. JASINSKI: A major factor for the difference is that in the proposed test procedure, DOE is proposing to use a reference system external static pressure of three-tenths inches water column for manufactured home products, whereas for the non-manufactured home products, the proposed reference system external static pressure is – are on the order of half an inch water column, and point six five inches water column.

MS. JAKOBS: So it was point six five, so if you have a manufactured home furnace that doesn’t come with a coil, wouldn’t that have the point six five then too?

MR. JASINSKI: No, that would – that would have a point three inches water column. Any manufactured home product class would use that reference system external static pressure.

MS. JAKOBS: Okay. I’ll have to look at that. We talked about that in our meeting, and nobody was real forthcoming from the manufactured home group.

MR. JASINSKI: Comments are always welcome.

MS. JAKOBS: Okay. And I’ll just have to look into that, I don’t –

MR. BROOKMAN: Tom Eckman.

MR. ECKMAN: I think one of the – as I understand it, one of the reasons is because the manufactured homes don’t have return ductwork at all, basically, a single return pickup in the – near the furnace, so there's no – there's a supply side, but there's no return side ductwork.

MR. BROOKMAN: Thanks, Tom. Steve Rosenstock.

MR. ROSENSTOCK: Again, Steve Rosenstock, EEI. This is kind of a – for that first category, is a weatherized gas furnace fan for single family home, non-manufactured home, is going to be used – is a proxy for the manufactured home even though they have significantly different external static pressures?

MR. JASINSKI: Yes. Well, yeah. In this case one approach that DOE could take is that it would use the same raw data from the weatherized gas furnace fan and potentially use a different reference system external static pressure, so in that case one potential approach could be to assign a different baseline and different analyses result based on the lower external static pressure. But this is – these are the type of comment that DOE is asking for, really comments on what is the appropriate approach for handling the additional product classes in the absence of the amount of detailed data that's available for the key product classes?

MR. BROOKMAN: Terry Smith, you're next. Pardon me, Terry Small. I apologize. Terry.

MR. SMALL: This is Terry Small with Mortex. I guess I'm a little confused. So on your baseline FER values, they were in the executive summary, there are nine product classes. Really that should have been 21 values including the additional product classes? If they all have different baselines? I'm confused.

MR. JASINSKI: So the approach that's being presented here is that the baselines that are assigned to the key product classes, you would assign those to the additional product classes with which it's grouped. So essentially, anywhere you see a value for weatherized gas furnace fan, you would just duplicate that value for the additional product classes that are grouped with weatherized furnace fans. So if you expanded that table, there would be 21 values, but for each additional product class it would just be a duplication of whatever the value of the key product class for which it's grouped. Does that answer –

MR. SMALL: Well just to comment. I think that the – certainly on some of these product classes, particularly the hydronic and all that, you're going to have some huge variations once you get into the additional product classes. So I don't think you're going to find that one size is going to fit all, but that's just my opinion, thank you.

MR. BROOKMAN: Terry, those kinds of comments in detail will benefit the Department when you sent them in.

MR. JASINSKI: Yeah, to add to what Doug is saying – sorry.

MR. SMALL: And Doug, what's interesting about is unfortunately – you know, we're a small manufacturer. We just don't have the resources. I mean I wish I had all of our product – I wish that there was a final test procedure then we could test our products in about a year's time we could tell you where we thought we were. I mean, we're completely flying in the dark on this. We're not certain about the test procedure, and just to figure out where we are on all these different products is going to require quite a bit of testing.

MR. BROOKMAN: Thanks, Terry.

MR. SMALL: It's almost as if we're getting the carts in front of the horse pretty substantially on this, and I would really – I would really caution that we show down on this before we start setting values, but that's my opinion, thank you.

MR. BROOKMAN: Thank you. Detlef.

MR. WESTPHALEN: Detlef Westphalen,

Navigant. I think one of the things with these 12 additional product classes is that we're not sure all of them exist. For instance, the manufactured home weatherized gas furnaces, and, you know, this is a framework, a structure with which to say okay, suppose significant quantities of these are sold. This is a proposed place to put them within the analysis structure. And so, you know, we're presenting this and requesting comment and also information on, you know, are these important product classes and what kind of sales levels are associated with them and what kind of characteristics do they have that would allow us to determine, are these the appropriate alignments.

MR. BROOKMAN: Okay. Thank you.

MR. JASINSKI: Yes, to add to what Detlef said, in addition to comments on whether these products exist, and if they do what the level of shipments are, Terry Small mentioned that there are factors that would create discrepancies with the key product classes with which they're paired. If in your comments you could detail what those are, that could provide information for DOE to modify the framework and could address those discrepancies.

MR. BROOKMAN: Final comments on these – actually I guess there are a couple of slides as they talk about these groupings. Okay.

MR. JASINSKI: So as I said, this is just a callout box with the questions that we've been discussing. DOE is interested in comments here and written comments on the methodology for differentiating the product classes that I mentioned, by application, and internal structure. And DOE also seeks comment and data regarding the market for the 12 additional product classes and their expected energy performance, specifically historical and future shipment data and energy performance data that would be useful to estimate FER or IFER for those product classes.

MR. BROOKMAN: We have another comment from Terry Small. Go ahead, Terry.

MR. SMALL: Yes, I'd just like to add one other thing. What is really interesting about this fantastic HVAC industry and market we have is that the industry has evolved such that it meets the needs of the consumer, particularly in indoor situations. No two houses are the same, and the application of HVAC to houses and apartments varies a lot so you have a lot of different products, a lot of different heat loads or cooling loads to meet. And I would be very worried that if you set too low of a bar for the product class -- the overall nine product classes, you may wide that inadvertently some of these additional product classes that wouldn't meet the value, to serve a particular application in people's homes or apartments here in the US. It's much easier to prescribe what is happening with an outdoor unit which sits outside the house or apartment, than it is what has to be fit into – and a lot of this could be replacement also remember, so there's not very much new construction going on. Most of this is really, for the foreseeable future, going back in and replacing existing equipment. It could be a real problem. So I would recommend that you carefully look at these additional product classes and take into account, maybe the uniqueness of their design, and, you know, just the application. Thank you.

MR. BROOKMAN: Thank you. We're moving on, Sam.

MR. JASINSKI: Another important aspect of the market assessment, as I said, is to identify manufacturers and their market share. Here DOE found that the top seven gas furnace manufacturers represent 99 percent of the gas furnace market. And the pie chart on the left shows that market distribution by shipments – market share distribution by shipments.

In addition, ten oil furnace manufacturers represent – the top ten oil furnace manufacturers represent over 90 percent of the market and here's a table here that shows on the left, the manufacturers that have an estimated – at least an estimated market share of ten percent, and on the right, the remaining oil furnace manufacturers that are estimated to have a less than ten percent market share.

And just to note for related products and also products like modular blowers that are often part of the discussion for CAC and heat pump issues, the market share distribution is very similar to the gas furnace market share distribution. The manufacturers are the same and the percentages vary by only a few points.

MR. BROOKMAN: Craig.

MR. MESSMER: Yeah, looking at that pie chart, I didn't see any -- this is Craig Messmer – I didn't see any analysis in the technical support document for small companies. Is that in there?

MR. JASINSKI: There's no analysis yet. The analysis that would relate to small businesses would be something that would occur in the NOPR stage of the manufacturing impact analysis. So at this stage, in the preliminary analysis, DOE is just striving to identify small business manufacturers, so that during the NOPR phase those small business manufacturers can be included in that manufacturing impact analysis.

MR. MESSMER: So that will be included in the cost benefit analysis, then?

MR. JASINSKI: Yes, so I guess it's important to raise another request that if you are a small business manufacturer and you're not included in that list that's included in the preliminary technical support document, please let DOE know so that you can be included in those downstream analyses.

MR. MESSMER: Thank you.

MR. JASINSKI: The second part of the market and technology assessment is the technology assessment, and the important outcome of the technology assessment is identification of technologies that manufacturers can use to improve the efficiency of furnace fans in their products. Here is a table that shows the technology options that DOE identified.

- The first is inverter technology for PSC motors. These are motor controls that can be used to extend the air flow and flexibility of PSC motors. Flexibility here just means the ability to match the demand.

- Second, X13 fan motors. I will say here that DOE is using X13 to – as a generic term for constant torque permanent magnet motors, and these motors are – well, we realize that X13 may be the name of a specific model by a specific manufacturer, but they're often discussed in the industry and referred to as X13, so that's the same – we're continuing that convention here. And these are more efficient than PSC motors because they have typically – they're more – they operate more efficiently and they also have an extended air flow range.
- ECM fan motors, again here, ECM is also trademarked, I believe. Here DOE is using this as a generic term for constant air flow permanent magnet motors. And these adds the energy benefits of X13 motors because they operate more efficiently and again, extend the air flow range available.
- Next, backward inclined impellors. These are impellors with backward facing inclined blades that can be more efficient than the standard or forward curved impellers.

- Next, toroidal (ph) transformer. And here I noted that these are only for the standby and off mode product classes, or the product classes for which standby and off mode are being considered in this rulemaking. Toroidal (ph) transformer has an annular – well, I won't read these in detail, but essentially their construction makes them more efficient than the conventional laminated core power transformers that are standard in products.
- Next, switching mode power supplies, similar to toroidal (ph) transformers for the standby and off mode product classes, and these are more efficient than the solid state power supplies – I'm sorry, these are solid state power supplies that are more efficient than the conventional transformer-based power supplies.
- Next, fan housing design modifications. Optimizing the shape of the fan housing has the potential to increase furnace fan efficiency.
- Next, air flow path design. Modifying the HVAC product envelope and elements in the air flow path, such as the heat exchanger, to reduce external static pressure also has the potential

to improve efficiency of furnace fans.

- And lastly, ECM control relay. Again, also particular to standby and off mode product classes. This is the use of a control relay on an ECM to disconnect it when it's not needed to eliminate the standby power that's associated with the controls of the ECM motor.

Any questions before I move on?

MR. BROOKMAN: Brian, please.

MR. JAMES: Brian James, Southern California Edison, on behalf of the California IRUs. Backward inclined impellers isn't necessarily a straightforward energy efficiency improvement. It is more efficient over a narrow range, but outside of that range it can actually be less efficient, as well as noisier in residential applications. So, that should be taken into consideration that it's efficient only over a narrow range.

MR. BROOKMAN: Thank you. And this is the kind of comment the Department would wish to elicit in this spot, I believe, that is, comments on these and others that may be missed. Charlie Stephens.

MR. STEPHENS: Charlie Stephens. I've been wondering since we started here where to address this, and I guess this is as good a place as any, so pardon me if I go backwards, but this touches on everything. I've been confused ever since I started reading the technical support document here, about whether we're regulating fans or air handlers. And what I see here in the beginning, in the introduction is that, you know, a fan is a component of an HVAC product, and I presume that most of those HVAC products that we're talking about are air handlers. Now that definition is entirely consistent with the list that I'm looking at here on the slide in terms of what design options you're looking at. They pertain to the definition that DOE put forward of that being an electric motor and an impeller and a housing and a control, period. Not the cabinet, not the air flow path, nothing else. I mean there's no other option I see here that relates to an air handler. These all relate, literally, to the fan.

And I can't help but go back and think of an analogy here where DOE right now, for instance, is considering regulating pumps, which are in an electrically powered device for moving water through pipes. Not all altogether different from this, different fluid. And DOE – I mean the proposal I see if you insist on the definition of fan that you have today, regulating – would you regulate pumps as a component of a residential or commercial appliance product, clothes washers? Are you going to regulate pumps by regulating the manufacturers of clothes washers? So if you insist on this thing being only about fans, I’m not sure I understand even the regulation proposals for hydronic air handlers. I mean if you get into that, there’s lots of things you could do to those to make them more efficient in terms of moving the air through them, but they have a fan. Hydronic air handlers have a fan in them like the others, but you seem to ambivalent about what you’re regulating here. And I think if you really are regulating air handlers, then this list is woefully short.

And, if on the other hand, you’re actually regulating fans, well, this is the right list. But I think the Department first and foremost needs to decide whether it’s regulating fans or air handlers. And if it’s air handlers in the end because you’re regulating the manufacturers of air handlers, then this list is not adequate, and we’ll add to it as we go through in our comments. But I think – I’ve been confused all the way through this document because people seem to be using this term fan and air handler interchangeably. And based on your own definitions here, they're not interchangeable.

MR. BROOKMAN: Thanks, Charlie. Yes, Abigail.

MS. DAKEN: To follow on a little bit on Charlie's comment. I'm wondering about the air flow path design, if you're regulating the fan itself and not the air handler, whether that's appropriate to regulating the fan.

The other comment I would make is that I'm sort of listening to people talking about improving the efficiency of the fan, and whether that is done at the cost of the efficiency of the entire system. I'd like to understand that better, but I wonder whether the difference that Charlie is referring to, between regulating air handlers and regulating fans, might help explain it.

MR. BROOKMAN: Greg. Thanks for getting that close.

MR. WAGNER: I'll try. Greg Wagner. To give a little example on the efficiency of components versus systems, with the advent of 13 SEER, 14 SEER regulations, coils have grown in size to take up more space in the heating volume, if you will, inside any residence, and so it's reduced the size that's available to furnaces, and as such, furnaces have shrunk in size since the advent of the 13 SEER regulation. That leaves less room for blowers and they're less efficient when they're smaller in size. So there are systems that have to be designed to meet the performance for the other regulations, and those drive what happens in terms of design options available to people that are putting together the furnace, the air handler systems.

MR. BROOKMAN: Okay. Yes, Diane.

MS. JAKOBS: There's also – it's just physics, but if you have higher velocity air you improve the heat transfer between the gas heat exchanger or the – any heat exchanger. So we can get a higher AFUE by increasing the air flow, which will burn more watts. So that's kind of a – one goes up and one goes down.

MR. BROOKMAN: Thank you. Yes, Dave.

MR. WINNINGHAM: Yes, this is Dave from Allied. Just to kind of add to Diane's, for our gas furnace, 80 percent versus a 90 percent furnace. The majority of the power consumption is on the gas side, but the heat exchanger for an 80 percent, for instance, typically less restrictive than a 90 percent, to extract more efficiency, you put a secondary coil which is going to typically either require more power in the blower system, so this additional metric could drive some unintended consequences as part of that.

MR. BROOKMAN: Okay. Thank you. Yes, please, Greg.

MR. WAGNER: I was just going to echo that that secondary heat exchanger is another one where it is energy consumed to pull out, extract, more energy and the cost difference between those, since you're doing 98 percent in the gas part of it versus two percent in the electrical consumption, you want to get the most benefit from the gas part of it from an energy efficiency standpoint. So those are some things to answer your questions of the beginning, Mohammed, so that's why system effects are the important part that we need to look at, not just components.

MR. BROOKMAN: Diane – follow on?

MS. JAKOBS: Okay. There is just one thing from your TSD that I learned, and I was aware of it in Rheem's furnaces, but I thought I was a special case, but it looks like the – actually the condensing furnaces had lower FER values, or lower E-sub-AE values than the non-condensing, which was the inverse of what I thought. But maybe because we all use, or almost all of us use these two … coils, and to go back to Harvey's air straighterners, maybe we're helping them and so we have this space in there for the secondary coil. I don't know it was just an unusual thing that I notice from your data. It is motor differences? I don't know. It was weird.

MR. JASINSKI: (comment off mic)

MS. JAKOBS: I think -- I know I've stated that but your data doesn't reflect that. The 80-plus has lower electrical consumption.

MR. BROOKMAN: Do you have any follow on or should we move on?

MR. JASINSKI: We can move on. When we present the table based on value, we can explore that.

MR. BROOKMAN: Okay.

MR. JASINSKI: Because that'll – it'll make it easier for everyone to see what she's referring to.

MR. BROOKMAN: Yes, please.

MR. LIN: Paul Lin from Regal Beloit. This table, and I thought in the analysis you had a higher efficiency PSC in the analysis, but I don't see that on your table here.

MR. JASINSKI: In the engineering analysis when we get to it, there is an efficiency level that's associated with an improved PSC, and an improved PSC in this sense just means a PSC motor that has – the baseline is described as a furnace fan that relies on a PSC motor that has three or fewer air flow control settings, improved – there are – an improved PSC in this analysis just refers to those that have more – a larger number of air control settings which contributes to a wider range of air flow and also flexibility.

MR. BROOKMAN: We have another individual who wants to – who's raised his hand. Jim Vershaw, you're next.

MR. VERSHAW: Hi, this is Jim Vershaw. I'm with Ingersoll Rand Trane. A few comments. At first I agree on the backward inclined impeller comment. If those were usable in the conventional furnaces, obviously they would have been used a long time ago. They are very loud and very tight tolerance, and they're difficult to manufacture and they have a very limited area where you can actually use them with good efficiency.

Second comment has to do with improving the efficiency of fan systems on furnaces, remember that in the heating mode all of the heat goes into the motor, either goes into moving the air or goes into the air stream, so as you take that efficiency of that motor up, you're going to have to put more gas into the furnace to maintain the house load. So there is an effect on how much gas will be used versus how much electricity is going to be used.

The other issue is as you look at higher statics, remember the PSC motor will unload and actually use less energy at high statics, whereas the ECM, the … DC motor will use more energy at the high statics. So as we start looking at different static points for measurement for fan versus for systems, that's going to be very confusing as to what the system is really doing, and then the consumer will be unable to determine how to choose – how to utilize that information. Thanks.

MR. BROOKMAN: Okay. Thank you. We're going to keep pressing on here.

MR. JASINSKI: After technology options are identified, DOE conducts a screening analysis, and the screening analysis is to evaluate the technology options according to the following criteria:

- technological feasibility,
- practicability to manufacture, install, service
- impacts on utility or product availability

- and lastly, impacts on health or safety.

The technology options that don’t meet these criteria are screened out or not considered in the downstream analyses.

DOE screened out three technology options. This table summarizes those technology options and the reasons they were screened out. First, housing design modifications. In this case DOE is requesting more data. DOE did not find any quantified data that quantified energy savings associated with specific design modifications to the housing. So if interested parties have that available, if they could provide that, DOE would really appreciate it.

Secondly, the air flow path design technology option, and this speaks to a lot of the discussion that was happening earlier. DOE is constantly considering the trade off between system efficiency and component efficiency because of the unique nature of this rulemaking. So in terms of how definitions are set, how product classes are differentiated, DOE is attempting to not neglect the fact that there are system impacts to the decisions that are made with regard to the framework and methodologies that we are using. So this particular case, air flow path design was identified as a technology option because DOE recognizes that there is an impact on the fan efficiency related to the air flow path design. Similar to the test procedure, the fan being tested as it is factory installed in the HVAC product for similar reasons. But in this case, the air flow path design technology option was screened out because DOE understands that there are impacts on thermal performance. However, on quantifying them and understanding the tradeoffs is something that DOE requires more information for, and because of the impacts and a lot of the examples that were provided by manufacturers here, there is a chance that if overall system efficiency is impacted, that product utility could be impacted. And as I stated earlier, one of the screening analysis criteria is product utility. So for those reasons, the air flow path design was preliminary screened out for this analysis.

Lastly, ECM control relay. This is the standby and off mode technology option where relay would be used to eliminate the standby power consumption of ECM motors when they're not being used. Again, this impacts product utilities, specifically reliability, because the control - if

ECM motor controls are turned off and on repeatedly, DOE has received comments that that could shorten the life of the motor which has an impact on product utility.

So after the screening analysis, DOE retained six technology options for the following engineering analysis. For more information about the screening analysis, you can refer to Chapter 4 of the TSD.

MR. BROOKMAN: Let’s just pause there. Comments on these technology options which the Department is suggesting in a preliminary way might be screened out. Adam.

MR. CHRISTIANSEN: So just with regard to the fan housing design modification, I believe – I’d have to go back to my computer, but I believe there was a study done in early 2007 –

MR. BROOKMAN: Louder, Adam.

MR. CHRISTIANSEN: Sorry. I believe there was a study done early 2000’s by GE that they looked at things like inlet cone of the fan housing, some curved sections, you know, improving the outlet dimensions of the fan, and they actually quantified some of those energy savings in that report. Those are things that don’t necessarily take up a whole lot of space within an air handler, and I think DOE should – I'll forward along the document to the appropriate person if you don't know what I'm talking about, but I think it's something that should be looked at.

MR. BROOKMAN: Craig Messmer and then to Diane.

MR. MESSMER: Craig Messmer. Can you explain what you meant by air flow path design? Is it just the fan scroll housing? Is it the inlet conditions or the discharge?

MR. JASINSKI: (off mic)

MR. BROOKMAN: Sam, sorry, your microphone is not working.

MR. JASINSKI: Sounds like it's on now, sorry. Yes, the air flow path technology options here refers to the envelope –

PARTICIPANT: It's off again, sorry.

MR. BROOKMAN: Use this one.

MR. JASINSKI: Thanks. Does that answer your question?

MR. MESSMER: Yes, and to follow up on that. What is the baseline air flow path design? I think you're going to find that products from different manufacturers have different air flow path designs, and you're going to have a widely different FER for different manufacturers. And if we don't establish what the baseline is, so how do we know what the improvements are going to be in the future, or even if the FER baseline is valid.

MR. JASINSKI: Yeah, in this particular case, DOE did not assign a baseline value because it was screened out, meaning because the air flow path design technology option was not considered in the engineering analysis.

MR. MESSMER: I guess what I'm saying is that it should be.

MR. JASINSKI: Okay.

MR. BROOKMAN: It should be screened out.

MR. MESSMER: No. It should be considered.

MR. BROOKMAN: It should be considered. Thank you. That's clarification. Diane. Please.

MS. JAKOBS: I wanted to go back to your comment about –

MR. BROOKMAN: To Adam's comment. Yes.

MS. JAKOBS: -- the paper about – we've looked at that paper too and at ASHRAE just last month, I was talking to some of Greg's engineers about whether what's important is that we're getting close to the wheel in that study, or they're giving more space between the sides of the housing and the wall of the jacket. Because one of the things, because we have all these components, they all have to fit together and mix and match. We have fixed widths, so we're trying to get a lot of air flow. We're trying to use the space we have, and I know our old Rheem air handler design had really tight – the sides of the housing were tight to the wheel, and we felt like that improved our air flow. It was very difficult manufacturing and we're always fighting about – because in manufacturing they had trouble getting the wheel into the housing and people on the line would pry it apart and then it would be out of alignment.

But Craig's engineers there told me that it was really that we had more room between the side of the jacket and the housing, it wasn't – so all these things all work together, the air is everywhere and it's hard to distinguish exactly what – you know, you change one thing and you might be changing something else without realizing it.

MR. JASINSKI: So are you suggesting that air flow path design should be screened out or should be retained or what?

MS. JAKOBS: Well, as a manufacturer if I was starting from scratch and I could redesign my air handler furnace, I would work on air flow path design, because that doesn't cost me anything.

MR. BROOKMAN: Charlie, I see Dave's not in his …, Dave do you want to jump in here?

MR. WINNINGHAM: Yes, I would encourage that the path design needs to be included. There are various configurations and designs of blowers, the development angle, the tolerances, the type of wheel, the angle of the blades into the wheel, the internal restrictions – all of these things are – can be critical and can have a significant difference on the performance. You know, we're all trying to squeeze it into the smallest possible envelope, but there needs to be a consideration for the design path, or the air path because that can be a much more cost-effective option to improve efficiency, rather than adding, you know, premium components.

MR. BROOKMAN: Okay. Thank you. Charlie Stephens.

MR. STEPHENS: Charlie Stephens. I would concur with all of the comments that have gone before me here, and the Department seems to, in screening this out – I mean assuming we're – the subject of this rulemaking is actually air handlers. Air flow path design, based on my own experience in the field, can often improve thermal performance when the air flow path is improved, and can improve the product utility, but the Department seems to have assumed that it's negative, or that because it's potentially negative that it should be screened out. I strongly disagree with that, based – I'm not going to name the products that I have worked with, but believe me some of them could have improved everything with a better air flow path. And I think it is a way to achieve efficiency relatively cost-effectively.

MR. BROOKMAN: Several people are in the queue. We're going to go in this order as efficiently and concisely as possible. Greg. And then Abigail, and then Steve, and then Adam, briefly.

MR. WAGNER: Okay. Greg Wagner. All these – certainly the first two options, the fan housing design and the air path design are significant players in the performance and efficiency of these products that we're looking to cover here, and you can see in the E-sub-AE and the other numbers you've been using that there's a broad distribution of electrical consumption, and it's a function of those different designs. And the question of how do you get a baseline, which I think this is targeting to where you start a baseline and then what is the max technology piece, may be difficult to find because of those parameters that are outside the scope of what this is, which is a function of heat exchangers and other things inside this unit. So I understand why it's screened out, but to the point of everybody making these comments, those things do affect the air flow efficiency.

MR. BROOKMAN: Abigail.

MS. DAKEN: So I heard somebody say that the fan is testing in situ in the HVAC product in which its intended, and what I'm hearing the manufacturers say is that as long as that is the case, they will in fact be modifying the air flow design to try to achieve higher efficiency. And so it seems strange not to take it into account in the analysis, though obviously, it's going to be complicated.

MR. BROOKMAN: Thank you. Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, I guess I was a little – when I saw that in the document, I was a little confused about it in terms of are you talking about the air flow path that's really controlled by the manufacturer, the air flow path that's really a function of the house, the duct work that's in the house, the existing house, or the new house in terms of how you can modify that path to make the fan system more efficient, I guess. Or are you just talking about the air flow path just within the fan housing unit, and that’s it? Because it seemed like you’re saying product envelope. I thought you were talking a little bit almost about the duct work where the fan is being placed, or am I misinterpreting? Again, --

MR. JASINSKI: The scope does not include the duct work of the house.

MR. ROSENSTOCK: Specifically just talking about within the fan unit, regardless of where –

MR. JASINSKI: Right. Yes, the HVAC product itself.

MR. ROSENSTOCK: Okay. That threw me off a little bit, thank you very much.

MR. BROOKMAN: Adam, thank you for being patient.

MR. CHRISTIANSEN: This is Adam from ASAP. I know I commented on the fan housing before, but I’m encouraged by the conversation here about maybe considering the air flow path design as well, so I would support that as well.

MR. BROOKMAN: Okay. Thank you. We’re moving on to the next slide.

MR. JASINSKI: I would also – I'll just say that to include the air flow path design, DOE would – the type of information that would be very helpful from industry participants and interested parties would be specific, quantified savings related to specific design changes, but also to echo what Mohammed said to open the meeting, is that DOE is also very interested in understanding where the limits of those design modifications are as it relates to impacting the overall system efficiency negatively. So to include a design option for the fan housing design and air flow path design, that's the type of information that DOE's continually looking for and would appreciate from interested parties.

MR. BROOKMAN: Diane. Oh, let's hear from Mohammed. Go ahead, Mohammed.

MR. KHAN: Sorry, Diane, I'll make this very brief. I just want to add on to what Sam just mentioned, looking – we're asking for the data about the improvements that can be made with changing the air flow path design. I would like to see that data also include not only what levels of improvements that you can make with whatever kind of changes, but also include the cost element of it, so, you know, how much – and I heard you earlier, Diane, saying that, I think your words were, it doesn’t cost anything. But there’s always some cost associated with anything. So that was it, thanks.

MR. BROOKMAN: Diane, follow on.

MS. JAKOBS: One of the problems with what you’re asking – you know I certainly want to help you, but like Rheem has one design, Lennox has one design. You know we all have our individual designs, and we certainly have opinions about each others designs, but we don’t spend a lot of time testing each others furnaces. So I don’t know if – I know I was – if we can use the data from the AHRI directory, I don’t know if you can use the E-sub-AE and characterize heat exchangers and try to sort out the data that way, but certainly at the very maximum each individual manufacturer could do is give information about their own equipment, and you would have to analyze it, and you shouldn’t play favorites.

MR. JASINSKI: We would love to do that.

MR. BROOKMAN: Yes, please, Craig.

MR. MESSMER: Craig Messmer, just to follow up with what Diane said and what I was trying to drive at before, there is such a wide variety of air flow path designs in the industry, when you do the baseline, you have to establish what that's going to be and what the air flow path is. You can have the same motor, the same fans, the same everything and the air flow path can make or break you on the FER. So there has to be some discussion on this, at least with the baseline. Otherwise you could pick an FER that only one manufacturer could, in fact, achieve, and that would not be good.

MR. BROOKMAN: This was very useful, this last discussion. Now we're going to the last slide.

MR. JASINSKI: And this is just sort of a summary of the results after the screening analysis. These are the remaining six technology options that were considered in the engineering analysis.

MR. BROOKMAN: So comments on the remaining six? Joanna.

MS. MAUER: Joanna Mauer. Just a question. Can you explain what you mean, the third option, ECM fan motors where it says multi-staging? Can you explain what you mean by the multi-staging?

MR. JASINSKI: Yes. They are used typically with a furnace that also – a furnace or HVAC that has multi-stage heating, and DOE found that in using the FER metric or IFER metric, multi-staging contributes to the efficiency improvements of that ECM fan motor, so it’s sort of a joint technology option that’s used together. So there’s efficiency benefits of the motor technology as I stated earlier, that it operates more efficiently and has a wider air flow range, but also that it’s usually used in multi-stage products, multi-stage heating products.

MR. BROOKMAN: Diane.

MS. JAKOBS: Well, we were just – Greg was asking if we used PSCs and X13s in the multi-stage, and we do. But we did a – we set up data collection equipment with our modulating furnace and to just kind of explain how it works, our modulating furnace goes from 40 percent capacity to 100 percent, and what happened was the furnace would run almost continuously at 40 percent, and the blower is backed off and running at a lower speed, but over a longer period of time. So that’s kind of the trade off that you would address in the test procedure. But if you’re going to imagine it’s running at 40 percent of the speed at a longer time, so it’s not on and off like most people are familiar with.

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, I’ll just say for with the multi-stage effecter, you’re also lowering the fan speed. However, the efficiency metric as proposed is only based on the maximum fan speed, correct?

MR. JASINSKI: No. the efficiency metric has the consumption from each of three rated air flow control settings. So if you look at the top of the equation, you'll see that it's – actually, I'll just go back to the slide so that everybody can see what I'm referring to. So if you look at the equation, the top is a summation of the operating hours times the power consumption in each rated mode. So for FER it would be cooling times the maximum – the power consumption in the maximum air flow control setting. The heating hours would be multiplied by the power consumption in the heating mode, or the heating air flow control setting, and then finally constant circulation.

MR. BROOKMAN: Diane, go ahead.

MS. JAKOBS: And it's actually, for multi-stage, you had us collect the watts at the lowest heating speed, but then there's a ratio and we increase the hours.

MR. JASINSKI: Right. These details are provided in the test procedure NOPR. I don't have a slide that can show that, but what she's referring to is that the trade off that she mentioned earlier is that you may be running the fan at a lower air flow control setting, but the hours are increased to account for that. So each of these variables CH, HH, CCH, those are the hours that DOE is assigning to those modes of operation, those are set values based on analysis that DOE conducted.

So, for instance, CH is set at 640 hours, heating hours is 830 hours, and then constant circulation is 400. But for multi-staging to account for that trade-off, the heating hours of 830 heating hours, for a multi-stage unit, would be divided by what's called the heat capacity ratio, and that's the output – ratio of the output capacity in the lowest heat setting divided by the output capacity in the highest heat setting, usually results in something around point seven, just for reference. And so that would expand the 830 heating hours to, I think it's 1185, I'm not sure.

MR. ROSENSTOCK: Can you adjust the air flow in the denominator as well?

MR. JASINSKI: The air flow in the denominator is the max – only in the maximum, yes.

MR. ROSENSTOCK: But you adjust the hours.

MR. JASINSKI: Yes.

MR. ROSENSTOCK: Thank you.

MR. BROOKMAN: Final comments on this slide? These issues, product classes, technology options are very, very important. We spent a fair amount of time on them. If we need to spend more time on them when we return, we can and might, but now it's time to take a break.

It's now 10:45. Surprisingly, we are tracking the agenda, which is a surprise to me, but let me know – we did have almost an extra half hour in there because we were efficient on the front end, so when we return we'll have to remain efficient to get through the remainder of the day.

Here in the Forrestal Building you must wear this badge visible above your waist. There are restrooms on both ends of the hall. If you're going to go for coffee, on the ground floor, which is directly below us, go quickly if you're going to go get coffee because we will resume at 11 o'clock.

And thanks for a good start. We really gained ground on the content here. This was good.

(Whereupon, at 11:15 a.m., the meeting was recessed for a 22 minute period.)

MR. BROOKMAN: So our apologies to those that were joining us via the web. We somehow got adisconnect going there, and we, for those that are joining us by the web again, we've delayed the meeting so that you could be included, and I'm pleased you're back with us. We are going to resume with Sam and launch into engineering analysis.

Engineering Analysis

MR. JASINSKI: Thanks, Doug. Yes, so I'll move on to the engineering analysis. Here's the "you are here" slide. The purpose of the engineering analysis is to evaluate technologies that reduce furnace fan electrical consumption and characterize the relationship between the cost to the manufacturer of implementing those technologies and the expected energy consumption reduction.

To the left you can see a very stylized representation of the expected relationship between the cost and efficiency. And essentially, the primary outcome of the engineering analysis are a set of cost efficiency curves, one for each key product class in this particular rulemaking that looks somewhat similar to that. And those results feed into our downstream analyses such as the life-cycle cost and payback period analysis, national impacts, and so on which will be discussed in further detail later on in the presentation.

For the engineering analysis, here's a list of some of the central sources of information that were used, publications like Appliance Magazine, the performance directories from AHRI, and if we look as far back as GAMA, manufacturer interviews, product tear-downs, and manufacturing cost modeling, and also product energy testing was also conducted for this rulemaking.

As I mentioned, DOE tests and tears down products. DOE acquired units for testing and tear down to assist in development of the FER and IFER values. This table here just provides a general overview of the types of products that DOE selected for testing and tear down. Twenty-six units were selected, six manufacturers were represented. DOE typically tries to select test and tear down units to span a number of manufacturers and even within - usually tries to select products within the same product line of a single manufacturer. And in this particular case, the selections fell in that air flow capacity range, 800 to 2200 CFM, and that's typically the maximum air flow capacity.

DOE also tries to select products that span the available range of efficiencies, and in this particular case, DOE targeted these technology variations which we've kind of touched on in previous discussions: the motor type, PSC, constant torque, brushless permanent magnet - referred to as X13, constant volume brushless permanent magnet - referred to as ECM. Again, the air flow capacity range. Heat exchanger type - there are a number of different types of heat exchangers, depending on the application. Some examples are clam shell, tubular, drum, hydronic - and those refer a lot to the application, as I mentioned, but also the geometry of the heat exchanger.

DOE also tried to isolate the variation between non-condensing and condensing units. As was discussed earlier and mentioned, there are impacts on fan performance when there is the presence of that secondary condensing heat exchanger. And finally, DOE also tried to investigate different fan housing designs. DOE is aware that there is at least one proprietary design available.

MR. BROOKMAN: Aniruddh.

MR. ROY: Aniruddh. Aniruddh, with an H.

MR. BROOKMAN: Aniruddh.

MR. ROY: Or Roy is fine as well.

MR. BROOKMAN: No, no. I want to get it right.

MR. ROY: Sam, one question I have for you on on this slide is, you know, with respect to the table ES.3.3 and 3.4, you have the backward incline impellor technology in there. Was that also considered under these technology variations?

MR. JASINSKI: So these represents the units that were selected for test and tear down. To DOE's knowledge there is not a commercially available product that includes a backward incline impeller, so information - I'll get into this - but information for design options that are not commercially available in an HVAC product, DOE relied on publications that had detailed data about expected impacts on energy performance and cost, if available.

MR. ROY: Okay. So the 63 percent reduction that is shown in that table is based on that data?

MR. JASINSKI: The ECM -

MR. ROY: For that max tech -

MR. JASINSKI: Yes.

MR. ROY: Okay.

MR. JASINSKI: It's based on test and tear down data as well as data from those reports.

MR. ROY: Okay. Thank you.

MR. JASINSKI: Anyone else? To develop the cost efficiency curves, DOE goes through the following four steps:

- First, DOE defines baseline specifications for each product class;
- Next, DOE identifies design options from the baseline to max tech as a pathway for improving the efficiency of the furnace fan;
- Next, DOE conducts tear down analysis for the selected products spanning the available range of efficiencies;
- And then finally, DOE uses a cost model to generate cost efficiency curves which account for the full production costs.

As I mentioned, the first step is specifying the baseline. DOE selected baseline models typical of the least efficient furnace fans used in commercially available HVAC models. For products that have previous standards, usually the baseline is set at whatever the current standard during that rulemaking, or previous standard. However, because furnace fans are not previously regulated, there is no previous standard, and so DOE selected the baseline to be typical of the least efficient furnace fan that's commercially available.

Across all product classes, a baseline furnace fan includes a PSC motor with three or fewer air flow control settings, a forward curved impeller, a standard sheet metal fan housing, a linear power supply - and again, this is referring specifically to those product classes where standby and off mode is considered - and a laminated core power transformer.

Any comments on the baseline specifications?

DOE, as I mentioned, DOE reviewed -

MR. BROOKMAN: No comments on baseline specification? I just thought I would give you a chance. Okay. Go ahead.

MR. JASINSKI: DOE's publicly available information, as well as the FER values and IFER values that were calculated using the test data to determine the baseline FER ratings that correspond with those baseline specifications - we have a question?

MR. BROOKMAN: Steve Rosenstock.

MR. JASINSKI: On this slide or the -

MR. ROSENSTOCK: Thirty-four, the previous - yes, that slide, thank you. So you test data from the manufacturer or you did your own testing?

MR. JASINSKI: It’s a combination of both.

MR. ROSENSTOCK: Combination.

MR. JASINSKI: DOE was able to find performance data in specification sheets from manufacturers, but then as I mentioned, DOE also used some - used its own test data for -

MR. ROSENSTOCK: Were they the same tests?

MR. JASINSKI: Meaning?

MR. ROSENSTOCK: Same external static pressure, same -

MR. JASINSKI: Yes.

MR. ROSENSTOCK: Okay. Next thing is, basically on this table, for baseline sample, I want zero for those cases, right, by way of a dash?

MR. JASINSKI: No, it’s not zero. This is - the dash here just represents not applicable in this particular standard. I’ll explain. So, standby and off mode for a lot of these products is already being considered in other rulemaking activities. So, for instance, furnaces and also some products that might fall into the CAC scope of coverage, there are test procedures and standards, either already specified or being proposed for those particular products. So their standby is not going to be included in this rulemaking.

However, for hydronic air handlers, there's no previous standard and there are no standards or proposed test procedures for standby and off mode for those products, therefore that's being covered in this rulemaking.

MR. BROOKMAN: Greg and then to Charlie. Steve, you weren't done. I'm sorry.

MR. ROSENSTOCK: No. So - so basically because the furnace system has a standby test procedure or off mode, you're not going to worry about it for this, but doesn't federal law says for any product with - that you're doing an efficiency standard that you have to look at standby?

MR. JASINSKI: Yes, I'll let Michael Kido speak to the statute.

MR. ROSENSTOCK: Okay.

MR. KIDO: Yes, that's correct, but given that there's already some coverage of that particular level of energy consumption in another portion, we're already considering that element as part of another test procedure. That's the way we're viewing it.

MR. ROSENSTOCK: Thank you. Okay, again, it was just - so you're saying there are some standby watts but you're not going to worry about it for this.

MR. JASINSKI: I think the confusion here - and I think there's some detail provided, I believe, especially in the test procedure NOPR, but the justification behind this proposed approach is that the fan is integrated – so well integrated into the controls of the HVAC product, that there's no distinguishable – that it's difficult to differentiate the standby specific to the fan, as opposed to the standby of the entire product. So the standby of the entire product for those other products which I've already covered, is already being considered in those other rulemaking activities. There's no additional standby watts that aren't being considered. What we're saying is the same standby consumption of these products is covered – is considered entirely by those other rulemakings. And so the similar case would be for hydronic air handlers, for this particular rulemaking, we are proposing to account for all standby and off mode consumption of hydronic air handlers.

MR. BROOKMAN: Greg, I think Charlie has a comment that relates to this. Charlie, go ahead.

MR. STEPHENS: Yeah, I would suggest that that's not true. As I suggested earlier, some of the air handlers that we're concerned with are air handlers that are also used as an indoor unit with a heat pump system, for instance, in our part of the world. I believe the Department hasn't finalized that test procedure yet, to my knowledge, but I believe the proposals show standby consumption for those systems with an outdoor unit to be on the order of 33 watts. Now the vast majority of that standby power is not in the air handler, it's in the outdoor unit. Now while you may be accounting for the standby consumption in the air handler portion, it is not 33 watts, I can assure you. And so you really do - if you're going to regulate an air handler, again, this is still a question I realize, but if you're going to regulate the air handler it's not the same number that you're going to have associated with these other rulemakings. It's going to be a different number. It may be a component in that other number, but when you sell this thing as an air handler and not a heat pump system, split system, those numbers are not the same and you need to get the right numbers on this product when it's sold as an air handler.

Secondly, by incorporating standby for hydronic for air handler here, you have grossly distorted the ratings for these things and how much energy they use. In the examples that are published in the PTSD, you've got a PSC equipped air handler, and you've got an ECM equipped hydronic air handler. The hydronic ECM air handler uses approximately one-half of the electricity annually, based on your calculations, as the PSC air handler, and yet its efficiency rating is approximately eight times as good. So you've got a rating here that says it uses one-eighth of the energy, but it actually uses half the energy when you look at the numbers in kilowatt hours. That is a highly misleading arrangement. And so I would suggest to you that you need to fix that.

MR. BROOKMAN: Thank you. Greg, and then to Diane.

MR. WAGNER: Okay. Two - this is Greg Wagner. Two comments. One to dovetail with what you were just talking about, with regard to the differences in product classes. This gets back to what we originally talked about in terms of scope, scope of what the law and regulations covers and the fact that these products haven't been covered previously for the standby watts, indicates they are a separate class, and are not covered by this standard. So that's just further indication regarding scope.

To on to a question I have for Sam, you mentioned that when you did this baseline analysis,that you did some testing and you took literature from the manufacturers. Your testing was to the standard as it's outlined currently, is that correct?

MR. JASINSKI: Yes.

MR. WAGNER: And you used the AMCA 210 type of test process. The manufacturers don't use the AMCA 210, so your numbers and their numbers are going to be different. They use either ASHRAE 37 which is different from the ASHRAE 51 equivalent to the AMCA 210, or they use another test which is that 103 test. So you can't add apples and oranges together.

MR. BROOKMAN: You think it would be substantially different?

MR. WAGNER: Yes, there's different corrections for density, and different method of testing, and this is what we covered in the last session and we did that in our written comments. And we'll certainly reflect all those differences.

MR. BROOKMAN: Thank you. Diane, and then back to Steve.

MS. JAKOBS: I did (off mic) …

MR. JASINSKI: Diane, I think the microphone is – there's trouble with the microphone.

MR. BROOKMAN: Is the mic on?

MS. JAKOBS: Oh, I pressed the button twice, I guess. I had three samples of one furnace model, and I got 405, 415, 416. So I mean it sounds like a little bit, but compared to 380, that's more than ten percent, I think.

MR. JASINSKI: So your samples were non-weatherized, non-condensing?

MS. JAKOBS: Non-weatherized, non-condensing. And before – I want to take back my – well, I'm not sure about my comment before. Part of it, I might have mixed myself up, whether a good number was higher or lower, but I do think that this differentiation between condensing and non-condensing, you know, is only 13 points on your chart, and that might reflect – it's really what we were talking about the air flow path and how you design it and what motor speeds you select, that a non-condensing gas furnace might use more watts to provide the same comparable performance. So it's one of the things, it depends on your design because turbulent air is good for heat transfer and we can get our AFUE up, but it's not as good for the fan watts, so those are all interact.

MR. BROOKMAN: Craig.

MR. MESSMER: Craig Messmer. Looking at the FER, I'm not at all thrilled by dividing it by the maximum CFM. It's going to skew a lot of numbers. Some of that's going to depend on the design of the product itself. Not everybody's – if it's a heating product, the intent is BTUs and here you're kind of dividing it by CFM. Nobody cares about the CFM, they only care about the BTUs. If you're just going to do the fan itself, then I don't see why you'd want to divide by the maximum CFM to get an FER. It should be an averaged number based on the CFM that's operating at the different multi speeds, for example. So I think that we're getting numbers that are so massaged that you're not going to have any reality to them.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. I was just also kind of curious if there was information out – you know, the new boiler standards kick in in September for higher AFUE, and then the automatic temperature resets control mandates, and then the furnaces kick in in May, next year, for all of them that are not in the condensing furnaces. And then you have the small motor efficiency standards kick in in 2015, which I think there's some correlation between those small motors that are covered by DOE and then the motors going into the furnaces. I believe a lot of the same models are covered by - again, the manufacturers will let me know which ones are - there's no correlation? They're different fans? Okay. Scratch that one, then.

I'm just kind of curious then if - I mean it's really just for the boilers, if that makes a difference in terms of some of these ratings.

MR. JASINSKI: I don't believe so.

MR. ROSENSTOCK: Okay. Thank you.

MR. JASINSKI: Rob.

MR. BOTELER: Yeah, the small motor regulation that goes into effect in 2015, it only handles general purpose open motors. It does not handle the type of motors that OEM specific.

MR. JASINSKI: Thanks.

MR. BROOKMAN: Let's move on.

MR. JASINSKI: Okay. Just a couple of bullets, and I hope I remember all of these. As Greg Wagner mentioned, there was some discussion during the test procedure public meeting about the data that was used to generate these values, and how manufacturers using different setups might impact that. After the framework document, or during the framework document public meeting, DOE identified AMCA 210 as a standard, and there were a lot of interested parties that commented that that was a widely used and widely known standard, and also was used to generate the air flow performance tables that can be found in a lot of specification sheets. I think there are even some specification sheets that reference the standard in a footnote. So it is important to get comments that might indicate whether or not those values would be different. And if manufacturer - comments related to how familiar manufacturers are with AMCA 210 and whether or not they use that or test setups according to AMCA 210 is important.

To Craig's comments, the - normalizing by maximum air flow capacity - we'll get to this request for comment. The intent here is two things. There's a relationship between - the higher efficiency motors react differently to increased external static pressures. For an ECM motor, it will consume more power to maintain a constant air flow at higher external static pressures, whereas a PSC will provide less air flow and therefore the consumption will go down. So normalizing by the maximum is a means to try to limit how sensitive the rating metric is to that, so that higher efficiency motors are not being penalized because they're still providing more air flow.

And on the other side, is it's also a mechanism to try to reduce the sensitivity of the metric to changes in capacity because DOE expects that air flow - maximum air flow capacity is specified with some relationship to BTUs, as you mentioned. I know there are a lot of numbers out there, you know, anywhere between 350 to 450 CFM per ton. Ton here is a reflection of the capacity. So that's just an overview. Comments regarding those assumptions and whether or not normalizing achieves those goals is something that DOE is very interested in.

MR. BROOKMAN: Diane.

MS. JAKOBS: So one thing that I was a little bit concerned about, these numbers, they look kind of similar to what - if you were just going to measure the CFM and measure the watts in an installation, you would get kind of same order of magnitude numbers. And we're already having trouble now where there are some hand held tests, combustion analyzers, and people are trying to, in the field, commission their equipment. And they're saying that we're not meeting our AFUE rating because they have this hand held analyzer that they're testing their installed unit on, and I wish that we could do AFUE testing with a hand held analyzer, but it's much more complicated than that. And those numbers, they look kind of the same, so I was thinking that the IFER, actually looked better because it was significantly different but my friends pointed out that we were already on the path to submitting standby watts. But these are similar order of magnitude numbers to what they're talking about in California, but a different test procedure, but so – just for what that's worth. Thank you.

MR. BROOKMAN: Thank you. Okay. Jim Vershaw, you're next.

MR. VERSHAW: Jim Vershaw, Ingersoll Rand. I think I made this comment during the test procedure thing. But we do not use AMCA 210 for either our furnaces or our air handlers. If we were making a fan only, we would, but this is an appliance that generates heating and cooling, and that falls under ASHRAE 37, and of course, furnaces are tested under ASHRAE 103. So the numbers that you're going to get using 210 are going to be different than what you find, at least in our literature.

MR. BROOKMAN: Yes, Dave.

MR. WINNINGHAM: This is Dave from Allied. I would echo what Jim has said. We do not use AMCA 210 either at Allied or at Lennox to generate air flow tables. And would also recommend that these baseline numbers be thoroughly reviewed before any minimum threshold level is established.

MR. JASINSKI: So once the baseline has been established, DOE identifies intermediate efficiency levels as a path to more efficient products. Each efficiency level above the baseline is defined by a specific design option used to achieve that level. DOE determined average percentage reductions in FER or IFER for each efficiency level and applied these reductions across all product classes. The reasoning behind that is DOE found that manufacturers use similar components and design paths to improve efficiency across all product classes that DOE is examining. DOE does not expect that the percent reduction FER associated with each design option, whether commercially available or prototype, will differ across product classes.

DOE based the reductions in FER associated with commercialized technologies on measurements or publicly available performance information, and DOE based the FER reductions associated with prototype technologies or those that aren't in commercial applications on research reports that included detailed performance data.

This table provides a snapshot of those percent reductions in FER. As I mentioned, DOE assigned the percentage reductions in FER to each efficiency level to obtain FER values for intermediate efficiency levels. DOE also assigned a reduction in standby watts for the standby design options.

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. And again, I know we had the discussion about standby before, but again, since you're analyzing this component as a stand alone appliance, was there any information about the standby power usage of these components, and in some cases did they ever increase, let's say, with level four, or the multi staging control added a couple watts just because it’s tracking everything.

MR. JASINSKI: Yeah, those – that standby consumption, in consideration of that, is considered in the other rulemaking, so for instance, in this particular case, in the components of the fan that are being analyzed, I think the analysis shows that an ECM motor contributes anywhere between three to five watts of standby and that is for the products where you see a non-applicable – those watts are included in the analysis and standards that are being considered or specified in those other rulemakings.

MR. ROSENSTOCK: Okay, and -- Steve Rosenstock, EEI – thank you for that. Suppose the baseline is, I’ll just say one watt. I don’t know what it is for the baseline unit. But then you get to level four and it’s five watts, you’re saying, oh, I’ll do that in another analysis. Well, hold on a second. You were analyzing this component. If you’re ignoring those watts, that’s reducing the energy savings, that’s going to have an impact on your energy analysis and your life-cycle cost analysis and all the other analyses. Isn’t it? I understand what you’re saying. It’s really covered in another – in the overall system standby, but since you’re analyzing this component as a stand alone appliance, by not looking at it – if it were zero, great, it’s no problem. It makes no difference whatsoever. But there is a difference upwards or downwards, it could have an impact on the rest of the – it won't have an impact on the metric, but it will have an impact on the energy savings and life-cycle cost analysis.

MR. JASINSKI: Those costs and benefits are included in the other rulemaking, so those –

MR. ROSENSTOCK: But there's a separate cost and benefit analysis for this rulemaking.

MR. JASINSKI: Yes.

MR. ROSENSTOCK: Okay. So, and again, it's a component system issue is you're saying we're going to do the standby for the system, but not going to worry about the standby for the component. It's kind of a dichotomy there.

MR. BROOKMAN: I see Alex wishes to comment. Find a microphone, Alex. Maybe that one right over there. Yes, coming back to you, Diane.

MR. LEKOV: Alex Lekov, Lawrence Berkeley National Laboratory. So to answer these impacts are included in the life-cycle cost analysis, and it will be explained in the follow up slides, when we get to this point.

MR. BROOKMAN: Okay. Thank you. Diane.

MS. JAKOBS: Just kind of to emphasize how intertwined all these parts are, on a furnace, our biggest source of standby watts is actually a transformer that you need when you run the air conditioning. So, at Rheem we talked about moving that transformer outside, so the guys downstairs would have to worry about it, but that didn't fly. So they work as a system, and we assume they're all going to work together and it's hard to attribute specific components to different modes of operation. It's difficult.

MR. BROOKMAN: Okay. Thank you. Keep going - oh, Greg, go ahead.

MR. WAGNER: Greg Wagner. Question about the efficiency number that you have there under number five, the center column, what's the basis for that?

MR. JASINSKI: The basis for that is research reports and data that was acquired using a prototype furnace that had a backward incline impeller installed.

MR. WAGNER: The one that was referenced in the TSD?

MR. JASINSKI: Yes.

MR. WAGNER: Okay. I reviewed that report, and that's testing a blower only. Isn't that tested in a unit? And it was one data point, and gentleman from Southern California Edison pointed out that as you vary performance, those numbers change. Additionally, that blower component was tested by Lawrence Berkeley, and they put a report out in September 2005 and in it, on Page 41, they basically say they see no efficiency gain from using that in it, in a furnace system. So I guess, do you look at all the literature, or just part of the literature?

MR. JASINSKI: No, we look at all the

literature. A lot of the issues that you are raising, there's a request for comment to get more information about the performance across the entire range of operation. The 2005 report that you mention, we do have access to some of the raw data for that, and that testing was done with the prototype. And here, the prototype I'm referring to is the premium ECM motor with the backward inclined impeller. A premium ECM motor here is a motor that is narrower, that is the diameter is smaller so there's less interference with the blower inlet, but it also operates at higher RPM which is characteristic of a motor that's paired with a backward incline prototype, and that prototype was installed in the - in a furnace, so that raw data was taken while it was installed in situ, to my knowledge. So some of the analysis is also done on that raw data that was used for that 2005 study that you mentioned.

And, as a preface to the comments that we're requesting, DOE is very aware that there are varying degrees of performance and DOE is asking for data and comments to understand what the expected relative efficiency of operation would be for implementing a backward incline impeller, among many other issues.

MR. WAGNER: Well, this ten percent used later to drive your energy savings, I notice.

MR. JASINSKI: Yes, I can say that with the raw data we saw anywhere from - a lot of the reports don't - obviously don't use the rating metric that we're proposing, that DOE is proposing. But the benefits – there's a wide range between, like you said, in some cases, very small to much larger than ten percent, and that's impact on FER. So DOE is proposing to use ten percent in the preliminary analysis and also asking for comment about the appropriateness of that number.

MR. WAGNER: Well, I just want to go back to the report that you referenced. Wegman (ph) in blower only, did have one point that was ten percent, but the rest of it was two to four percent in the other systems they analyzed. But the specific one that got to ten percent when Ian Walker and company out of Lawrence Berkeley tested it, they report that they didn't see any improvement or enhancement.

MR. JASINSKI: Sure. The ten percent reported in that is not using – this is ten percent in FER, so the FER is actually a little bit more sensitive. So a ten percent reduction there would actually be something along the lines of 20 – a lot larger percent reduction in FER. So this is not simply taking the ten percent from that report and plugging it into our analysis.

MR. WAGNER: I would say it's less sensitive because you have multiple operating points and the efficiency is going to change over those operating ranges, as pointed out earlier, and shown in the report, and it would actually reduce those numbers, not increase them.

MR. BROOKMAN: Okay. Thank you. Detlef.

MR. WESTPHALEN: Detlef Westphalen, Navigant Consulting. I guess we wrestled with some of this data as well, and, you know, some of this work was going on over a number of years, not all of it was made public. Some of the reports that were made public showed less benefit than some of the other data that was – that we were eventually able to obtain.

So, the story is not all in the reference. That just happens to be the public reference that could be cited. And so one of the questions is, whether more of this data could be made public, but that's not for me to answer.

MR. BROOKMAN: Let me just note that this is important stuff and we're diving rather deep it seems to me. We need to make sure we come up high enough so we cover all this material. Diane, go ahead.

MS. JAKOBS: I just want to say that I think it was several years ago, maybe about the time you came to … to visit Sam, but I did try to get – I was on the CSA823 committee, and I did try to get a hold of this prototype to test it in one of our furnaces, and I talked to Lau and Regal Beloit, and there seemed to be some intellectual property, they didn't know if they could share with me, and because you have to run the wheel, you know, it's not just a matter of getting that particular wheel, you have to run it at much higher

RPM, so I was trying to get the motor and the control that I never did get it. I tried for six months or something, so I did try to test this in our furnace, and was unsuccessful.

MR. BROOKMAN: We've had a lot of comments on slide 36 and there are many other equivalent slides which follow, so let's press on.

MR. JASINSKI: Okay.

MR. BROOKMAN: Final comment from Craig, and then we're moving on.

MR. MESSMER: Craig Messmer. I see these percentages on this chart and I looked in the TSD, I don't know where they come from. Are you going to explain where these come from? Because 45 percent, 59 percent, are pretty big numbers.

MR. BROOKMAN: You're referring again to slide 36?

MR. MESSMER: Yes.

MR. BROOKMAN: Keep going, Sam. Sam, are you saying where these --

MR. JASINSKI: As I mentioned, we used the publicly available performance data that was in specification sheets to derive FER values and IFER values, in addition to the testing that was done by DOE.

MR. MESSMER: And you did it at the static pressures required by the new FER --

MR. JASINSKI: Yes.

MR. MESSMER: -- test procedures? Because the motors aren't really that much more efficient. But, that's okay.

MR. BROOKMAN: So in your comments, right. Okay, then on to the next.

MR. JASINSKI: For all product classes except hydronic air handlers, DOE analyzed four efficiency levels in addition to the baseline and the max tech for a total of the baseline plus five additional efficiency levels. Here are the results for the primary - or excuse me, the non-hydronic key product classes. We won't spend too much time reading each of the numbers unless someone has prepared a specific comment about the values. If not, written comments on these levels would be appreciated.

MR. BROOKMAN: If there are overarching comments on these numbers as we had in the previous slide, then I think that would be helpful. Then we will move on.

MR. JASINSKI: For furnace fans using hydronic air handlers, DOE considered two additional efficiency levels, efficiency levels six and seven, and those are using the design options that reduce standby and off mode energy consumption. Here's the analogous table for hydronic air handler furnace fans. So as you see, the baseline through - well, one through five have the same design options, and then there are the two additional, the switching mode power supply and toroidal (ph) transformer for six and seven.

MR. BROOKMAN: Brian first.

MR. JAMES: Brian James, Southern California Edison. Just a point of clarification. Are six and seven an add-on to five?

MR. JASINSKI: Yes.

MR. BROOKMAN: Diane.

MS. JAKOBS: Well, we have a hydronic air handler and we - the way we advertise it, we match it with a condensing tankless water heater which would - if you looked at the efficiency of the condensing water heater, and you looked at this, you would assume that your operating costs would be much lower than a condensing furnace. And I don't think that's true at all. So I think that this is misleading because I think you can, in the same installation, have a choice between a direct - you need to make a direct comparison between a gas furnace and a hydronic air handler.

MR. JASINSKI: Yeah, I don't mean to speak for Diane, but I think this comment is related to the discussion earlier about how the metrics for hydronic air handlers uses the integrated fan efficiency rating which includes standby and off mode and therefore is normalized by total annual hours because it includes those, which makes these numbers a lot less in comparison. So correct me if I'm wrong, but -

MS. JAKOBS: Yeah, I mean - I like these numbers better. But, you know, just because of the waiting for the standby mode at the much lower watts level, they just look like you're saving money, and you would not be.

MR. BROOKMAN: Okay. Thank you.

MR. JASINSKI: So now, just a request for comment about the rating metrics, that they will not be dependent on capacity because they are normalized by the maximum air flow capacity. This is something that I asked earlier. If anybody has comments related to how the proposed metric is impacted by capacity.

MR. BROOKMAN: Move on.

MR. JASINSKI: After establishing FER values, the next part of the engineering analysis is to develop costs for these values. The manufacturing cost models were developed by DOE as part of the efficiency level approach. First, bills of material are generated during product tear down analysis and entered into a cost model. The cost model generates manufacturing material, labor, and overhead costs. The physical tear down, as I mentioned earlier, is conducted on representative products that were selected based on the criteria that I spoke about, and as part of this preliminary manufacturer interviews are conducted to further refine some of the inputs for this cost model. And that flow chart there provides a graphic for what I just described.

This is a lot of detail about what is included in the cost of production numbers in terms of the structure and classification of the manufacturing cost. I won't go into a lot of detail about these, but you have this slide for reference, and it's also included in Chapter 5 of the TSD.

MR. BROOKMAN: Rob.

MR. BOTELER: We had a couple of comments earlier about the cost of the ECMs and one of the things that we as motor manufacturers noted is we're not aware of any conversations with Navigant to actually get motor costs from us. Maybe they got motor costs from the air handler manufacturers, but they didn't get them from us so we're not sure if they are correct in your calculations.

MR. JASINSKI: Typically, manufacturer interviews are conducted mostly during the NOPR phase, and my understanding is that typically manufacturer interviews are targeted towards the HVAC product manufacturers, so those prices, if we do get any, would come from them.

MR. BROOKMAN: Diane.

MS. JAKOBS: I mean certainly we did talk to you, I don't know. Two weeks ago, I took the same heat exchanger and the same jacket and we offer it with a PSC motor X13 and ECM. I did one, one sample, and it was – our cost for the X13 was almost double what is in this table. And then we had AHRI group that we've been discussing all this, and I asked if other manufacturers saw the similar pattern. So I had agreement from other manufacturers. If you gave us that small a data set, we would criticize you, but that's what we have. That's just what I did for a check.

MR. JASINSKI: There will be an opportunity during the NOPR where extensive manufacturing interviews are conducted to have these types of conversations and refine the analysis.

MR. BROOKMAN: Alex.

MR. BOESENBERG: Alex Boesenberg, NEMA. I would encourage the Department and Navigant on those interviews to bear in mind, when you make the cost scaling factors, that certainly I heard more than one fan manufacturer here mention that they do, some of them do pretty small runs, which means that you don't get the economies of scale that may be reflected in those original estimates. If it's a million motors a year, not buying a million at once, maybe only a few hundred, and that of course results in a lot less savings, so please bear that in mind. Thank you.

MR. BROOKMAN: Yes, Dave.

MR. WINNINGHAM: I would concur with Diane's comments. We actually analyzed about six furnaces with similar configuration with the exception of the motor and the controls, and found a distinctly different – difference in price delta. I would also recommend that as you look at this price delta, to include all aspects of the installed cost. Because, in many cases, the higher efficiency motors require additional controls and wiring that goes along with them, and make sure that you're including those costs as part of that.

MR. JASINSKI: Sure. Thank you. And I guess it would be good to mention that -- a lot of manufacturers are mentioning that they're doing analyses – if you can share that data in your written comments, that would be really appreciated, but also, as a note, if there is information that you are wanting to protect, the manufacturer interviews are conducted under NDA agreements so that might be another opportunity to provide data that you might not want to submit publicly.

MR. BROOKMAN: Diane.

MS. JAKOBS: We kind of brought it up, that everything's going so fast, but, you know, if you're interested in one little data point, it seems trivial, but if that's still interesting, I guess –

MR. JASINSKI: Every little bit helps.

MS. JAKOBS: Thank you.

MR. BROOKMAN: Charlie Stephens.

MR. STEPHENS: Just a quick point of clarification. Charlie Stephens. Are these fan costs and fan pricing, or air handlers?

MR. JASINSKI: Yeah, I'll get into that, I'll show you specifically what's included in the –

MR. STEPHENS: Okay. Thank you. Because the design options only so far, are fan related.

MR. BROOKMAN: Let's proceed then.

MR. JASINSKI: So to answer Charlie's question, the costs used in the engineering analysis represent the cost of the furnace fan, and not the cost of the entire HVAC product. The following components are included in the manufacturer production cost, MPC, estimates:

- the fan motor and integrated controls,
- the primary control board,
- the impeller,
- the fan housing,
- and components used to direct or guide air flow.

And the last one is somewhat ambiguous, but I will explain that. When reverse engineering these products, there are elements that are easily distinguishable as intended specifically to direct air flow, maybe over the heat exchanger, or - and these would be typically, you know, sheet metal or something like that. Those elements were included in the costs because they're expected to have an impact on the efficiency, therefore we want to include them in the cost.

MR. BROOKMAN: Greg.

MR. WAGNER: Were motor mounting arrangements also considered? I don't see that up on there. In other words, there's something that holds the motor in place.

MR. JASINSKI: Yes.

MR. WAGNER: Okay. Just not listed.

MR. JASINSKI: So the fan motor and integrated controls - yeah, it’s not explicit, and so as a point of clarification, the fan motors are typically considered a purchase part and in a lot of cases, that - the mount may come as part of that purchased part as an assembly from a component supplier. But, DOE does reverse engineer them also to get costs, whether it’s a purchased part or - but it is included.

MR. BROOKMAN: Terry Small, you’re next.

MR. SMALL: Terry Small at Mortex. I just wanted to ask, it looks to me that you’re basing your manufacturing cost on a manufacturer that would be making one and a quarter million fan furnaces a year. And that may be indicative of a residential furnace manufacturer, sort of what I would call a high volume, low mix manufacturer. But a lot of these product classes, including the additional product classes, the volumes are such that they’re really low volume, high mix, and that would be completely inappropriate, those manufacturing costs, for some of the smaller manufacturers. So could you address that?

MR. JASINSKI: Sure. I think the next slide will - it’s a good segue into the next slide.

So as many interested parties have commented, DOE separated furnace and product classes into high volume and low volume product classes to account for factors that impact manufacturers' production cost and purchasing power. For instance, some products - DOE is aware that some products are produced at significantly higher volumes than others. Some manufacturers offer most types of HVAC products, while others only focus on small niches.

So high volume manufacturers operating in lower volume adjacent markets are expected to have the same purchase part price efficiencies consistent with their overall purchasing volume. This just means that even if a particular HVAC manufacturer is offering a - one product that has a very low volume of shipments, if that manufacturer also produces another product that has a high volume of shipments, they will get the same - similar pricing because they can purchase motors that might be used in both.

And then lastly, low volume operations, were modeled to have lower production volumes and fewer shifts per day, to account for the fact that not all manufacturers have production volumes on the order of 1.25 million units per year. And at the bottom here, you can see - these are the products - this is the separation of product classes into high volume and low volume. So all product classes - oil furnaces and hydronic air handlers were classified as low volume product classes. The rest were high volume.

And the math here is right. Like, non-weatherized gas furnaces, that accounts for condensing and non-condensing. So not all nine product classes are listed here, but all the products are.

MR. BROOKMAN: Greg.

MR. WAGNER: Greg Wagner. In the third bullet item, you mention that the high volume manufacturers are going to get - expected to get the same purchasing power for all products. That may or may not be true, because small volume products are run through different processes than high volume products, and so there are different costs based upon volumes of production. You can't make that, I guess, universal blanket statement there.

MR. BROOKMAN: Diane.

MS. JAKOBS: To make things harder for you, our hydronic air handler uses the same blower system as a gas furnace. So even though we're not selling a lot of them, you know, they're coming from the same pool that we have for gas furnaces.

MR. JASINSKI: That's exactly the third point, that for someone in that situation, you're using - you're ordering one component for both the small production volume and large production volume together.

Do DOE uses a design option approach to estimate the cost of technologies not commercially available in furnace fan applications. These are essentially the design options that aren't offered in products that can be torn down. So here you have the table that shows the efficiency level and design option, and then the high volume and low volume estimated manufacturer production cost.

And just as an explanation, so the inverted controls for the PSC motor, this cost is based on a reverse engineering inverter that can and was used in a furnace fan application. There's the specific model that was used, and that comes out to, as you can see, $12.00 for the high volume, and $16.00 for the low volume, and that's only the cost for the inverter.

Next, the premium ECM, multi-staging and the backward curved impeller, DOE used a ten percent markup on the estimated cost for an ECM as the added cost for the premium ECM motor. As a reminder, the premium ECM motor is that ECM motor that's a little bit narrower and operates at higher RPM, which is - DOE expects is required for backward curved impellers. DOE used photographs and specifications found in research reports to determine cost model inputs to estimate the MPC of the backward curved impeller. It turned out to be $12.00 for low volume and $12.32 for the high volume.

MR. BROOKMAN: Greg.

MR. WAGNER: On that BC wheel technology - backward inclined wheel technology requires much tighter tolerances in order to be effective. How is that accounted for, because the tolerances are on an order of magnitude tighter in order to get the same effect. In addition to that, the motor mounts and the support structure, et cetera, were going to have to be significantly beefed up in order to be able to be shipped in process. So I would question those dollar numbers on those bases alone.

MR. JASINSKI: In this particular case, the cost model for a standard forward curved was - the products were compared and as I said, the inputs for a backward curved were determined, based on the differences identified between the two. So if there are other factors that would need to be included in that cost, written comments or comments during interviews that would tell us what else needs to be included, and how much that costs so we can use those as inputs, would be greatly appreciated.

And then finally, the efficiency - excuse me - the estimates for efficiency levels six and seven are identical to those used in the HVAC products, the other standby and off mode rulemakings.

MR. BROOKMAN: Craig.

MR. MESSMER: Just going back to that slide, you really think that you could make those products for $12.00? And the backward curved impeller and motor for $107?

MR. JASINSKI: Based on our analysis.

MR. MESSMER: Okay. You have that somewhere that we can take a look at that and comment on it?

MR. JASINSKI: Yes, it's in the TSD, and if you provide written comments explaining why that should go up, then that would be appreciated.

MR. MESSMER: There's so much detail in the TSD that would tell you not how those are derived.

MR. JASINSKI: Well, there's detail about the methodology used and the cost model. So if you can talk about maybe a particular component that's not being included that's necessary, I think you mentioned that the mounts need to be different or if you can explain the different processes, the cost model used can account for most of those variations, we just need - DOE just needs to know what those variations are.

MR. MESSMER: Well, given they're not used currently, there's not a good model to give you that guidance. But what I'm suggesting is there wasn't any details in the TSD to be able to make that kind of evaluation of how you generated your costs.

MR. JASINSKI: Well, as I'm saying, nothing - I'm not leaving any details out. Essentially, you look at the standard forward curved impeller that's included in current models and by observation you compare the design, based on what type of processes DOE expects are used, what types of materials, that's put in the cost model, and the cost model uses assumptions about material prices and all those other costs that this slide shows, to generate the estimated manufacturer production cost. If there's something missing or something that shouldn't be included, or something that needs to be tweaked, those are things that we can use to change our inputs to the cost model, to generate different values. But for this particular case, that was the methodology used. So if that methodology needs to be changed, DOE would appreciate comments on what we left out, or how it should be done different, and that way we can refine the analysis.

MR. BROOKMAN: Mohammed.

MR. KHAN: Mohammed Khan, DOE. First, I appreciate the fact that, you know, in some instances there might not be a full enough description on the methodology for you to comfortably be able to comment on. However, if you're able to look at these numbers as you are right now, and it seems to be that you believe that they're off, they're probably too low, and you know that they should be much higher, based on your expertise and your manufacturing knowledge, your manufacturing processes, it would be very helpful for us for you to comment on what your process is and how you know these prices should be higher based on your knowledge alone, rather than not being able to comment on our methodology. But just give us what you know and then we can certainly take that information into account. Thanks.

MR. MESSMER: Well, to that point, we manufacture a product that's not like these currently, but the product that we manufacture would be in a different process than what would be used for the manufacture of these types of products in the tolerance level that's described in the literature and other places that we know is necessary to apply that technology, would have a different manufacturing process all together. So using the same metric for evaluating one technology versus the other wouldn't necessarily be appropriate.

MR. JASINSKI: So if you, in your written comment for example, if you could explain the process that would be used, that's an input we can use in the cost model that would change the result. And in addition to what Mohammed said, another very important factor in refining these costs are the inputs that we get from manufacturers who have the expertise and who are actually producing them. So those are also considered. It's not just what the model generates.

So the next few slides are comments specific to each of the design options. This one in particular is comment on inverter driven PSC fan motors. DOE requests data and energy-related - data regarding the energy performance and costs. As I said, DOE based its cost on a reverse tear down of an inverter that can be used in these applications, and the energy performance information was taken from a product that was formerly commercially available that used this technology.

Here's a snapshot of the engineering analysis results. Essentially the data used that make up the cost efficiency curve. At the top you can see - this is for the high volume, key product classes. At the top you can see the manufacturer production cost. And as I mentioned, because DOE doesn't expect that manufacturers are using different components or pathways to improve efficiency across different products, then the same manufacture production cost is applied across all product classes here.

Here's that same data, just in graphical representation. And as you can see, it reflects the stylized version that I showed earlier where, as FER decreases, meaning the energy consumption decreases, the estimated manufacture production cost increases.

MR. BROOKMAN: Yes, Dave.

MR. WINNINGHAM: This is Dave from Allied Air. A question on EL-4 where you've got an ECM plus multi-staging. Is the additional cost – the furnace fan is one component of that multi-staging, but there are other components that go into that multi-staging, is that at all accounted for in your –

MR. JASINSKI: Yes. The increased cost of the primary control board is included, in addition to wiring, and also the gas valve.

MR. BROOKMAN: Diane, you wish to comment on these numbers?

MS. JAKOBS: It would be the control, the gas valve, the wire harnesses, and the motor.

MR. JASINSKI: Uh-huh. Here are the results for the low volume key product classes, again, non-weatherized oil, non-condensing and hydronic air handlers. As you can see those manufacture production costs are higher to reflect the fact of the low volume – the factors that I spoke about earlier in terms of the differences in volume.

And here are those in graphic form. As you'll notice, the hydronic air handler curve has two additional points, and those are related to the standby and off mode design options.

One particular issue that DOE requests comment on is the turn down ratio of the different motor technologies. Here the turn down ratio is the ratio of the minimum motor speed to the maximum motor speed. DOE has preliminarily found that high efficiency motors, on average, have lower turn down ratios, which indicates that it has a wider range of achievable speeds. So DOE seeks comment on the typical turn down ratios that can be achieved technically and in practice by each motor technology. And I provided – there's a list here of the motor technologies of interest.

MR. BROOKMAN: Yes, Paul.

MR. LIN: Paul Lin from Regal Beloit. In the TSD, I'm not sure if I – maybe I missed it – where you talked about what speeds you assumed on the turn down? You did in the detailed report on the speeds.

MR. JASINSKI: Yes, it's the maximum and the minimum.

MR. LIN: No, in evaluating the turn down ratio for a PSC, the high efficiency, did you specify what RPM you were turning down to in the FER, in detail?

MR. JASINSKI: No, I think – in the TSD we just provided the actual turn down ratios, but I can explain that what was done, is for all the units that we had information for, the performance information is usually in the form of a table of air flow and CFM across a range of external static pressures for each available air flow control setting. So to generate those ratios, the air flow at something close to the proposed reference standard, external static pressure, the air flow in the minimum was divided by the air flow in the maximum at that external static pressure for each model that we had that information for. And then, you know, generated average values based on that. But I believe the table with the percentages is in there, that's how that information was generated.

MR. BROOKMAN: No additional comments on turn down ratio?

MR. JASINSKI: DOE requests comment on proprietary permanent brushless magnet motor technology. DOE is aware that there might be intellectual property around some of the higher efficiency motor technologies, so DOE seeks comment on the validity of its premise that alternative motor technologies can achieve comparable performance, i.e., the turn down ratios and efficiency, at comparable cost to the brushless permanent magnet motor technology offered by Regal Beloit. Many interested parties have commented that there are issues related to this, so DOE seeks comment on the validity of that assumption. And essentially the availability, cost and relative performance of alternatives.

MR. BROOKMAN: Yes, please, Steve.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. In terms of this, do we have any information about the patents length of these manufacturers? I mean of these patents for whichever aspects of the technology. You know, a typical patent can last as long as 17 years. So depending on – and they can be extended as well. So again, I don't know what the time frame for the expiration of the patent is after, let's say, 2020. I don't know exactly how these other manufacturers are going to use similar technologies without – they'd have to pay a licensing fee or something.

MR. BROOKMAN: Diane.

MS. JAKOBS: Part of it, it isn't just the motor technology, it's the good job that GE and Regal Beloit have done in providing us engineering tools, so that we can easily apply their products. And I know Rheem has been approached by manufacturers from other countries and they, on the surface, seem to have this similar motor technology, but they want us to provide them the program. Well, we use a Regal Beloit program to program the motors, so it's all kind of tied in that we don't – we program the motors, but we use engineering tools from Regal Beloit in order to do that. So I guess we're not as smart as maybe we could be, but that's kind of where we are. We depend on the vendor to provide the technology for us to use this ECM technology.

MR. BROOKMAN: Okay.

MR. JASINSKI: Yeah, just as a follow on. The crux of this is that the MPC estimates reflect what DOE expects are current manufacture production costs, but DOE is trying to understand the market factors that need to be considered to understand what, in the presence of standards and in the absence of standards, I think we'll talk about these different scenarios, what will happen to our assumptions and costs.

MR. BROOKMAN: Rob.

MR. BOTELER: Rob Boteler with NEMA. Yeah, just to pick up on that comment, that's exactly right. What the motor manufacturers in the US do, is we have labs where we actually bring in the fan equipment from our customer, and we go through a characterization process for our ECM that's in a lot of cases, unique to each manufacturer's application. So it's not just an off the shelf product that's available.

MR. BROOKMAN: Okay. Move on to six.

MR. JASINSKI: DOE is requesting comments on high efficiency fan motor control cost. DOE would like information regarding whether or not more costly primary control boards that are required to be paired with higher efficiency motors, and this, just as a clarification or a preface, DOE is aware that ECM or higher motor efficiency technologies come with their own integrated controls, but this request for comment is aimed at trying to understand the impacts on the primary control board of the HVAC product, whether or not those become more complicated, and in turn, more costly when being paired with those higher efficiency motor technologies.

MR. BROOKMAN: Terry Small, you’re next.

MR. SMALL: Terry Small, Mortex. I’d like to point out that right now the watts spread, the number of manufacturers, and usage in PSC motors gives a lot of flexibility for both big and small manufacturers to use the technology. If we end up outlawing PSC motors, which I don’t know whether that’s the hidden agenda here, I think you will - then we’re relying on one or two manufacturers of the more efficiency technologies for motors. That would be a real disservice to the consumer. Thank you. .

MR. BROOKMAN: Thank you. Other comments on high efficiency fan motor control costs? Yes, Diane.

MS. JAKOBS: We talked about it in 2010, but one of the issues with the programmable motors is replacement in the field. And I think you added something in there for that, but when we started out we ended up with kind of a special motor for every furnace model, and then to replace it, a lot of our customers, our distributors didn't want to stock all of these flavors of ECM motors, and because they're expensive. So it turns out that maybe to replace your ECM motor you have to air freight it in, because no one keeps it in stock. You have to get it directly from the manufacturer. And we've tried to do some things to get around that, but I don't know how widespread it is in the industry. So that issue of where does the program reside for this programmable motor? Does it sit in the motor or in the furnace? And then there are safety implications if – it's like all our components don't really talk to each other, they kind of assume each individual component knows what it's supposed to be doing and if there's a mismatch it might be a safety hazard.

MR. BROOKMAN: Okay. Paul, did you have a comment?

MR. LIN: I was just going to comment that there exists more than one or two motor manufacturers that provide ECM technology, so that there's a breadth of manufacturers that provides motor technology relative to the access as well as a fully … ECM.

MR. BROOKMAN: Okay. I have a comment from Jim Vershaw. Jim, you're next.

MR. VERSHAW: Jim Vershaw, Ingersoll Rand. On issue four, the turn down, you've got to remember that there is an upper end to how fast typical blower wheels can be turned and a lower end to what bearings can handle the motors. That kind of limits your turn down. So please be aware that if you're going to try to go above 11, 1200 RPM, you're going to have to change the blower wheel and make it more expensive. So maybe if your analyses are going above that RPM, you've got to be aware of that.

On issue six, on the fan control, yes. The furnace controls change with fan type, or motor type I mean. You will get substantially different needs for different types of motors, and usually they're more complex as you go up in motor complexity as well. Thanks.

MR. BROOKMAN: Okay. Thank you. On to issue seven.

MR. JASINSKI: Issue seven is regarding backward inclined impellers, and we've touched on some of these a little bit already, so DOE seeks comment on the expected efficiency improvements across the range of operating conditions in residential applications. This request speaks to the issue that's been raised about how the relative performance is different under different operating conditions. So DOE is requesting information to understand that so that it can be reflected in the analysis.

MR. BROOKMAN: I think we already received one comment on this, did we not? Additional comments on backward inclined impellers? Diane.

MS. JAKOBS: I was working on this a couple of years ago, but there's an ISO standard - I think it was someone from Lau who was telling me about it, but there are different levels and he had a graph where he showed where for different diameters and for larger diameters, it is significantly more efficient, but he had them where they were crossing, just in the ten inch area where we are. And since that was my project in advanced R&D that was a kind of disappointing revelation, but we're kind of - for residential furnace fans and diameter of wheels that we're using, there seems to be certain tradeoffs in that area, and where if you were going to a commercialized unit where they are more and more common, that there's clearly an advantage. But in our specific size, there is some issues where the trend is not what it is at larger diameters.

MR. BROOKMAN: Okay. Greg.

MR. WAGNER: Greg Wagner. I commented a bunch on this earlier, but I'll just reiterate that the literature that you reference in some of the testing shows that there are varying degrees of performance improvements and reduction, depending on where you're operating it in the system. So it's not a universal - that it translates into appliances.

MR. BROOKMAN: Okay. Additional comments?

MR. JASINSKI: One that we didn't touch on and I'll mention it is the DOE is seeking comment on whether the backward inclined impeller could impact product offerings that might - if it's incompatible with certain designs or components currently used in furnaces. That's important information to understand how implementing them might impact the mix of product offerings.

MR. BROOKMAN: Greg.

MR. WAGNER: I'll comment on that one. Specifically to that with the implementation of 13 SEER furnaces in particular, and other products like that, have shrunk in size because of available space to fit them in most homes. They have eight foot ceilings as a max, and so when you're putting in a bigger coil to do the air conditioning part, the other remaining parts of the system are shrunk down. Back when Wegman (ph) and those guys did the research in 2003, that wasn't part of the equation. Since then, furnaces have gone from 46 to 52 inches down to about 33, 34 inches, principally. So there's even less space today for the air moving section, if you will. So to your comment about designs and impact, that's a significant impact on being able to implement some of these technologies perhaps, in many applications.

MR. BROOKMAN: Thank you. Other comments?

MR. JASINSKI: Regarding the air flow path design, DOE seeks comment on air flow path design changes that could result in improved air flow efficiency, and in addition to that, cost and efficiency data related to those air flow path design improvements, and also the expected tradeoffs between air flow efficiency and thermal efficiency or system efficiency for those designs. But I think these are issues that we have already touched on in depth, but written comments would be really appreciated.

MR. BROOKMAN: Yes, and if you want to call out any specifically that you don't think we've covered sufficiently, that would be okay, but – Jim Vershaw, you're next.

MR. VERSHAW: Jim Vershaw, Ingersoll Rand. Back to the previous issue, if you look at the Wegman (ph) report, once you get above 1200 CFM –

MR. BROOKMAN: Jim, see if you can speak up, please.

MR. VERSHAW: Okay. I am. If you look at the Wegman (ph) report, the results above 1200 CFM showed that FC wheels are actually more efficient than BI wheels. So I think you've got to be careful on the backward inclined as far as capacities. You get above three tons of air flow, the performance is going to fall off unless you essentially different wheel diameters and speeds. Thanks.

MR. BROOKMAN: Thank you. Okay. And comments on air flow path design. We've covered this somewhat, maybe fully. Additional comments? Terry Small, you're next.

MR. SMALL: Hi. This is Terry Small with Mortex. On issue eight, and this we've had a lot of discussion on it. But I think what was interesting, I'm a bit dismayed that the word safety has never crept into the discussion so far. And so much of air path design is around the safety aspects of whether it would be a heat exchanger, or a natural gas furnace, or resistance heat, where you're worried about where the limits operate, even on a hydronic unit. So I think that the air path design is very much to be determined more by safety, which of course is a liability to manufacture. We're less concerned about efficiency when it comes to safety. Any comments on that?

MR. JASINSKI: Yeah, I would just say that one of the major screening criteria is we evaluate technology options for their health and safety impacts, so if there are specific health and safety impacts that would be related to any type of air flow path design, DOE would really appreciate comments regarding that, so that it can be considered in the screening analysis.

MR. BROOKMAN: Additional comments on air flow path design? And then we have kind of a summary box, correct?

MR. JASINSKI: Right, just other comments or recommendations related to the analyses I've presented: the market and technology assessment, the screening analysis, and the engineering analysis in general.

MR. BROOKMAN: Any overarching comments at this point? Okay, so it’s now 12:30. I’m going to suggest we pause for lunch, and I think we need it. We’ve covered a lot of ground. It’s been very, very productive conversation. I appreciate especially all of you coming forward with such good comments.

You’re probably familiar – many of you worked in this building before. Once again, you must wear this badge. This room will be locked during lunch, or it will be supervised, so you can leave your stuff here. There’s a big cafeteria, down to the ground floor about 100 yards in that direction after you get to the elevator. It’s 12:30. We will take a full hour for lunch, because that’s about how long it takes, which means we’ll resume at 1:30. We’re a little behind on everything, but we’ll catch it up.

You may need an ID to get back in. Sometimes they require it, sometimes they don’t, but you’ll have to go back through security portal – what do they call those things. So anyways, thanks for a good morning, we’ve got more to cover, but we’ll get there, and we’ll see you back here to start at 1:30.

(Whereupon, at 12:30 p.m., the meeting in the above captioned matter was adjourned for lunch recess, to reconvene at 1:30 p.m.)

AFTERNOON SESSION

1:31 p.m.

MR. BROOKMAN: We're still a few folks short, but let's start back up. Thanks for coming back. Thanks for being on time. We're now going to proceed with Markups, Energy Use Characterization, and LCC, and payback period analysis and hear from Alex Lekov.

Markups, Energy Use Characterization

MR. LEKOV: Alex Lekov, Lawrence Berkeley National Laboratory. So we completed engineering analysis, and now we're continuing on the economic analysis with the focus on the impacts on the consumers and follow up by national impact analysis.

So here is the diagram showing where this belongs in the flow of the overall analysis, and directly switching to my first topic, which are the markups. But here is essentially, it is a component of the overall economic analysis.

So markups or product price determination, is used to characterize the channels, how a product are distributed as well, to determine the price paid by the consumers for baseline and higher efficiency products.

So in this part of the presentation, I also will be talking about the energy use characterization, which essentially develops the energy consumer savings for the considered efficiency levels. And those will be tied in the overall life-cycle cost and payback analysis, which also are developed for all analyzed efficiency levels.

Here is the overall flow. What you see here is the typical life-cycle cost analysis. Essentially, it's based on total installed cost for the products, and lifespan operating expenses. This is the total installed cost represented by the upper part of the chart, lifetime operating expenses represented by the lower part of the chart. All the components, as you see them on this chart, will be discussed in some detail in the next slides.

So, starting with the markups. Markups relate consumer price to cost of goods sold. The markups are not the same for baseline and for the higher efficiency standard. This is a methodology that DOE developed over the years and it's been the same for many rulemakings, some of you participated over the last period. So we have baseline and incremental markups. The incremental markups do not include the component of the cost that are not impacted by the higher efficiency product, and that would be primarily the direct labor cost, which includes salaries, renting occupants.

DOE’s approach also developed the markup originally for all geographical areas considered in the analysis. The lower of the slide shows the sources for development of the markup for all market participants. I suggest not to read it in details, manufacturer markup comes from engineering, wholesale, and mechanical contractors come from Hardy (ph) and AMCA reports. General contractors markups, as well as manufactured home. Manufacturer and contractors come from different table of 2007 economic census. And the sales taxes are coming from what’s called Sales Tax Cleaning House Data, which essentially includes this data – reports this data by state.

As mentioned in the beginning, one of the purposes of the markup analysis is to identify the channels, the distribution channel for the product. The important thing here is to highlight that furnace fans are essentially components of a furnace fan equipment. Therefore, they’re distributed as part of the equipment. Therefore, the channel shown here, the two market segment, replacement and new construction, are for the furnace fan equipment, and you’re familiar with similar charts which were shown during the residential furnace rulemaking, residential … rulemaking. There is a separate channel for manufactured homes.

So, with that, here is our first question. DOE in this analysis did not consider a distribution channel for replacing furnace fans which are already included in installed equipment. So the question here is if such things exist, what's the market share if it exists? So any information on this topic will help DOE to determine whether such distribution channels should be included in the analysis.

MR. BROOKMAN: Diane.

MS. JAKOBS: Okay. This one thing I went in – we have a man who's in charge of quality, and I went and talked to him about replacement rates for higher efficiency motors versus PSC motors, and we went back and forth, and we came up with that we're seeing a failure rate of double in higher efficiency motors than we do with the PSC. And you have to keep in mind that our focus is on the warranty part because that's what we're paying. But he said they start out pretty even the first year, and it can get much, much worse if there's a specific problem. But he was saying overall he would say it was double the failure rate.

So something is going on there, and just the idea that you have a copper control board in a air stream that might have moist air, that that's not a failure that can happen on a PSC motor. It's only because you've added this electronic control that you've added another failure mode.

So you're saying for replacing furnace fans, usually because the set screw is jammed onto the shaft, you know, they probably end up replacing several components even though maybe the motor control board is the only component that you end up doing a whole assembly. So I'm not exactly – I know in the analysis you excluded the warranty period, but actually if we have a lot of warranty cost, we're going to put that in our original sale price. So, you know, I don't know how to handle it, but that bit of information that the higher efficiency motors pretty much have double the failure rate.

MR. BROOKMAN: Do they have different maintenance requirements or anything like that? No, they're not.

MR. LEKOV: So let me connect to your statement. I believe you are referring to replacement in case of failures. Those, you will see a little bit further, those are accounted in the analysis. Here is the primary issue is a replacement – whether such things exist – a replacement for efficiency reasons.

MS. JAKOBS: Ah, like –

MR. LEKOV: That they're already – in the frequency, you'll see the detailed analysis, there is a whole slide on this topic. It has been accounted for.

MS. JAKOBS: We are not excited about that at all because of the safety implications. So we discourage it. I know it exists.

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI, but it's also replacement in case of current motor failure, right? That would also fall under that? That they've decided not to replace the whole unit, but just the fan because that's all that needed to be replaced and the old fan is shot, so replace it with a new fan?

MR. LEKOV: I would say the repair and maintenance slide will probably talk more about this aspect of it. Okay. Thank you.

So with that, here are the results. Essentially, the average markups for the market participants as explained in the introductory slide showing them for mobile home and non-mobile home classes, but the baseline and incremental markup and also the market participant. Note that those are average values.

The LCC analysis and the salary (ph) – we do this several times – represent actually distribution of values. So the households are getting different within the range of this average.

Maybe more informative is this one, that's the final, actually, average markup by product class.

MR. BROOKMAN: Yes, Craig.

MR. MESSMER: I have a question on the incremental markups you have. This is Craig Messmer, I'm sorry. You've got a lower value. Is that incremental going to apply to once it is the new baseline? I mean if you go to a higher standard which becomes the baseline, you don't really have an incremental markup any more, correct? Isn't that now what the same markup would be for the baseline? I mean, I don't understand why they're different. You've got a much lower markup for the incremental cost than you do for the baseline cost. And I read the document, and I know there's a graph and curve that you used to come up with that, but if you have – if you have an option to a piece of equipment, yes, it might have a smaller markup for that option, but if it's the baseline unit, it's going to have the same markup for the whole unit.

MR. LEKOV: Yes, the baseline markup is the baseline. If the unit is a baseline unit, then the baseline markup is applied to the baseline unit.

MR. MESSMER: Okay. But why is the incremental lower then?

MR. LEKOV: The incremental markup indicates that not all cost are additionally marked up when the equipment becomes more efficient. And as I already stated, this is the only difference is the direct labor cost, essentially. The salaries don't change it, the people. If they can – for example, a distributor, salaries are the same; renting in the warehouse is the same; utilities that he pays inside are the same. This is our interpretation, and that's the basis of this.

MR. MESSMER: Right. Go back to – I mean one of the things in the document you show that the X13 to the consumer is going to be an extra $50 or $60, compared to the baseline. So that's telling me that the margin for that $60 is going to be – it's going to be much smaller than what the margin was for the base cost.

MR. LEKOV: So just go – to highlight this, this incremental markup applied to the incremental cost only.

MR. MESSMER: That's what I'm saying. No, I get that. I just don't think it's valid is all. Enough said.

MR. BROOKMAN: Okay. Thank you. Other comments on these two markup slides?

MR. LEKOV: So this was the questions about any recommendation aspect of the markup analysis. And with that –

MR. STEPHENS: Yes, I do have one.

MR. BROOKMAN: Yes, Charlie.

MR. STEPHENS: Only on manufactured homes, your numbers on the manufactured homes, new construction, look a little high to me. And I don't know if it stems from your terms of reference – you called it, I think, in the chain, a contractor, a manufactured home contractor. Where we live, they're called a dealer.

MR. LEKOV: Correct.

MR. STEPHENS: And they sell the home and they do arrange for the setup, which doesn't really have to do with the mechanical system, typically. But I'm trying to understand, when you say contractor, where do you get your markup for a manufactured home, as I say in our region, dealer, for the thing? Is he a contractor, or is he a dealer?

MR. LEKOV: So the one for new construction, you are correct, dealer or builder or general contractor, this is the term of the participant. And here are the sources that are used for the derivation of this particular markup. As you see, the general contractor markups comes from financial data from 2007 economic census, specifically from the residential building construction sector tables.

MR. STEPHENS: Well, yeah, and I guess what I'm getting at here is in the bullet on manufactured home, manufacturer and contractor markups. Manufactured home, manufacturing sector, I understand that, and that's for the making and assembling of the home and the installation of the – the buying and the installation of the HVAC system and components. But then you have all other specialty trade contractors. The people who sell the new home are not a contractor. They're more akin to a car dealer. They sell a home like a car dealer sells a home, and there is a markup, but I don't think the markup is a contractor's markup. A typical contractor's markup where we are is like 1.3. I think that you'll find if you actually look – I don't think that source is where you're going to find the right numbers is what I'm getting at here. I think you need to look more closely into how manufactured homes are sold, because I've never heard the term contractor applied to that level in the chain.

MR. LEKOV: Okay.

MR. BROOKMAN: Thanks, Charlie. Yes, Tom.

MR. ECKMAN: And I would recommend that DOE consult the group that's working on the new manufactured housing standards for the markups in that sector, since you have another rulemaking that's proceeding down those lines. Access to that information should be readily available.

MR. BROOKMAN: Thank you.

MR. LEKOV: Thank you. So with that, switching to the next precursor to the life-cycle cost analysis, which is the energy use characterization. And the purpose of it is to determine the annual energy cost. In order to do this, energy consumption of the furnace and product in the individual households needs to be determined with associated energy prices.

So it came through this morning, the way the energy use is determined in its essence, is sum of the energy use at each operating mode: heating, cooling, and constant ventilation for each household. The primary components are the operating hours and power. In addition to this, the analysis account for the effect of more efficient fans on the overall energy use of the household space conditioning equipment. The next slides will go in details of all those.

MR. ROSENSTOCK: Quick question.

MR. BROOKMAN: Steve, please.

MR. ROSENSTOCK: Are there plans to use some of the RECS 2009 data for this analysis as you go on through the NOPR stage?

MR. LEKOV: Absolutely. The NOPR phase will be based on RECS 2009, and we already started to download the tables.

So in order to do the energy use analysis, you need to have a sample of households. So if we start with RECS 2005, and apply a set of criteria – see the small four criteria at the bottom, and they determine whether the household actually includes the furnace end product. Once this is determined, we – you can tend to physically think of it as RECS 5000 households. We apply the selection criteria down to 3000. Now we are here at the house – we're splitting this mobile home versus non-mobile home part of the sample.

I'll focus more on the non-mobile home part.

We look at the households, separate them by fuel type. And as you see here, on the right side are the nine key product classes as discussed this morning. So the primary and most interesting point is how we develop the sample for the gas households.

So first, the entire sample is applied for non-motorized gas for the condensing, non-motorized gas for the … After that, we select just the households that are in the center region to use for the sampling for non-condensing, non-motorized furnace fans. We add another criteria, household – to the center sample – households that include central air conditioning equipment to identify the weatherized gas furnace fans. To this sample, to the sample that is for the center region, has central AC, we apply the criteria which is listed right there, that has gas water heater with some limitation on the square footage, to isolate the sample for hydronic air handler heating and cooling.

So that’s how primary the entire sample is developed and used in the Monte Carlo simulations for the determining the energy consumption for each household.

MR. BROOKMAN: Joanna Mauer.

MS. MAUER: Alex, can you just explain again why the identification of a house that has central AC indicates that it would be a weatherized gas furnace fan?

MR. LEKOV: So everything is based on the available data. Weatherized gas furnace is essentially a package that includes heating and cooling, so from the sample we are removing the ones that don't have cooling. They are not weatherized furnace fan …

MR. BROOKMAN: Abigail.

MS. DAKEN: So, Alex, this is essentially a follow on question because I didn't quite understand the response. When you say has central AC, does that mean that the household has central AC, or that central AC is included in the same product?

MR. LEKOV: So, step back. For the non-condensing, non-weatherized furnace fans we're using the entire sample that is incident US. Now, the same example, we look at households that must have central air conditioning. So I hope this answered the question. So –

MS. DAKEN: I'm sorry, would that include households that had –

MR. LEKOV: -- in order to qualify for as a weatherized gas furnace fan product, the household needs to have a central air conditioning.

MS. DAKEN: So a household that has a split system, central air conditioner, with an indoor coil and an outdoor coil, and then a non-weatherized gas furnace, would end up in your weatherized gas sample?

MR. LEKOV: Yes, it's going to be in this sample.

MS. DAKEN: Okay. Thank you.

MR. BROOKMAN: Ted Eckman.

MR. ECKMAN: So how does this account for – how does this market share allocation using RECS either 2005 or 2009, account for the federal standards change in 2013 for condensing versus non-condensing requirements?

MR. LEKOV: So I think we'll answer this when we talk about the baseline efficiency distribution.

So we have the sample now and we're starting to calculate the energy use. Here is the chart. Essentially, the household reflects the formula which you saw in the beginning. Furnace fan energy use you need to determine power, you need to determine the operating powers for each household. In addition, for each household we calculate the impact on the energy use. So the power requires the determination of fan performance curves and system curves. The operating powers, there are two separate methodologies for heating and cooling operating, and for continuous fan operating powers. The details are on the next slide.

So, starting with fan power determination. This chart is just an illustration. Here is – I'll go in additional details of describing how each of these are derived. So, in essence, from the manufacturer data we are deriving the fan performance curves in terms of air flow, the upper three, for each of the operating modes. Simultaneously with this, develop the power curves as the bottom three lines. And this we impose the system curves that's for this particular household, which allows to determine the operating mode at each of these three modes, and to arrive at the furnace fan power as shown on the right side. So that's the schematic. This is just one general presentation for a specific furnace fan design.

MR. BROOKMAN: Diane, please.

MS. JAKOBS: I just want to point out that if you look at this graph, I mean there's not any strange peaks, it's all kind of even flat if you look at the bottom three curves, and it's kind of – it's like the fan laws govern that at higher static, the energy consumption goes down. So there's not a lot of weird things going on. There's all this thing about manufacturers will game the system by only having one point. I mean this is kind of how they work, so –

MR. LEKOV: So that's an illustration, I hope the more specific slides will get us deeper in this discussion. Okay. So --

MR. BROOKMAN: Before we move on, Paul.

MR. LIN: Just one comment. I see that you've used three different fan speeds for the three different settings. Sometimes manufacturers utilize only two speeds of the three or four speeds that are available in the motor. So on a heat and a cool, it could be one of two speeds, and the constant fan could be one of the heating or cooling speeds, and not the low speed.

MR. LEKOV: So this topic has been discussed in detail in the furnace fan test procedure discussion, and this morning also quite a bit was touched upon. There is a – exactly – there may be some simplified cases that will not have settings for all three.

So let's start with a system curve variation. It's needed because it is how the operation of the furnace fan in the individual household is determined. And it is characterized by assigning an external static pressure value at the maximum cooling air flow operating mode. How is actually this incorporated in the analysis. As mentioned multiple times, DOE compiled a number of ESP measurement from 27 studies that includes furnace fan, single family and manufactured homes. Now, once we have this sample, here the table shows – illustrates this kind of – hopefully in a more clear way. We split the sample to two parts for non-mobile home products and mobile home products. After that we tender those two larger samples, looking at the sample whether it has air conditioning coil or not. As a result of this we are coming with two sets of data which essentially represents a distribution of values which are after that, randomly sampled for the households that meet these conditions.

MR. BROOKMAN: Diane, go ahead.

MS. JAKOBS: I just want to point out one thing. So, on the previous graph, manufacturers have to have three coefficients to describe one fan motor curve. Where we can describe every duct system with just one coefficient. So, I mean, it just seems disproportionate. I know this is an engineering assumption that people do to do load calculations and design ductwork, and it’s simplified. But, you know, the degree of accuracy is suspect. I mean it represents something, but I don't know that – I seriously doubt that you have it – while you have it under system curve derivation, I don't think you looked at whether the system curve represented the 1300 field conditions. You were just looking for the average static. If someone asked me to estimate a system curve, I'm sure I would come up with the same thing, I don't know how accurate it is. I mean I kind of doubt it's very accurate.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Just as a quick question, in terms of – again, there's all this data, you show the averages. Do you have any sort of standard deviations, or do you have the median value that – again, just for all the numbers that you were collecting, that type of data might be useful for us to see any sort of correlation, or just in terms of the range of values that you got in the field.

MR. LEKOV: So we can affirm the furnace fan test procedure proceedings, DOE published a list of all 27 studies, and the data is available.

MR. BROOKMAN: Greg.

MR. WAGNER: Greg Wagner. I looked through, not all 27 of them, but ten-plus of them, I've forgotten now how many, and I couldn't find a standardized methodology, or a method that, again, would allow you to average those. They're not taken in the same fashion in each of those test setups. So I would just say that averaging this is putting together a pile of stuff that's not necessarily equivalent. So if you look at study to study, they're not the same test setup.

MR. LEKOV: Maybe part to answer, DOE's analysis does not use average rates. Those are distributions, very wide distributions per sample, but this is just to show where the average of this distribution is.

MR. BROOKMAN: Additional comments on this?

MR. LEKOV: So we got the system curve, now let's focus on the fan performance curves. So first step DOE did is to derive the average fan performance curve, a set of average fan performance curves. So those were done for the six efficiency levels, essentially representing design options. In addition to this, at each of these efficiency levels, DOE developed a separate fan curve for the seven fan sizes listed here, from one through five turns. So if you think of a metric six by seven, starting with the 42 reference performance curves.

Here's the small picture in the bottom shows how this was developed.

In essence, DOE took the manufacturers' public literature for every single model, something between 700 and 800 models. We extracted all the performance data, flow and function of … and we develop – see how for each pressure there is a range of values. So for each of these cases we fit the curve to represent the range of this reported operating conditions.

Now once this is available, it's a need to fit it to match the FER values derived in the engineering analysis. This morning has been explained, I believe, in good details, that a single FER value was derived for each of these – for each product class and for each efficiency level. However, there are some differences between the set we developed, which is based on 800 models and accounts for the sizes compared to engineering. There are not very large differences. So, adjustment factors were derived to DOE's performance curve to match the FER values as described in the engineering analysis.

So as a result of this, since we need to do it for each product class for each efficiency level, and in addition to this, need to be done for all nine product classes, the sample answer with 376 furnace fan performance curves and those are the curves that are used in the Monte Carlo simulation when we do the sample – we do the sampling. So again, there is a DOE developed 100 representative performance curves to fit as close as possible to the operating conditions in the individual households.

MR. BROOKMAN: Diane.

MS. JAKOBS: All right, you said you used fan performance curves from literature. It's unusual to show the watts, so really you're talking about the air flow, right?

MR. LEKOV: You are right that some manufacturers – not all manufacturers, report the watts curve, but there are some that report the watt.

MS. JAKOBS: I'm aware of two.

MR. LEKOV: Yeah. It's a pretty significant sample.

MS. JAKOBS: It's a small group.

MR. LEKOV: Yeah.

MS. JAKOBS: So you only used their furnaces in your analysis, the ones that had –

MR. LEKOV: No, we used all that have air flow, and for the watts curve we used the ones that are from available manufacturers, which is a little bit smaller sample.

MS. JAKOBS: The TSD in the references, it shows like specific furnace specification sheets – are those the only furnaces that you used in your analysis then? So did you list which manufacturers furnaces data sheets you used?

MR. LEKOV: It's the spreadsheet actually includes the entire sample – is correct? Yeah.

MS. JAKOBS: But I mean, I don't – you can't have any Rheem data, right, because we don't publish it.

MR. LEKOV: Yes, there are other companies have also the watts data, but Rheem has the air flow data.

MS. JAKOBS: So that's what I was – so did you use our air flow data?

MR. LEKOV: Yes.

MS. JAKOBS: Okay. But somehow it's divorced from the watts part of it because we didn't give you that information. I'm just kind of a little confused about – there's kind of a part about what is a static and what is a CFM, and then there's a part about – to calculate FER you have to have the –

MR. LEKOV: Both of them. Okay. I could – maybe we could elaborate on the derivation of how this is used in actual sample for the manufacturer that reports just the air flow data.

MR. BROOKMAN: Yes, Victor.

MR. FRANCO: Hi, Victor Franco from Lawrence Berkeley National Lab. So actually we have air flow data for a lot of the manufacturers, especially non-weatherized gas furnaces. We only have for, as you mentioned, for only a few manufacturers the watts per CFM. To generate the air flow curves, we used – we try to use all the data. For the watts per CFM, we used to derive the power curves, we used the literature from just the available data. We have some test data that we were able to map also to some of the manufacturers, that was the 26 models that were tested, so that helps increase the number of manufacturers.

MR. BROOKMAN: Greg.

MR. WAGNER: When you did the testing, you did it to the AMCA 210 that's described in the –

MR. LEKOV: That's probably – Sam?

MR. JASINSKI: Yes.

MR. BROOKMAN: Sam says yes.

MR. WAGNER: I mentioned it this morning, but again, there's a difference in the way the correction factors are used between AMCA 210, ASHRAE

51 and the ASHRAE 37 that all these charts and data will be, and that is in ASHRAE 37 they correct as if it's a constant mass flow, so therefore you're correcting to standard CFM. In AMCA 210 you're correcting as if it's a constant volume pump and you're adjusting your pressure and power. So they are two different methodologies for correcting to standard air density. So the data is not – you've got apples and oranges again.

MR. BROOKMAN: Sam Jasinski.

MR. JASINSKI: Yes, Sam Jasinski, Navigant Consulting. Like I said, we're interested to look at the comments and make sure we understand what the differences might be between the test method that we used, which is proposed in the NOPR and based largely on AMCA 210 versus ASHRAE 37. But some of those test models, some of the models that were tested were compared to the performance data that were published in the specification sheets, and the raw data did not differ too dramatically between what we took for measurements using AMCA 210 and the measurements that were in the specifications sheets, which according to manufacturers, was taken with ASHRAE 37. So this is a very important issue and one that we want to make sure that we understand completely, so that the values that we're – the test procedure that we're using is appropriate, but also that the values we're basing our analyses on to conservation standard, are also appropriate.

MR. WAGNER: Greg Wagner again. I would suggest you take a look at that test data and process then because there should be a difference that is noticeable. Having done enough of these tests where we typically are running AMCA 210 because we make belt fans, but we also work with our customers and do testing with the ASHRAE 37 mode. And there's a distinct different between those curves, and it's a clear DC offset that you're going to see between those two. So if you're matching up, that means one of the two sets of data is probably all wrong. So I would just caution that there's some systematic error probably involved there.

MR. BROOKMAN: Okay. Thank you. Are we ready.

MR. LEKOV: So now we have the methodology. Here are illustrations of the results. This is the performance curve for a very specific case, non-weatherized gas furnace fan, non-condensing, three ton size, heating mode. And here are how the fan performance curves will look in this particular case.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. You said that the average … static pressure was about either point – 0.73 or 0.52, depending on central air conditioning in the previous slide. It ranges from 0.52 to 0.73, whether you have central air conditioning or not, correct?

MR. LEKOV: The average value is 0.65 because you need to weight it for –

MR. ROSENSTOCK: Okay. So again, looking at this graph, going from 0.52 to 0.75, the air flow ranges, I'll say from around 790 CFM to as much as 1100 CFM. For that furnace, what is the required CFM to meet the needs of that house?

MR. LEKOV: So, first, again this is a non-condensing, non-weatherized furnace fan, so the value in terms of power that you need to utilize reflects the three operating modes. The required CFM will be the CFM depending – for this particular product class, the average values it will be different depending in the distribution of the average value which is 0.65.

MR. ROSENSTOCK: I guess – Steve Rosenstock, EEI. My point being is if there's a need inside that house for at least, say 1000 CFM, some of the products will not meet the required CFM. Or am I missing something?

MR. BROOKMAN: Charlie.

MR. LEKOV: Yeah, the –

MR. BROOKMAN: We also have – why don’t you go first. Please say your name again.

MR. FRANCO: Victor Franco, LBNL. So we consider the requirements that the household needs in terms of an air flow. If – what’s usually done in the field is if the air flow requirements need to be at a certain level, you change the air flow setting. So what’s on the LCC spreadsheet then, the air flow setting for like say the PSC needs to be higher, it’ll go to the higher air flow setting. So it will consume more energy to meet the requirements.

MR. BROOKMAN: Charlie.

MR. STEPHENS: Charlie Stephens. I’ll just add that in the field what a house needs is a very fungible term. The average oversizing factor in the field is what results in some fairly short cycle times, so houses almost always get more than they need, based on the habits of most contractors out there, more air flow than they really require. So, you know, I’m looking at the error bands, if you will, in the field in these actual houses that we’re trying to use as representative of the whole population of house, and quite frankly, there's a lot of mushiness out there in those houses and I think what we're trying to do here is land on an average set of values to sample from on either side of average values and try to come up with something that is a reasonable approximation. And again, when we get down to this, we're looking at this from candidate standard level to candidate standard level. We're looking at differences in the end.

And I don't see any real problems here with the methodology that's going on. I just talked to my field tech during lunch who also added that he finds remarkable agreement between field conditions and how an air handler behaves under certain external static conditions, and the manufacturers literature in most cases. So it's actually more predictable than you think, and the least predictable part of this is the house itself, and how this thing is matched to a duct system in a house. So I think the methodology we see here is actually a pretty good, reasonable approximation given how messy it is in the real world.

MR. BROOKMAN: Go ahead, Victor, go ahead.

MR. FRANCO: Just a clarification. The adjustment is made more in terms of the safety requirements. So for example, there are some households that when sampled, they might go into one point something static pressure, and at that level you're going over the bounds of what you need in terms of air flow. So -- for those households. So there is obviously a band that is acceptable. Over that band is where – and that's a smaller effect in terms of how many households actually change air flow settings.

MR. BROOKMAN: Diane.

MS. JAKOBS: Well, that was one of my – that was related to my question. I'm kind of surprised by this linear line for the X13. Are you saying that that one maybe you change the motor speed as you went up in static or –

MR. LEKOV: No. That's --

MS. JAKOBS: I think after your last reply, that's not what you were saying.

MR. BROOKMAN: Victor, go ahead, and then back to Paul.

MR. FRANCO: So on the X13 is actually mostly based on Lennox data for a couple series of models, and test data. And for this specific three ton unit, that's a flat for actually for other curves that we have. It's actually more like the PSC, it's a little bit more of a curve, but it is decreasing, it's decreasing faster than the PSC curve usually. But it depends on the fan size and the product class.

MR. LEKOV: And also here, to bring up here note – see the distributions, so it is essentially representing performance conditions – a set of performance conditions at static pressure, so this allows to account for a number of models from different manufacturers if we have – if the data is available.

MR. BROOKMAN: Paul. Wait, Diane's not finished. Keep going.

MS. JAKOBS: Well, I mean, that's one way to look at it that you're accounting for this broad band by drawing a single line, or you could think that you're only accounting for a thin line and you're not accounting for the broad band. So it's a matter of opinion, you know, whether selecting one thing is really, you know, do you – as an engineer, you always have a broad band, nothing's ever exactly correct. So there's always the choice. You can pick the top, you can take – so –

MR. LEKOV: As you said, it's a methodology.

MS. JAKOBS: The watts will change dramatically.

MR. BROOKMAN: Okay. Paul.

MR. LIN: I guess the comment, and I'll

defer to a lot of our OEMs, but when I look at this curve, usually your PSC motor is designed at one specific point in terms of the fan load. As you increase the load on a PSC motor, it's not going to deliver more air flow versus a discrete torque or constant torque ECM motor. So to see a static pressure rise with more air flow on the PSC motor versus an X13, to us, it doesn't look right. The data that we've taken relative to an X13 motor versus a PSC motor on a higher static environment, we see more air flow delivery from an X13 versus a PSC high static. So, from this graph, I'm not seeing how it relates the data we've taken in our air flow chamber.

MR. BROOKMAN: Thank you.

MR. LEKOV: So –

MR. BROOKMAN: Wait just a second. Go ahead Victor.

MR. FRANCO: Just to point, this is for heating mode, this is for air flow – the curves for cooling would be different. I don't know if that's the maximum air flow, but that's the design that you were looking.

MR. BROOKMAN: Paul.

MR. LIN: Well, whether it's heating or cooling, it's a load on the motor, and regardless, the motor doesn't know whether it's in heating or cooling. It's only going to deliver its design load point, and it's only got so much torque available. As you increase the load on the motor, on the PSC motor, it's going to fall off that curve, and deliver less. Whereas an X13 will deliver up to a certain point and then it'll start falling off like a PSC motor. And then if you look at a fully variable PSM motor, you'll ramp the load up until the current limit, and then it'll start falling off. So that's why I'm saying the curves don't look like the data that we have in our lab.

MR. FRANCO: So one possibility – again, Victor Franco – is this is an average. Since this was based on one manufacturer, the other data is based on more manufacturers. This depend on the air flow setting for the heating speed, so potentially that's – that could be the –

MR. BROOKMAN: Sam Jasinski.

MR. JASINSKI: Yeah, just as a point of clarification that might help with the conversation, is the green curve, the PSC with controls – that refers to a model that uses a PSC that's driven by an inverter. So just in the conversation, comparing the X13 to the – there's two PSC curves there – you may be referring to the comparison with the red one, but the green one, as a clarification for everyone else, the with controls is referring with that inverter technology that we spoke about during the engineering analysis, if that changes anything.

MR. BROOKMAN: Mohammed.

MR. KHAN: Yes, this is Mohammed. Thank you, Sam, that's a very good clarification. And I don't know if the gentleman was going to respond to that, but since I have the mic, I was just going to ask you if you could please share that particular data specifying exactly what kind of PSC, with or without controls, the exact test condition specifications, and then we might be able to look at that and see how that might compare or marry up or doesn't marry up to the distribution that Alex was talking about.

MR. LIN: Yes, this is Paul Lin again. I think what we're going to do is submit some of that data that we've taken in the lab. We've taken manufacturer A, B, and C furnaces and applied a PSC motor to it and then in the same box, applied the X13 and then applied a fully variable system in the same box and compared static pressure versus CFM and we were doing that not for this particular rulemaking, we were actually responding to utility questions relative to static pressure and watts with various ECM motors. And so it just happens that this particular data is useful for this rulemaking.

But one comment about the averaging is, although the average data shows that, I think it’s – if you look at each individual case, it’s the same thing, which is the X13 is going to deliver more air flow than the PSC motor, the red line. And even though you have an average, that kind of skews that rule that we’ve seen in the lab, which is – you almost define physics here.

MR. BROOKMAN: Both Greg and Diane I’ve seen simultaneously.

MS. JAKOBS: Okay. Ladies first. Just from our understanding, you know, these guys they come and they explain this new whiz-bang thing and we try to make sense out of it in our applications, but the PSC, it drops down and – the red line -- it drops down pretty severely. And then when we got the blue, the two blues, you know, it’s almost a straight line across. So static pressure is like out of the equation. And then the way I understood X13, it’s kind of a compromise between the two. It’s better than a PSC and not as constant as the ECM.

MR. BROOKMAN: Craig.

MR. MESSMER: Having stared at millions of these curves, but looked at them in an opposite direction than what you guys publish them for whatever reason, normally flow is on the bottom and the static pressure going up the vertical axis, it takes me a little while to get used to looking at this way. But I can tell you that, to echo what these folks are saying, those curves don’t look quite right, and the PSC would be a more vertical curve in this type of arrangement. But that’s also dependent upon where you’re operating that PSC motor relative to its peak efficiency point.

So averaging a bunch of curves using a variety of different designs is going to give you really odd looking results that don’t necessarily reflect the typical or a median type of an arrangement. So to summarize, I guess, what you’re getting is a blending here that’s giving an odd looking curve to this process, and that’s what these folks are looking at and trying to figure out why this doesn’t look right.

MR. LEKOV: So Craig, it would be great if we hear about an alternative methodology, instead of averaging for a range of existing model data, what are other options, and DOE will look at those.

MR. MESSMER: I'm not sure where you're going with this, so I don't know how to pose –

MR. LEKOV: What would be an alternative approach to the averaging that is done this way here, basically deriving the performance curve –

MR. BROOKMAN: Diane, you want to start –

MR. LEKOV: -- for a range of available data.

MR. MESSMER: No, my question is I don't know where you're going, what's the end goal of this use of these performance curves.

MR. LEKOV: So these performance curves are after that used to determine the energy use of specific households that under these conditions, normalized – for example, this specific case.

MR. MESSMER: (off mic)

MR. BROOKMAN: Diane.

MS. JAKOBS: Well, I think if I was doing it, because you have such a large range of data, instead of just averaging it, I think I would want to look at like on either range, because it seems to me you're distorting the shapes of the motor curves. So it seems like it might be better to select one from the high range and one from the low and look at it, you know, at least as a sanity check.

MR. LEKOV: Yeah, that's an alternative.

MS. JAKOBS: Yeah, that's what you just asked.

MR. LEKOV: Yes.

MR. BROOKMAN: We're going to keep moving ahead.

MR. LEKOV: So the same sample, here are the power curves. So on the left side, in terms of watts per CFM, on the right side, the watts which … more clearly show for the same four designs.

MR. ROSENSTOCK: Doug?

MR. BROOKMAN: Yes, please, Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI, and I'm looking at the – and again, I appreciate the graphs – I'm looking at the graph on the right and so what I'm seeing here is – and again, remembering the static – average external static pressure that you had was from 0.52 to 0.73 in a previous slide – in terms of a non-weatherized, non-condensing gas furnace, what this graph tells me is that for those operating conditions, 0.52 to 0.73, and again I don't know what the standard deviation is, that the PSC fan with the controls is going to use more energy than the baseline PSC fan. Is that correct? That's what this graph says. And the reason I ask that is because in the technical support document later on, it’s saying that the annualized energy savings with the PSC with controls and I’m not sure how you get there from this graph.

MR. LEKOV: So remember that the household is not getting the average value – it’s a range of static pressures, so could be from much lower from what you are stating –

MR. ROSENSTOCK: Or it could be higher.

MR. LEKOV: -- or it could be higher.

MR. ROSENSTOCK: So again, I don’t know if it’s an average or a median, but again, looking at this graph and then looking at the – I’m just wondering if again, I don’t know what percentages within that range of operating performance or external static pressures, but let’s say 80 percent of the homes are within that 0.5 to 0.8 external static pressure range – again, I don’t have the exact number – I’m still not seeing – and later on in this analysis, in this preliminary analysis, how you’re getting any annual energy savings from going to PSC with controls.

MR. LEKOV: So with the PSC with controls is a very specific design. It’s essentially based on – it’s included as an efficiency level in this analysis and is based on actually single prototype developed five years ago and not in manufacturing. And the purpose of this specific design is to allow for a wide range of rotational speed and appropriate CFMs while using a PSC motor. So as Sam pointed, this is a design with inverter. As a result of this, it has certain advantages if you're going to, let's say, use it at constant ventilation. But on the other hand, if you use it at some higher static pressure in heating and cooling for longer hours, it may end up with results that you notice.

MR. ROSENSTOCK: But again – Steve Rosenstock, EEI – but based on your field results, again, you show that the average was 0.73 for the households with central air conditioning, so again, I don't know what the variation throughout the day or throughout the season is, but if it's not more than 0.2, it would be 0.53 to 0.93 – aren't you going to have a higher energy usage with that product?

MR. LEKOV: It's much wider than what you're just saying. But yes, that's correct in some fraction of households.

MR. ROSENSTOCK: Because I didn't see it anywhere, I'm not sure what that range is, so –

MR. LEKOV: In some fraction of households you end up with higher energy …

MR. ROSENSTOCK: Thank you.

MR. BROOKMAN: Victor, and then coming to Greg and then to Charlie. Yes.

MR. FRANCO: Victor Franco. Just to add then, the results you'll find a little bit of this discrepancy. On the heating and cooling in general, it's similar or lower performance or more energy use and the main advantage is on the constant fan. So on average you could get some energy savings in terms of electricity, and that's what you'll see in the end results.

MR. BROOKMAN: I'm not sure, but I have this general impression we're gaining on it here, I think, and I think the Department is earnestly seeking your comment on these methodologies and how to make sense of them from experts such as sit in this room, so Greg is first, and then Charlie.

MR. WAGNER: Real quick, I had a similar sentiment than when you look at these it's going to look like it's going to use more energy and since you're saying that on average it's always above that 0.5, it will use more energy. But this is the problem with also tying it to static pressures versus putting it against flow. If you had flipped these curves around and put them in a normal way, you would see it against flow and you'd have different numbers and different results, and it might be more indicative because the green line delivers more air and it wouldn't have to run as long, so it might make more sense. But this whole business of shoving stuff together like this when they have different shapes of curves, you're going to get skewed results that look like this.

MR. BROOKMAN: Okay. Charlie.

MR. STEPHENS: Yeah, this is Charlie. I think – I don't think I'd necessarily characterize it as skewed results. What you're doing here is statistical analysis. You're trying to represent – you're trying to come out with a single number at any given box in a matrix, based on thousands of samples. And when you sample all around, you're going to have houses that have no air conditioning; houses that have 200 hours a year of air conditioning like we do and where you've got 18-2200 hours of heating; you're going to have houses that have low static pressure in the duct system. There's going to be all different kinds of things, and you're sampling from all of those houses, and then looking at the net result in the end and trying to put a single number in a box. The single number could have to do with the fact that you selected a different manufacturer's system whose motors and fans run at a different point on that curve, above or below it. Or it could be just that it's a different static pressure, or it could be that – there's enough variables here that you just have to statistically have to try to come out with some sort of central variable that gives you an answer in the end, because the Department's required to come to an answer.

We do this with our field data all the time, and we actually go out and measure things. But we still, in the end, if we want to come up with some one number we have to somehow average and smush all that together with some reasonable answer, knowing that there is a distribution around the answer, you know, a standard deviation, if you will, around that answer. All we do is acknowledge that and say, yep, it's this plus or minus whatever, and is it reasonable within that range. And I think in the end, we're all going to have to look at the results and ask if it's reasonable within that range.

But again, I don't find anything that bothers me based on my own statistical work with real data from the field, doing exactly the same thing as we're doing here, only from – with field data.

MR. BROOKMAN: Okay. Thank you. Diane – we need to move on here shortly.

MS. JAKOBS: Okay. I just wanted to make one point. So we talked about the field static is so much higher than what's assumed for the coil only rating. And if you think back to when we developed, our industry with DOE, that at the time it was developed for the SEER rating, 0.2 inch static, if you're looking at the red line, that was a conservative number. I mean the watts went down, and it was only when we added the ECM and X13 where the slope is the opposite and it's rising. So it's not like someone specifically tried to game the rating and make things look in a way that was misleading, it's more like new technology has changed the original assumptions.

And I'm on a lot of standards committees and one of the things we've struggled with was this thing about not backsliding. And if you want to update things for new technology, but it's going to cost the efficiency to go in the wrong direction, you're not allowed to do it. So it's really hard to know what, what do you do? Because sometimes we make a whole bunch of assumptions when we put together these energy descriptors and as the industry learns, as installers learn, some of those assumptions aren't so good any more. But if you implement it into the rating, it may cause your energy descriptor to actually show an improvement for the same unit, and you're not allowed to do that.

MR. BROOKMAN: Okay. Thank you. Dave.

MR. WINNINGHAM: Just a general comment here that the control points of the static pressure ranges – we're selecting here from the field data – and really in a lot of cases, outside of what a manufacturer would recommend. And we're in the process of setting a metric in which we measure them that is outside of those boundaries. And if you look at these curves, what they would suggest is a large energy saving would be to shift that point to the left to reduced static pressures where you see the biggest improvement between the technologies. Because as you go out to the right, they're converging and you really aren't seeing the benefit of the other technologies to the same magnitude. And while the manufacturers have a concern around safety and reliability of the equipment and the installation, there's an obvious performance difference here that I think DOE needs to take into consideration.

I understand, you know, the people who are specifying want to have something that's real world, but what we have here is a comparison tool. So to compare one product to another, and I think as we're looking at that we should align it around where it's designed to operate.

MR. BROOKMAN: Okay. Thank you.

MR. LEKOV: Okay. So now we have the fan performance and the power. The next point is we need the operating hours. So the operating hours for each product, they're essentially heating or cooling … and capacity. For this analysis those values were adjusted for –

MR. BROOKMAN: Alex, pardon me for interrupting. I forgot and I dropped Jim Vershaw out of the queue. Jim, I presume your comments relate to the previous discussion, so Jim, why don't you do that now. I apologize, Alex.

MR. VERSHAW: Can you hear me?

MR. BROOKMAN: Yes.

MR. VERSHAW: Jim Vershaw, Ingersoll Rand. One of the things that really pointed up -- that last chart pointed out to me was how much the continuous fan hours and watts can skew what's going to happen in the real world. If you could end up with a system that could come up with a lower FER and yet if you don't use continuous fan, you'll use more energy, looking at the red and the green lines. And I've just got to wonder the value of putting in the continuous fan in this thing versus the number of people who do use continuous fan – and I think those are based maybe on a couple of states in the far north. I'm really concerned that we can end up with some unintended consequences by having that included in this whole calculation.

MR. BROOKMAN: Okay. Thank you. Alex, back to you. I apologize.

MR. LEKOV: All right. Continuing with the derivation of the operating curves in heating and cooling mode. As I said, basically, function of … and capacity of the equipment, corrected for fan … ratio and as well an adjustment factor applied. The adjustment factor is important basically it includes statistical data, predictions regarding the future building shell efficiency in terms of physical size of the household and shell attributes. And this is from EIA's 2012 data. Also the result is adjusted for the average climate conditions. The data we have is for 2005. We used the AA methodology to average it over the ten years period and there are two other conditions which are included in this adjustment factor.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Question on the last slide. Steve Rosenstock, Edison Electric Institute. In terms of building shell efficiency, I don’t know if I found that section in the technical support document. For the new homes is this assuming that all new homes will meet IECC 2009 or IECC 2012?

MR. LEKOV: This is based on the EIA’s forecast for the integrity of the envelope in 2018.

MR. ROSENSTOCK: Okay. Steve Rosenstock, EEI. In terms of forecast for new homes, I would suggest using the values shown in IECC 2012 because DOE came out with their final determination and states are supposed to update their codes by the spring of 2014. So you might want to use that for you new homes portion of your analysis. Thank you.

MR. LEKOV: Thank you. Now, for constant fan mode, it’s based on fan constant circulation study conducted in Wisconsin and Minnesota. DOE based the adjustment for the national sample using this dataset. However, it’s very different for the other regions in the United States. For the south hot, humid region, it’s ten percent of the value used from these studies, and for the north and south hot and dry, it’s half of it. The table shows actually the results from the study on the left side, and if you go right on the side, you see it drops half and drops by 90 percent in the last column. So those are the values used in the analysis.

MR. BROOKMAN: Diane.

MS. JAKOBS: I looked at this and I thought it made a really strong case that we shouldn’t consider circulating fan mode. I mean, 97 percent in the south don’t use it, and 84 percent in the north don’t use it, so I don’t see how this supports the idea that actually – because of – for a gas furnace, because of the hours, we’re actually attributing 20 percent of our FER value to the constant fan motor. But hardly anyone uses it, and then, you know, so it’s like – I forget – I think it was like 34 percent for heating and something – whatever it adds up to, to air conditioning, is less. So I would look at this data and I would interpret it completely differently, and I would say constant fan circulation is not a consideration.

We were on the – Greg and I were on a CSCA23 committee – in Canada, that’s different. They have a ventilation requirement in their building code, and there are a lot of people using the constant fan with a duct to the outside air, and they are using it. But here in the States I don't see that we are using it.

MR. BROOKMAN: Charlie.

MR. STEPHENS: Charlie Stephens. I hope to be able to provide some data on this. I would disagree. Five years ago, I would have agreed with Diane, but based on recent trends, both in ventilation and in the sales of rather expensive filtrations systems that contractors really love to sell, there is a substantial increase in the use of circulation mode where I live in the four states of the Pacific Northwest, and I hope to be able to document that.

MR. BROOKMAN: New home construction?

MR. STEPHENS: Mostly in new home construction, but also in older homes as well because again, this is an adjunct of a filtration system. What's being sold is a $400 to $500 dollar electronic filtration system, generally, and to use it and to make it effective, you have to circulate the air in the house. And we've got a number of houses that circulate 24/7, 8760 a year, at some speed that we've encountered out there. They're always running at some speed. And that's not the norm, but there are some out there that actually do this.

And it’s only – from what we can tell, it’s only in the last five years or so where this is becoming ubiquitous enough that we’re actually quite concerned about it. As I say, the driver is only half filtration, the other half is this ventilation requirement where one way to meet that is to let fresh air in. April Air is an outfit that makes the connection to the outdoors. It’s done on a timer. It is a – if you have a ducted system in the Pacific Northwest, it’s common to just put a hole to the outside with a damper on it, and you run your air handler in circulation mode on a timer, so many hours a day, typically about eight hours a day.

And this is new because the ventilation requirements are just now starting to come into the code everywhere. And I would suggest that DOE not only here, but in other places in the analysis, pay more attention to the last five years. In some cases your data only seems to go through about 2006 or 2007o, and I’m talking about financial data here too, we somehow stop short of 2008. There’s a lot of trends going on out there right now that I would suggest are not temporary, and I think we really need to bring some of this up to date. And circulating mode is one of those places that needs to be brought up to date, and I hope, as I say, to provide some data.

MR. BROOKMAN: Thank you. Greg. Oh, actually, Greg – Dave, do you want to follow on?

MR. WINNINGHAM: Actually, this is a question for Charlie. Charlie in the instances where you're using constant circulation, are you looking for a lower constant circulation value? Because there's equipment that's designed different ways. You can have a cooling speed, a heating speed, and a lot of equipment uses one of those two steps for constant circulation. Other manufacturers will choose to have a constant circulation value that's much lower. One of the outcomes of this could be that more manufacturers, an effort to drive an FER number up, drop that circulation speed and value.

MR. STEPHENS: Yeah, I – that's true. Everything you just said is true and I had an alarming report just last week of one manufacturer who may have a single speed for circulation, and it's the highest speed, which concerns us somewhat.

MR. BROOKMAN: Okay, Greg. Thank you.

MR. WAGNER: This is Greg Wagner. I was just going to say that since we're talking about anecdotal – as Diane said, we've served on committee up there in Canada, and they did expressly talk about this in the circulating mode because of that requirement of internal – of bringing in external – outside air and circulating for ventilation purposes on a continuous basis. What they're finding though, is that most people wind up turning them off once they get their first electric bill, so it's not being used nearly as much as what is reported. So that runs counter a little bit to what Charlie's saying, but I suppose if you're putting –

MR. BROOKMAN: This is Canadians, right?

MR. WAGNER: Well, no, I'm saying I suppose if you put in a really expensive house and have a lot of money, you will keep running things continuously and have that nice ventilation system going, because you can afford to do that.

MR. BROOKMAN: Okay. Keep going.

MR. LEKOV: This is the slide that request comment on this topic. I know we got some and probably more are coming in the written comments. Here I will just acknowledge that the impact of more efficient furnace fan is accounted for the heating – as an impact on the heating and cooling compilation, and it's a connection to Steve Rosenstock's this morning. Question here, it shows that for all products other than air handlers, essentially the analysis are accounting for the difference in power between the PEC and ECM and X13 motors from the furnaces and the air conditioning rule – the numbers are coming from the rule and explain there. So that's how it's accounted for.

For the hydronic air handlers, it's simply included in the metric, as explained this morning.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Steve Rosenstock. I really appreciate that, and just as a quick follow up, when it says the difference is three watts, is that a three watt increase or decrease?

MR. LEKOV: The furnace fan products with ECM motors use three watts more, from eight to 11.

MR. BROOKMAN: Thank you.

MR. LEKOV: So the next slide are an example showing the results for non-weatherized gas furnace both non-condensing and condensing. This is the energy use.

MR. BROOKMAN: Joanna.

MS. MAUER: Joanna Mauer. Has DOE provided either average annual electricity use or electricity use savings for the three different modes of operation separately? I was trying to find it and I wasn't able to find it in the TSD or the spreadsheet.

MR. LEKOV: They're probably not in the TSD.

MS. MAUER: Okay.

MR. LEKOV: The spreadsheet may allow for this derivation, but it would be a separate run.

MS. MAUER: I see, so it's not something you have. The comment is that I think it would be helpful if DOE is able to provide that kind of information.

MR. BROOKMAN: Okay. Paul.

MR. LIN: Paul Lin. So I just want to make sure I understood. Additional fuel use is because of the higher efficiency of the motors?

MR. LEKOV: Yes.

MR. LIN: And was the high efficiency on the cooling side taken into account, because you didn't have to reheat, or recool?

MR. LEKOV: Yes.

MR. BROOKMAN: Diane.

MS. JAKOBS: I just want to point out the units are different, and if you get it all in kilowatt hours, that the last column is more significant. So there's a conversion there. But just comparing the first two columns, so for X13, you're going to use half of the electrical – so if the annual electric use is 508, then the savings would be 290. So are you going to cut your electric bill in half, is that what you're saying? For the furnace?

MR. LEKOV: That's the average value compared to the baseline. From 798 will drop to 508.

MR. BROOKMAN: From the baseline.

MS. JAKOBS: Okay. But if you're looking at different columns –

MR. ROSENSTOCK: Thirty-six percent.

MS. MAUER: -- so it's 798 minus 290 is 508. Oh, okay.

MR. ROSENSTOCK: Thirty-six percent. Steve Rosenstock EEI. That's an estimated 36 percent reduction.

MS. MAUER: Oh.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Just a quick one, non-weatherized furnace fan, non-condensing and condensing, for the annual electric use that's both in the heating and cooling mode?

MR. LEKOV: Total. Total.

MR. ROSENSTOCK: Total, so –

MR. LEKOV: And continuous.

MR. ROSENSTOCK: So – and that's kind of average for those with and without the central air conditioning, right?

MR. LEKOV: The entire sample, yes.

MR. ROSENSTOCK: For the entire sample. Okay. Very good. Thank you.

MR. BROOKMAN: Tom Eckman.

MR. ECKMAN: This is based on the RECS distribution? Or is this per standard household?

MR. LEKOV: That's a result of everything I explained, all ten slides, the entire methodology when you derive the system curves, the performance curves, get to a specific household, do the calculation, do the sampling in a Monte Carlo, and you arrive at this average value.

MR. ECKMAN: And the AEO estimates of annual energy use for heating and cooling, or the RECS estimates?

MR. LEKOV: The starting points are the RECS estimates.

MR. ECKMAN: And you convert to AEO going forward, for projections? I just don't know how these weights – the underlying question that is whether or not the new furnace standards which – and the new air conditioner standards which go into effect during the period of time before this standard would go into effect, will change the annual loads you're using here to derive these savings, because the minimum values for both AC SEERS –

MR. LEKOV: Those are accounted for.

MR. ECKMAN: -- … going forward basis, using the AEO data.

MR. LEKOV: That is correct.

MR. ECKMAN: Okay.

MR. BROOKMAN: Greg. Alex, one more --

MR. WAGNER: I'm confused. When we look at that chart you just had, you look at the condensing versus the non-condensing, we see the condensing uses less watts of electricity in the baseline. All the way down, I guess. But on your FER data in the key product classes, it's the other way around. Why would there be a difference between the two?

MR. LEKOV: So this is energy use, kilowatt hours. The FER is normalized watts per CFM.

MR. ROSENSTOCK: The run times are less on the condensing side because they're higher efficiency.

MR. LEKOV: Yeah.

MR. WAGNER: No? I don't know how – it's kilowatt hours, so you're accounting for an annual run time in that, but we are accounting for run time in the FER as well. I guess they're just flipped from each other and so it makes – begs the question of, you know, what's the FER measuring, or is it an accurate reflection of what the energy use between the two different blowers would be?

MR. BROOKMAN: So, we're due for a break. It's now three o'clock. Let's see if we can do this in ten minutes. And resume at 3:10, and then maybe Alex and others can put their heads together and see if they can unscramble this – what seems to be divergent results. Okay.

So we're taking a break now. Everybody get up, move. We're going to resume in ten.

(Whereupon, at 3:00 p.m., the meeting was recessed for a 10 minute period.)

MR. BROOKMAN: I've asked Alex to pick up where we left off, which he says he's in a position to explain the divergence that Greg was referring to. Alex.

MR. LEKOV: So here is the explanation. We're talking about non-condensing furnace fan product and condensing furnace fan product. The sample for non-condensing is primary from the south where the condensing includes the north. The south is dominated by the cooling coil which is at high speed. So, while you have a large heating coil, but lower operating point. So that's kind of mathematically how you are getting to this.

So with that now we'll go through the life-cycle cost and payback period analysis. Basically we have the total installed cost, have the lifetime operating expenses, and applying a number of economic parameters to arrive at the life-cycle cost as well as the payback period. Most of you are familiar with DOE's approach to the life-cycle cost analysis. The primary thing here is that it's performed from the consumer perspective. The analysis models, the uncertainty and variability of input, using Monte Carlo approach, and is implemented in the Excel spreadsheet with CrystalBall software.

Starting with the components of the life-cycle cost analysis. Consumer price, not much to say here. We have manufacturer cost. For above baseline standard to the markups were explained. Applying sales tax, arrive at consumer price.

Installation cost. Installation cost for furnace fans, there is not much because the furnace fan product is installed in the factory as a part – it becomes part of the furnace fan equipment. There is one exception in this analysis for the external ECM furnace fan installation, we add some for installation cost primarily for check up and adjust the air flow.

Now the next component is you need energy prices, because energy prices multiply energy use you're getting the cost of energy is part of the operating expenses. So in this shipments analysis we are using the average marginal monthly prices, and those are essentially a product of three components which are the average annual energy prices, using monthly price factors, and marginal price factors. So, here are the sources listed for all these three components using this methodology. And I could go in some details. In essence, the average annual prices are for 2010 from these sources. The monthly energy prices are essentially the same sources, but over a 20 year period. And the marginal energy prices are from the RECS 2005 data, it actually provides the billing data for these regions.

MR. ROSENSTOCK: Question?

MR. LEKOV: Yes.

MR. ROSENSTOCK: Steve Rosenstock, EEI. I understand this and I guess my question is again, for the updated analysis, well especially for natural gas since the bottom's kind of fallen in terms of natural gas prices compared to four or five years ago, will those projections be updated based on, I'll say either AEO 2012 or other more recent forecasts?

MR. LEKOV: Yes.

MR. ROSENSTOCK: Thank you.

MR. LEKOV: And in line with what Steve just said, here is the methodology how we calculate the energy prices over the entire analysis period, and its primary source is the most current version of AEO 2012. So for the next round of this rulemaking, it will be updated with the most current AEO data.

Repair and maintenance.

MR. BROOKMAN: These are annualized, right? I'm sorry, go ahead.

MR. LEKOV: Yeah, they are annualized.

MR. BROOKMAN: Yes, Paul.

MR. LIN: Paul Lin. Just maybe just a question, because a lot of times I look at EIA data, because we try to factor in some savings calculations for some of our products. But if you look at California relative to the EIA data, it looks fairly low. I don't know if you take it into account the tier levels. As you consume more and more energy in California, you get more and more charges.

MR. LEKOV: So the answer is it is by geographical area, so we applied it by geographical area, and for the next round of analysis it will be even much more detailed than the 14 areas. It will be 27 areas because 2009 will have the RECS data and we'll be able to apply that.

MR. LIN: But my point though is that in the EIA data, I think California was like 15 or 17 cents average, and I know that that's not an average consumer price based on bills, because the 15 may be on the early stages of the tiers, but not at the end. That's where the consumer actually ends up paying. You probably –

MR. ROSENSTOCK: Steve Rosenstock, EEI. Well, if you look at the – there's only a few utilities that have that sort of increasing price tiers. Most utilities don’t have anything like that. They have seasonal pricing that will vary, but – what? Congratulations. So and – even in California, it’s revenue divided by sales is how they come up with the annualized value. California is – and Hawaii are kind of at the high end. There are many other parts of the country where the annualized price is like seven cents for residential. And especially some of those going to time-of-day pricing, some of them are getting prices as low as off-peak, three cents, four cents kilowatt hour. So prices are all over the map, but this again is a nationalized average, which I think is what this graph is showing, it’s not – it’s not bad at all.

MR. BROOKMAN: Okay. So let’s –

MR. ROSENSTOCK: But there are going to be some very regional specific, just like with natural gas, there are certain parts of the country that are going to be much more expensive than others.

MR. LEKOV: So getting into the repair and maintenance part, essentially, repairs occur if the fan motor lifetime is less than the furnace equipment lifetime. We determined the failure year, expressed essentially the motor lifetime expressing operating cost, divided by the furnace fan annual operating cost, the labor cost is coming from the RSMeans data and we – this is essentially through the center of the sample, we determine which households will encounter this expense. The maintenance cost is essentially just in this analysis, assumes that will be a blower checking as part of regular equipment maintenance, and it happened that we had a survey regarding the maintenance frequency of these type of equipment and we used from RSMeans the labor hour cost.

MR. BROOKMAN: Charlie Stephens.

MR. STEPHENS: I have one question here to make sure I understand the effect of your analysis methodology here, which is annualized repair costs. If the – I'm just going to throw out some example numbers. If the furnace lifetime is say 18 years and the motor failure for those that fail is 12 years, how many motor replacements will I pay for?

MR. LEKOV: Essentially one. You have, after the 12th year, another one comes.

MR. STEPHENS: But you're annualizing these costs. Are you annualizing the next motor replacement in year 13?

MR. LEKOV: Yes.

MR. STEPHENS: Then you really should not annualize these costs. You need to put these costs into the analysis. Because what you just told me is that by the time I hit the end of the furnace lifetime, I've paid for one and a half motor replacements, and that's not what actually happens.

MR. LEKOV: No, you're paying for a whole motor. This is how it's included in the analysis.

MR. STEPHENS: Well, are you annualizing the cost, or are you imposing them in year 12?

MR. LEKOV: It's annualized over the period with the total cost, I believe.

MR. STEPHENS: Well, you really need – there's a difference, when you're using discount rates, and depending on the discount rate the effect changes, but you really need to impose those costs. You don't pay those on an annual basis, you pay them when they happen in the year they occur. And I've made this comment before. You shouldn't be annualizing repair costs that occur every 12 or 15 years. If it's every one or two years, that's fine, but when you start doing that and annualizing it, you actually distort the analysis financially. So you really need to change that part of the analysis and not annualize the repair costs.

MR. BROOKMAN: Tom, you want to follow on?

MR. ECKMAN: Yes, treating it as a periodic capital replacement X years out, and then it's a discounted value back to the –

MR. LEKOV: So in the year of the replacement?

MR. ECKMAN: Yeah.

MR. BROOKMAN: Good. Okay. Thank you. Yes, Craig.

MR. MESSMER: Craig Messmer. Okay. The lifetime of the motor you said is in terms of operating hours, and it was based on the small motor ruling.

Does that differentiate the life of the motor if it's an EC motor or if it's a PSC motor, because they will be different? EC motors have a significantly shorter life span that PFC motors.

MR. LEKOV: We use a distribution of more the left. I don't believe that we used - that we differentiated.

MR. BROOKMAN: So in your supportive data, Craig, that would be helpful.

MR. MESSMER: I'm going to have to defer to my compatriots here that are motor manufacturers to tell us what the expected life is of these motors.

MR. LIN: Well, in the small motor rule, that talks to cap start, cap run, cap start induction run, and polyphase motors, and they're all fixed speed motors. So there's no consideration in there for ECMs whatsoever. So they're not in the small motor rule.

MR. MESSMER: Okay. So that's inappropriate to use that data then. We need something else, right.

MR. BROOKMAN: Paul, first.

MR. LIN: From a specification standpoint, I could be wrong, but I remember ECM motor life specifications from manufacturers to be the same as a PSC motor, on your specs.

MR. BROOKMAN: Diane.

MS. JAKOBS: I think that's true, but I don't think that's - well, when I talk about what our actual returns are and our warranty costs, that's what we ask for. That's not how it's playing out.

MR. BROOKMAN: Dave, you're next.

MR. WINNINGHAM: Yeah, I would agree with that, and I think the expectation is for them to be the same, but I think in the real world, they're not. More complex systems in our products tend to have different failure rates, higher failure rates. And I think for each of these technology levels you need to take that into account, into your life-cycle cost, because, you know, a lot of times you will have a motor and a control, and they're going to replace the whole thing. And we need to account for those costs accurately to come to the right conclusion here.

MR. BROOKMAN: Diane.

MS. JAKOBS: I think with the PSC motor that the bearings are probably the weak point, and then as we add the control board to the assembly, the control board with all the components and the potting (ph) and all that, that that's a weak link in the device. So we have a different failure mode with the high efficiency motors.

MR. BROOKMAN: Okay. Thank you.

MR. LEKOV: Another important component is to determine the lifetime. So, in general, it's assumed that a furnace fan lifetime equals the furnace equipment lifetime. For the individual product cost there is a different methodology for determining the equipment lifetimes, and it's based on an analysis for not only the … furnaces, it’s based on the analysis which were performed also for the furnace rule, and it uses a combination of shipment data, REX data on the age of the furnaces, and the historical HS data on the stock.

For the mobile home and electric furnaces, we use the decision … survey, and those are the sources and the methodologies used for the determination of the furnace fan lifetime.

The average values are summarized in this table for the individual product cost.

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. I can’t remember – I’m trying to think in the – I’m just kind of – and again, maybe other people – in the small motor rule, I can’t remember – what was the lifetime – I thought it was like a 15-year lifetime for those motors that were under the small motor rule.

MR. LEKOV: So I would just like to – essentially we are talking about the entire furnace fan component here, in terms of assumptions for the lifetime. The failure of the motor is accounted in the repair and maintenance, the right rate.

MR. LIN: Paul Lin. I think you just be careful with taking the small motor and then cross-referencing that over to an HVAC motor. The design of a general purpose duty small electric motor as defined by the DOE standard is much different than an HVAC motor. There's different requirements and loads on those motors. Diane mentioned the bearing being the weakest link on most HVAC motors. It's sleeve bearing on the PSC and ball bearing on the ECM. And on the general purpose, small electric motor, they're all larger ball bearings with, I would say, higher loads and a lot of times there are different application environments that may reduce the life or may increase the life relative to the HVAC environment. So I think drawing a comparison between the two may not be accurate. The HVAC motor is an air-cooled rated motor, whereas the small electric motor is not. So there's a big difference between the two.

MR. BROOKMAN: Okay. Steve.

MR. ROSENSTOCK: Steve Rosenstock. Yeah, again, thank you for that. Just kind of following on, so you would say that the HVAC motors would tend to have a longer life based on the operating conditions?

MR. LIN: I think the HVAC motors have a more benign environment versus the small electric motors.

MR. ROSENSTOCK: Okay. Thank you.

MR. BROOKMAN: And would you say, looking at this table that this is an accurate reflection?

MR. LIN: Paul Lin. This table here is referring to the appliance equipment.

MR. BROOKMAN: Yeah.

MR. LIN: Is not referring to the life of the motor, so I can't fault the distinction between the two.

MR. BROOKMAN: So we can - go ahead. Diane.

MS. JAKOBS: Diane again. Yes, I think this reflects the life of our furnaces, and especially, you know, after 15 years, you have to change the motor out, you're good to go for another ten years or more.

MR. BROOKMAN: Okay. So this winter I could be in trouble, right? Go ahead, Craig.

MR. MESSMER: Is this slide saying that the furnace fan is the life of the unit?

MR. LEKOV: The furnace as a whole analysis in terms as it's a unit in the analysis, the furnace fan product equals the life of the equipment.

MR. MESSMER: Okay. They typically get replaced when the motor gets replaced?

MR. LEKOV: Correct.

MR. MESSMER: So -

MR. LEKOV: Oh, that's a comment.

MR. MESSMER: They change out both parts at the same time.

MR. BROOKMAN: Okay. Diane.

MS. JAKOBS: So you're saying when you get a new furnace, you don't keep your furnace fan because it has some life left in it, you're done with it when you replace your whole furnace system.

MR. LEKOV: That's correct.

MR. BROOKMAN: Okay. Dave.

MR. WINNINGHAM: And just back to the life issue. The motor side of it can be one thing, but how a manufacturer applies it - and some manufacturers may choose to be more aggressive than others and to the operating window that they're placing that motor in. So I don't think that just a generic statement around, you know, the expected life of an HVAC motor is, you know, from the suppliers is X because in most cases we're specifying to them what we need from them for performance and we kind of choose where we're going to operate it in regard to temperature rise and bearing temperatures.

MR. BROOKMAN: Okay.

MR. LEKOV: So, DOE uses discount rates to determine the lifetime of the operating expenses for the product, and the methodology is to derive those discount rates from estimates of the finance cost to purchase a residential product from the large federal reserve board survey of consumer finances. The sources at the last bullet. There are actually a number of surveys, each of them contain 200,000 data points, and the finance cost is essentially represented as the financial cost of any debt incurred to purchase the product or as an opportunity cost.

Now, here essentially, the interest rates that are encountered in both new construction and replacement, I will repeat - this is a question - those are real interest rates. They account for the inflation. In essence it's when people ask how we compare with the current one, you add three, approximate.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. So, the – for the mortgage, it's basically assuming that it's a real rate of three percent, but the nominal rate of six percent. Is that a good way of kind of looking backwards over the last, I'd say, 20-plus years.

MR. LEKOV: '89 through 2007, about 200,000 data points. And I guess the issue with replacements, again, there's no data from 2010. I know it would be a real interest rate of – a nominal interest rate of about eight percent. Looking back over 20 years, that might be a little on the low side, just because interest rates were a lot higher in the late 80s, early 90s. So, again, it's kind of in the weeds, but again – and especially in terms of replacement, especially after the recession, I have no idea how more people are financing the replacements but it's much harder – I think it's probably much harder for a lot of people to get loans or home equity loans than it was just seven years ago, so that might also push up the real rates as well.

MR. BROOKMAN: Other comments on discount rates?

MR. LEKOV: Product assignment in the base case. Base case product efficiency assignment reflects the projected market share of products at different efficiency levels, and it reflects the fact that not all consumers purchase products at the current minimum standard, as well as the LCC recognizes that the consumers already purchase products at efficiency greater than or equal to projected standard level. So they are not impacted by the standard.

The approach taken is - the sources for the methodology are explained here in the bullets. Basically, we're using historical data that comes from sales of furnace by efficiency and by product class which is not available, so we use stakeholder comments from the furnace rule which stated that the ECM share rose from ten to 30 percent within the last five years. Just for the PSC product classes, there was no data, so it was assumed that 50 percent are at the baseline level and 50 percent are at improved PSC motors, and there are no designs representing PSC with controls.

Regarding the market share projections for the ECM motors. So if it's done based on the fraction of motors - fraction of equipment with ECM motors in the current directories, which is 45 percent in 2010, we assume that this fraction of 45 percent will actually meet the market share in 2080. And the market share in replacement versus new construction was determined from Canadian survey.

MR. BROOKMAN: Diane.

MS. JAKOBS: I know in 2010 public meeting I said that 30 percent of our sales were going to ECMs, and back then when we had, I don't know, tax rebate it was called, and we're all geared up, you know, everybody's going high efficiency, and last year it all turned back around and everybody wants to buy the bottom. So you don't have that graph, but it's in here, you know, where it shows this big bleep, and then you go up from there. We've actually come way back down. And I don't know where it's going to be. We're kind of focused on the lower end of our offering because that seems to be where we need to be competitive.

MR. BROOKMAN: It's come all the way back down to where it was? Wow. Dave.

MR. WINNINGHAM: Yeah, I don't have the data specific, but it has - it is turned more complete down.

MR. BROOKMAN: Okay.

MR. LEKOV: So I assume it's also at the comments right now. And here are the life-cycle cost and payback analysis report from DOE's preliminary analysis for the furnace fan products.

MR. BROOKMAN: Craig.

MR. MESSMER: It's Craig Messmer. I didn't read all the way through the technical document, but the lifetime operating cost includes the cost of the repair, the replacement of the motor as well? The average lifetime operating cost?

MR. LEKOV: As part of the operating expense.

MR. MESSMER: Well, somebody's getting a good deal. Thank you.

MR. BROOKMAN: Well, I mean – Craig, you should feel free to offer you additional thoughts on this, how this could be improved.

MR. MESSMER: I mean, replace an EC motor, I mean I've seen prices in contractors that charge customers over $5-600 dollars sometimes, and this is already $800 for the average lifetime, operating cost for the whole unit. So if you replace that motor one time, you have nothing left for the electricity for the whole use. So I'm not – you don't really say what the repair costs are, do you?

MR. LEKOV: I don't think it's listed here, but it's in the TSD.

MR. MESSMER: Okay. I'll have to take a look at that more carefully, because I think it may be under-reported.

MR. BROOKMAN: Charlie Stephens.

MR. STEPHENS: Charlie Stephens. Yeah, I think you've got to remember this is all rolled up into one number. Not everyone out there got repaired. So the overall number of homes that had a motor replaced might be three percent or four percent or something of the total. So, when I weight that in the costs, it's not $500 bucks, it's not even $100 dollars, it's probably more like $45 dollars or something because it's only a fraction of the homes that actually had to replace a motor. So this is a very rolled-up set of numbers. And it’s more like an expected value in a distribution, really.

MR. BROOKMAN: I saw Dave first.

MR. WINNINGHAM: Well, just to echo what Craig had mentioned. I think the markup in the after market for replacement parts, you know, after the warranty period is much, much higher than what you would find for an OEM. That combined with the difference in failure rates, I think we need to be careful that we include a realistic view of that in these life-cycle cost.

MR. BROOKMAN: Okay. Thank you. Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. It might be — and again, I think I’m going to agree, because if you take a look between three and four, in a previous slide, the savings were about the same, 290 versus 265 kilowatt hours, but life-cycle cost changes between three and four are quite dramatic, both because of initial cost and lowered reduced lifetime energy savings, plus, probably, some of the repair costs. So go from a five year payback to a 22 year payback, something’s going on there.

MR. BROOKMAN: Paul.

MR. LIN: Paul Lin. Just wanted to comment because I’ve heard some of our OEMs talk about replacement of the whole ECM. We spend a tremendous amount of energy and time educating the contractor base that - of how to diagnose between a control failure versus a motor failure. So we offer control only replacement, as well as a motor only replacement, to try to tackle the total cost of install. So it's not – so after the markup, it's not the whole motor. It's hopefully a smaller portion of the cost than what it used to be.

MR. BROOKMAN: Okay. Tom Eckman.

MR. ECKMAN: I have a question, this is to the manufacturers and motor manufacturers, both, whether the X13 type technology suffers the same fate because it has a control board too. Is it a higher frequency replacement item than the ECM? And is it like the ECM in terms of magnitude, that it's double your PSCs?

MR. BROOKMAN: Diane.

MS. JAKOBS: Just this specific point in time, X13s are more of a problem for us this month than ECMs. But they're newer, so I don't know that that reflects on the technology. It's both. When I was talking about double, we were talking about –

MR. LIN: Both X13s and ECMs.

MS. JAKOBS: Yes.

MR. BROOKMAN: Dave, you want to weigh in here?

MR. WINNINGHAM: Yeah, I think, you know, looking at the various technologies and looking at what the real world failure rates from various manufacturers would be a good exercise. We're not here to say it's poor motor designs, but we do see higher ORT (ph) rates and failure rates in the field of more technical products.

MR. BROOKMAN: Okay. Terry Small, I see you've raised your hand. You're next.

MR. SMALL: Terry Small with Mortex. I think this just proves that the consumer might know something that we don't know. I really think that choice three, the X13, the payback period from our experience of what we're paying for the motors is going to be much lower, you know, it might be eight or ten years. And I'm not sure that's an acceptable payback period when you consider you're making some generous assumptions about discount rates, et cetera. So, maybe the consumer actually is voting on an economic basis when they're tending to stick with PSC motors. It's my opinion.

MR. BROOKMAN: Okay. Thank you. Final comments on this chart. Noting that you have plenty of time to write copious comments and send them in.

MR. LEKOV: So DOE invites comments and recommendations regarding overall life-cycle cost analysis.

MR. BROOKMAN: Joanna, you have a question?

MS. MAUER: Why was 2018 chosen as the first year of the analysis period?

MR. LEKOV: That's the five year period after the final rule.

MS. MAUER: And why is the assumption that the standard would have gone into effect five years after the final rule?

MR. ROSENSTOCK: That's typical. Steve Rosenstock, EEI. That's typical for motors, five year lead time.

MS. MAUER: This is on furnace fans, so I'm asking about furnace fans.

PARTICIPANT: (comment off mic)

MS. MAUER: So again, this is not furnace, the furnace rulemaking, but a furnace fan rulemaking.

MR. BROOKMAN: And we can accept an affidavit on that point.

National Impact Analysis, Shipments Analysis

MR. LEKOV: We discussed the consumer, let's now focus on the nation. The national impact analysis has shipments and - shipments component and national impact analysis component. So, the national impact analysis, we need an estimate for the national energy savings as well as the national economic impacts, which are presented in terms of NPVs.

Now, here is the process. Essentially, starting with some inputs which come from the life-cycle cost -- primarily from the life-cycle cost analysis and the results from the shipments model, we're going into the calculation process to determine the national energy savings and national consumer economic impacts. And after that, those are reported in terms of quads and net present value by estimating the savings over the period, 2018 and 2047, and same for the NPV calculations for the products.

Starting with the shipments analysis. The shipments projections are done by markets. Three markets are identified for the furnace fan products: New construction, replacement, new owners. The new constructions are coming from new housing construction projections and historical market share. The replacements are using the product lifetime applied to the product stock. There is a market segment called new owners, this is for the existing buildings that acquire furnaces or furnace fans for the first time, and it's in this particular market to include also consumers that switch between the furnace fan product classes.

In addition, the projected shipment inputs are done separately by region, north and south, and in accounting for impacts of standard levels, the shipments are adjusted using the price LCC. And I'll be talking in more details during the next several slides.

Now, same thing here what I just said verbally, it's presented on this graphic.

Now, shipments model input. Very busy slide, but essentially includes all the information if you want to read it. What are the sources for the historical shipments? What's happened in the replacement shipments? Shipment sources for the shipments to new housing. We're talking also about how we develop the so-called new owners, and I was pointing to the source of calculation of condensing and non-condensing market shares.

MS. JAKOBS: Can I ask a question?

MR. BROOKMAN: Yes, Diane.

MS. JAKOBS: So I'm looking ahead at the graphs, but -

MR. LEKOV: Which one? The shipments model results?

MS. JAKOBS: Yeah, the historical one, that looks familiar. And the next one, though - so the next one, you're kind of assuming we're going to go back to 1992 and just go back on our old trajectory, which I really wish would happen. So part of your analysis - you're so detailed - but are there housing projections? I mean there are a lot of houses that have been foreclosed on, and they're not - no one's living there any more. All that -- is a housing stock expected to go back to where it used to be.

MR. LEKOV: So the slides here, the model explains how we arrived. Those are all those details of the shipments model that utilize the sources listed here to arrive at this conclusion.

MS. JAKOBS: But you don't really talk about how many houses there are that are going to need this equipment, and that might -

MR. LEKOV: No, in fact, that's an accounting which is done exactly this way within the spreadsheet. That's published on the DOE website.

MR. BROOKMAN: Charlie.

MR. STEPHENS: Alex, I can tell by looking at your graph there and knowing what your furnace lifetimes are, that there's something wrong with your model already because when you see a 50 percent or nearly 50 percent drop in 2008 shipments, which I think most of us know was due to housing start failure, there should be an echo of that about one furnace lifetime later, and there's not even a tiny ripple in your projections out there. All those houses that didn't get built, that didn't get new furnaces, aren't going to get replacement furnaces either. So I don't know where that echo is, but there should be one there.

MR. LEKOV: So this reflects essentially the AEO's projection of the new housing start projection. So this is what it is.

MR. STEPHENS: This is all shipments, right?

MR. LEKOV: Correct.

MR. STEPHENS: Including replacements?

MR. LEKOV: Including replacements.

MR. STEPHENS: There should be an echo of what you're seeing on the left there. If I play out your furnace lifetimes, you know, there should be an echo of that somewhere, and it's not there. So I don't know where your model went wrong.

The other thing is that I've got a bunch of houses that are being built for me right now in a pilot program that aren’t going to use any air handlers or ducted systems because they’re design space heating loads are between 12 and 15,000 BTU per hour. So this is a trend - the codes are going there, and there aren’t any furnaces, ducted systems that are small enough for these houses, and so the people who are building these houses are using other means. And I think it’s a trend that you need to pay attention to, because by the time you get out 20 years from where we are now, which is way less than 20 years from the time this takes effect, 2018, things will have moved to the point where, unless we reinvent the air handler and the furnace, I don’t know that you’re going to maintain anything that looks like an increase here.

And I don’t - I’m not going to say anything about AEO, but the fact is that the trends in the marketplace that we’re seeing, and that in part, my organization is actually driving, suggests that any increase out there is probably ill-advised in your projections.

MR. BROOKMAN: Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. You always have to make a projection and I think that I would say that this numbers look a little ambitious for a couple of reasons. Number one, the era especially from 2000 to 2007, was the housing bubble and new homes were being built at a rate like - single family homes, about 1.2, 1.4 million per year. And the latest numbers that I saw in terms of houses built are about 600,000, and I think that might even include multi-family as well as single family. And new home sales, single family home sales were – well, they jumped up to all of 350,000 on a seasonally adjusted average. So I don't know how long it will take. It might be much more of gradual slope than what's being shown here, that there's going to be some sort of explosion starting in like 2013 or so. And the 2009, 2010 and even maybe some of the other numbers were helped by federal tax incentives that disappeared. I believe they expired at the end of 2011 or 2010, I can't remember – no, 2010, that was when the rush was. They were in effect from 2009 to 2010. So again, there's – again, I'm trying to – I know it's AEO, but I don't know what economic factors are going to lead to this explosion of shipments back to where it was in – during the housing bubble. Again, this is just personal opinion that that I think that rise is going to be much more gradual than what's being shown here. Again, thank you.

MR. BROOKMAN: Yes.

PARTICIPANT: I think another thing you're seeing evidence of here, and that bled over from the 2006 minimum efficiency increases, particularly on the air conditioning and heat pump side, is that people chose to repair instead of replace. And I think that is still an ongoing trend, and as we look at rules that potentially put into place more expensive equipment, that trend could possibly continue and actually be a detriment to seeing increased energy savings by people being able to afford newer higher efficiency equipment.

MR. BROOKMAN: Okay. Thank you. Greg.

MR. WAGNER: I would echo that, that you do see more replacement parts being sold. Also if you would look at the use of room air conditioners, those sales have continued to increase. So people are finding other alternatives to the expensive options of new equipment.

MR. LEKOV: Are there any observations regarding heating equipment?

MR. WAGNER: The repair, again, they're doing what they can to repair.

MR. LEKOV: Repair is in essence, a delay.

MR. WAGNER: A delay, correct. Replace components. Parts.

MR. BROOKMAN: Okay. Thank you. Yes, Alex.

MR. BOESENBERG: Alex Boesenberg, NEMA. For what it's worth, there are some comments in the distribution transformers rulemaking that are very similar in that the - some of the proposed increased efficiencies, utilities directly stated they would repair existing units to old efficiency levels rather than buy new. So there's other industries with the exact same trend, largely owing to the economy and first price cost - first purchase cost, whatever you call that.

MR. BROOKMAN: We kind of moved very quickly over the first slide, the precursor slide, the inputs. If that's okay, that's great, and we move to the graphics. Additional comments on all of those, and maybe you can keep going, Alex, talk about the line graph.

MR. LEKOV: So basically this is the outcome of the shipments model. Here shows the baseline - this is essentially a line from the previous chart, and shows the standard cases, and as here, … there is a, in case of higher cost, we're seeing a drop in the purchases, and delay, essentially, which is a little bit further.

MR. BROOKMAN: Yes, Diane.

MS. JAKOBS: If you just look at like the foreseeable - I mean, it starts at 2015, so like 2016, 2017, they're going to go up at an amazing rate, which will be good, and then - I wish this was true. I would echo Steve's comments. It's so hard because it's been so erratic, and we have - even if you look at the slide before, we had all this - a whole bunch of sales, and those furnaces are going to wear out. So maybe it's going to be compounded, but just like this dip is going to be echoed in 15 years, I can see it's really hard to make this assumption, and this seems to be very aggressive.

MR. BROOKMAN: Thank you.

MR. LEKOV: So, from here we have the shipments results. We're going to calculate the national impacts, and here are the inputs that go into the national impact analysis. Annual energy consumption per unit, this is from the life-cycle cost analysis. Shipments, from the model just described. The equipment stock from uses annual shipments and the lifetime of the product. And the national annual energy consumption is essentially a product of the annual energy consumption and the equipment stock.

Here it's important to say that DOE actually applied a rebound impact for this product, thus reducing the economic national economic benefits, and those came from the - they are based on the 2009 Wisconsin study. They were applied- somewhat differently to the north and south. And in addition to this, the national impact analysis using .. source conversion factors for converting the … energy consumption into primary or source energy consumption, and those are from NEMS (ph)

In this case, DOE particularly requests comments on the values used to characterize the rebound effect.

MR. BROOKMAN: Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, I don't know if I'm sure that study is available, but in terms of that field study, there was a state standard requiring ECM furnace fans, is that what I'm reading?

MR. LEKOV: No, it's based - actually the study did a targeted replacement of furnace fans with - furnaces with PEC to ECM models, and they over a period of time, they calculated how people are using a constant ventilation, constant circulation. And they found that it's quite significantly more people are using constant ventilation.

MR. ROSENSTOCK: So, but those are replacing the furnace, not just the furnace fan in those cases, is that correct? Again, it's a component system thing again, because I think that's going to play a big role in terms of - my opinion - it'll play a big role in the rebound effect.

MR. LEKOV: My understanding is they're replacing the entire equipment.

MR. ROSENSTOCK: The entire furnace, okay. Two comments. Again, we're just looking at this component. I'd be very surprised to see rebound effects that high because you have the same furnace. If and some - you're just looking at the component, you're just replacing the fan, you're not replacing the rest of the furnace for some reason, again, just looking at the fan as a component, because that's what this analysis is about, the furnace efficiency is the same. The thermostat settings are the same. I don't see how much of a rebound effect you're going to get because in many people's eyes, you may or may not get that much energy savings. You replace a furnace, I think some of these rebound effects might be available because, again, people might think oh, I've got a much more efficient furnace, I can raise the thermostat a little bit. So I think if we're just looking at the fan, especially I think a 20 percent number might be a little on the high side. I don't know about the 10 percent, but, and again, but if you're assuming – again, just for the fan, those numbers might be high, but if it's the whole furnace, 20 percent might still be a little on the high side, but again, that's just my thoughts on that. Again, it's all a matter of how we're looking at this analysis.

MR. BROOKMAN: Mohammed.

MR. KHAN: Mohammed Khan, DOE. I just want to point out that if you're in the constant circulation mode, only, so you're just running the fan that's in the furnace or AC unit or air handler, whatever you want to call it, you're not heating or cooling. You're just moving air. So I would think it wouldn't matter.

MR. BROOKMAN: Charlie Stephens.

MR. STEPHENS: Charlie Stephens. I mentioned this earlier and I don't want to go into it in great depth, we're running late, but you're not just moving air. You're filtering air. And you're going to say in a lot of cases I don't know whether there's a correlation or a causation here. I don't know. I'm not convinced that people are doing this because they bought an ECM equipped furnace, or because the contractor sold them a great electronic filter system and promised them really good indoor air quality if only they added another $500 bucks to the job, and I don't know whether it mattered what kind of furnace they put in or not. But I know that every time I've had interaction with these contractors and people who have, there has been an attempt to upsell a filtration system, and it almost always comes with circulation attached. And the other piece is ventilation. There is ventilation going on here, and they are sometimes using this in a ducted system. They're using the air handler to distribute the fresh air that they bring in on the return side.

So that's a trend and you can't ignore these things because they're going on. But I don't think you can attribute it as rebound effect to the choice of an ECM motor. If you require ventilation because the code says you have to have ventilation and you choose this inlet fresh air to do it, it doesn't matter what furnace you picked, or what the motor is, you're going to have to run it so many hours a day, regardless of what's in there. So then you save a little energy if you pick the more efficient fan.

But, you know, the fact is, to really apply rebound effect, there has to be a cause and effect, and I'm not convinced that these things are related. The choice of an ECM motor results in more circulation time.

MR. BROOKMAN: Diane.

MS. JAKOBS: I read this paper a long time ago, and I'm from Chicago, and I'm close to Wisconsin. But my impression from reading it was more that during the shoulder months, that people open the window and run their circulation fan to distribute the air. So it's not necessarily a filtering, that it was just to distribute the air within the house. And it seemed like it was a pretty good study, that there was a significant reason for where they went from PSC to ECM, and it seemed like a good study.

MR. BROOKMAN: Okay. Thank you.

MR. LEKOV: So, here is an illustration of how the ECM market share, in the absence of standards, was calculated. It reflects the two, the ten percent and the 30 percent point, and 45 percent in 2018.

MR. BROOKMAN: Go ahead, Diane.

MS. JAKOBS: So in your curve there, I would go back down to 15 percent in 2011, and see what that does to your curve. It would probably make it go way up, right. But – there was a significant event when the tax rebates ended.

MR. LEKOV: So more data points would be appreciated.

MR. BROOKMAN: Okay. Thank you.

National Energy Savings and Net Present Value

MR. LEKOV: So, I'll go directly to the – those are the national energy savings for the product classes based on the preliminary analysis.

MR. BROOKMAN: Joanna.

MS. MAUER: Joanna Mauer. In the TSD there is some discussion of double counting of cooling savings. Is that relevant to the scope that's included in the preliminary analysis, the issue of potential double counting of energy savings?

MR. LEKOV: The scope was discussed this morning, and the equipment that includes -- some furnace fan equipment is not considered in this rulemaking, and it was listed on one of the first slides this morning.

MS. MAUER: And is that equipment that's excluded where potential issue of double counting would come in, not for the equipment that has been included in the scope.

MR. BROOKMAN: Let's hear from Sam Jasinski.

MR. JASINSKI: So one of the key product classes, weatherized gas furnaces, actually includes the central air conditioner component, so it does have a SEER rating, so that one would be subject to the CAC rulemaking, and that is where – an example of where this double counting may occur, and has to be considered in the energy savings.

MR. BROOKMAN: So for those of us that don't know, what is double jumping?

MR. JASINSKI: Double counting is –

MR. BROOKMAN: Oh, double counting.

MR. JASINSKI: Yes. Essentially the SEER rating used for CAC and heat pump products does consider the fan electricity consumption to a certain degree, so Alex can explain in more detail, but measures were taken to be sure that any savings attributable to the SEER standard would not double counted in these numbers.

MR. BROOKMAN: Got you. Okay. I obviously mis-heard the term. Okay. Other – so there's a lot of content here in these two slides. Comments on what you see here.

MR. LEKOV: So those are the results on the national energy savings and the net present value. They are listed in the technical support document also.

MR. ROSENSTOCK: And Doug, just real quick. This is Steve Rosenstock, EEI. This is 2018 to 2048?

MR. LEKOV: Correct.

MR. ROSENSTOCK: Thank you.

MR. BROOKMAN: Thank you, Steve. Greg.

MR. WAGNER: So if I'm reading this right, I look at column three and four, going from an X13 to an ECM, we save less energy?

MR. LEKOV: Over the analysis period, depending on the product class. So looking at the three and four, X13 versus ECM, product classes are listed on the left side, you compare the values next to each other.

MR. WAGNER: This is energy savings in quads?

MR. LEKOV: Correct.

MR. WAGNER: I guess I'm –

MR. BROOKMAN: Dave.

MR. WINNINGHAM: I think this points to a disconnect back to our summary results page, where earlier we had shown the EL levels and the approximate savings for X13 of 45 percent, and 59 percent for the ECM, where your results page showed for non-weatherized, non-condensing showed a 35 percent savings for X13, and only a 33 percent savings for ECM plus multi-stage. So, I guess I am very concerned that the EL levels shown as a percentage don't align with the data that has been presented. They have taken them to the extreme edge of a single category.

MR. WAGNER: And this is Greg. And the same thing holds for the next column, column four to column five. That's nowhere near that ten percent level that was talked about earlier for that technology. So how did that go from ten to 30? Or 50 on say, NWGC?

MR. LEKOV: For which product class?

MR. WAGNER: Non-weatherized gas condensing, column four to column five. It's about 50 percent jump.

MR. LEKOV: Between the ECM and the ECM with backward impeller?

MR. WAGNER: Yeah. I'm guessing, and I don't know how these were derived, but there's some kind of glitch in this modeling? These numbers don't match up with those EL levels that Dave was just talking about.

MR. BROOKMAN: Okay. While he's searching there, Jim Vershaw, you're next.

MR. VERSHAW: Okay. Jim Vershaw, Ingersoll Rand. Based on the conversation on the projected shipments, doesn't discussion about these numbers become mute? If those numbers were wrong, doesn't it change all these numbers?

MR. BROOKMAN: Jim, several individuals in the room are nodding their heads in sympathy. So thank you for the comment.

MR. VERSHAW: And -- okay.

MR. BROOKMAN: Additional thoughts or comments on these two very busy tables? Nothing additional? Okay. Yes. Diane.

MS. JAKOBS: So this table – is it saying that –

MR. BROOKMAN: Which one, Diane?

MS. JAKOBS: I'm sorry, net present value results. If the interest rates go up to seven percent from current three percent that the savings will be negative?

MR. LEKOV: So remember that one-year change in the interest rate is not going to impact the distributions for the interest rate is over a 20 year period.

MR. ECKMAN: This is just the discounting of the values, right, according to federal requirements, either three or seven, so you're just following OEM – OMB. Get the right.

MR. BROOKMAN: Tom, state it again.

MR. LEKOV: Talking here about the discount rates?

MR. ECKMAN: Yeah.

MR. LEKOV: Okay. Yeah, those usually DOE presents two cases at three and seven percent. That's just the options here. And both of them are used when a selection is made, when the potential standard levels are considered, both of those values are used.

MS. JAKOBS: So does negative mean you're not saving money?

MR. LEKOV: Correct.

MR. BROOKMAN: And Greg, go ahead.

MR. WAGNER: And these are based upon the previous slide, the quads saved and the projected increase in sales combined?

MR. LEKOV: It's not the savings, it's the economic impact nationally, on all consumers.

MR. WAGNER: Okay. We're going to be going back and revisiting these things, looking at those growth rates, as well as the projected numbers?

MR. LEKOV: No, those three and seven percent –

MR. WAGNER: No, not the discount rates, those are the numbers you use. But the other projection numbers, is this going to be rerun? Taking a look at these anomalies that are going on here?

MR. LEKOV: So DOE will utilize all and any inputs that -- we'll consider all and any inputs that are coming from the interested parties.

MR. BROOKMAN: Yes, Paul.

MR. LIN: Paul Lin. I just want to clarify slide 105, page 105, your subsection of ECM market share. That is assuming that there is no, just natural progressing in the market, that there is no mandate to move towards an ECM, correct?

MR. LEKOV: That's the base case, correct.

MR. BROOKMAN: Yes, Tom.

MR. ECKMAN: Not to add a lot of work, but I think part of the confusion in folks' mind as we go through this is that we have a rolling up of multiple cases here that is strongly influenced by the location of the equipment, and by the association of that equipment with these product classes. So some are cooling, some are heating and cooling, and some are just primarily heating. And so the benefits are different by candidate standard level based on whether it's a cooling piece of equipment or a non-cooling piece of equipment. And so these can look really weird when you see a summary because the population behind each one of those is really different.

So it may be useful if we see some of the geographic distributions. So we know that this is representing the south and the southwest. This is representing the north and the north – because when you look at these, they don't make a lot of sense intuitively because you're getting these weights together, and the population is migrating to the south and the southwest where there's more cooling, so the benefits for cooling get larger for some technologies than for others. So I'm just – it's kind of a mind warp to look at this and make intuitive sense out of it when you know that the impacts are different by candidate standard level because they have either larger cooling benefits than their adjoining companion.

MR. LEKOV: In the past, DOE responded to interested parties request for such scenario.

MR. ECKMAN: Yeah, I'm not so much interested in scenarios, but seeing some of the derivation of the – the precursor tables before these that show – that can tell us that this is a product that has really – its location is in the cooling climates. We had that one table where we had condensing, non-condensing, but this is just a manifestation of that, where you could look at it side by side, and some of these are bigger than the adjoining number – gets larger because it's in a cooling climate than the preceding candidate standard level which should be more efficient, but they're – I'm not being real clear here but –

MR. LEKOV: No, I understand.

MR. ECKMAN: It's just hard to – the generalization that the national level makes less sense than it does at the regional level.

MR. BROOKMAN: Right. Okay.

MR. LEKOV: But on the other hand also, just remember that there is no original standard for furnace fan products. So the results need to be presented also as a whole. What you're asking is for more information –

MR. ECKMAN: Just in order to interpret them, seeing the sub-national level gives – it's easier to grasp what I'm looking at because I know there's a difference in technology here.

MR. BROOKMAN: Let's move on.

MR. LEKOV: So, this is an additional point, relating to some analysis that DOE performed. In 2011, DOE published a notice of policy stating intention to incorporate full fuel cycle metric into the cost benefits analysis. In essence, an additional multiplier or conversion factor is applied to the energy savings associated with either primary fuels used by the product and for these particular products, this methodology was applied, and results similar to these previous two tables that you saw, but including the full fuel cycle of impacts are presented in the technical support document.

MR. ROSENSTOCK: Comment?

MR. BROOKMAN: Please, Steve.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. We will make written comments, but we’re very – we think that there are significant problems with doing the full fuel cycle analysis. The numbers shown in the technical support document refer to a paper that was published elsewhere, so there was the methodology and the results, but there is no information about the actual derivation of the values shown in the table. And I think there are special issues when you’re looking at the full fuel cycle, you really have to go international for any, especially for fuel oil, and I believe that there is just quite a huge variation in terms if you’re looking upstream in terms of the energy use with energy production, especially for fuel oil, that could be understated. And on the electric side, it’s overstated. So I think there are issues with using it. We objected before. We maintain our objections and we will write and file written comments. Thank you.

MR. BROOKMAN: Okay. Thank you. We’re going to move on.

MR. LEKOV: So comments on the full fuel cycle and DOE invites comments and recommendations on any aspect of national impact analysis. Go ahead, Sam.

MR. BROOKMAN: So now back to Sam Jasinski.

Manufacturer Impact Analysis

MR. JASINSKI: Thank you Alex, thank you Doug. I will give a brief overview of the preliminary manufacturer impact analysis. As I mentioned earlier, the bulk of the manufacturer impact analysis is actually conducted during the Notice of Proposed Rulemaking. But during the preliminary analysis activities, DOE makes an effort to set the stage for the analysis in the NOPR by basically starting to put together an industry overview and also identify key issues. Here's the "you are here" slide, to show you where it falls within the grand scope of the rulemaking.

During the preliminary manufacturer impact analysis, DOE identified 11 small business manufacturers associated with these products. As I mentioned earlier, if there are others that aren't identified in the – in Chapter 3 of the TSD, please let DOE know. Also as part of the preliminary manufacturer impact analysis, DOE conducted onsite and telephone interviews, not on the scale that it will during the Notice of Proposed Rulemaking, but again, as part of the preliminary activities. We did have the pleasure of receiving some feedback from manufacturers during preliminary interviews.

The interview topics included the engineering analysis, overview, methodology, and results. Key issues as identified and defined by the manufacturer, current market conditions, such as shipment, market share, product mix, et cetera. Potential impacts of new energy conservation standards, especially with a focus on potential conversion costs, and then finally, a discussion about cumulative regulatory burdens. As we've heard, there are a lot of state, federal, and international standards, as well as some voluntary programs that – regarding the efficiency of furnace fan products.

Some of the key issues that were identified during these interactions with manufacturers - preliminary interactions with manufacturers:

- higher up-front costs for consumers. Manufacturers are concerned that higher initial cost can lead to consumer switching to less efficient products, essentially by making a component more expensive, in higher efficiency products, the overall – consumers will switch to systems that are overall less efficient, to reach lower price points, or the same price point that they would have prior to standards.

- Secondly, higher initial cost may also push consumers to repair, as we've heard, rather than replace units.
- Another key issue are conversion costs. Stringent standards may require significant capital conversion costs to implement the technologies that we've identified, to reach the higher efficiency levels.
- And finally, reduction in innovation. Manufacturers are concerned that a new furnace fan standard would take resources away from development of new products and in addition, higher standards for furnace fans place new constraints on manufacturers and may limit their options for maximizing maximum system efficiency, essentially resources are finite for manufactures, and the more targets you give them, the more it takes away – it adds constraints they have to focus those resources on meeting those specific standards as opposed to focusing on innovation on overall systems.

MR. BROOKMAN: Many of you are familiar with manufacturer impact analysis or preliminary manufacturer impact analysis. Comments on those before we move on. Yes, Paul.

MR. LIN: Paul Lin with Regal Beloit. Just to maybe touch on some earlier comments from Diane relative to cost of AC of the X13 motor being two times of what you guys are showing here in the preliminary analysis. I wish we were – maybe we need to adjust our pricing to Rheem when we go back, but I think maybe the bigger issue is maybe some comments could be given from Navigant and DOE on this report in terms of the product mix. Because I think the product mix has a large deal in coming up with an average X13 cost. A higher horsepower will have a lot higher cost versus – so we have a third, a half, three-quarter, and one horsepower. So if you look at a model by model basis from a third horsepower to a one horsepower, there is significant cost delta between that. So, depending on your mix analysis on getting together an average product cost, that's the assumption. What is the assumption on your horsepower range to come up with your average cost? I think that's maybe some of the discrepancy that the OEMs may see relative to the costs that you have in your analysis.

MR. BROOKMAN: Mohammed.

MR. KHAN: This is Mohammed Khan, DOE. We try to make our samples as statistically representative as possible. And I'm not really sure how many samples were really used, but maybe Sam could comment on that.

MR. JASINSKI: Yes, so for this particular rulemaking activity, as I said earlier, we had 26 units selected for test and tear down. But because there are a lot of similarities with previously regulated and products that are being currently regulated where similar analyses have been done, we do have data beyond those 26 units, and I'll call them cost factors that you mention, are something that we tried to account for in the analysis. So when we do the tear downs and select products across what's commercially available, capacity and horsepower, things of that nature are taken into consideration so that we can try to understand how the cost of, for instance, a motor, would scale with horsepower.

MR. BROOKMAN: Is that mix listed in the TSD?

MR. JASINSKI: No, we try to prevent – keep details about the selections protected so that it's hard to disaggregate the results.

MR. BROOKMAN: Diane.

MS. JAKOBS: This kind of goes back to the test procedure, but in the NOPR for the test procedure, you came up with four hours for an average testing time to calculate FER. And in my personal experience now running it, that's correct. Only you went on to say that wasn't a burden, and that would be horrible for us. So, I don't know, we might - it's a huge impact to double the amount of testing we have to do. And you've seen our air flow test stands, and - but just in the analysis you went through something and said it was two and a half percent of the sales price or something, but for a manufacturer impact, just the amount of test time that's required, is a big deal for us, and that's kind of reflected in our participation.

MR. BROOKMAN: So send those details in. Yes?

MR. JASINSKI: Yes, absolutely. Information that would help DOE quantify the burden in terms of hours to test or the equipment necessary -

MS. JAKOBS: So that would be like an increase in R&D test time. I have trouble quantifying that.

MR. JASINSKI: Well, just number of hours, things like that, help.

MS. JAKOBS: Well, I can say I agree with you on the hours, just does it give me heart palpitations or not. But it’s also – we have to – we verify our ratings every year, so it’s not just when you design the equipment and release it, it’s ongoing cost that will go on forever, so it’s a big deal for us at four hours.

MR. BROOKMAN: Okay. We’ve also heard from Terry Small. Terry, you’re next, and then Steve Rosenstock.

MR. SMALL: Terry Small, Mortex. I know on one of the pages there’s a discussion on the PSC market and eliminating it. I think that the forecast is pretty optimistic, the paybacks are optimistic, and the payback on going to the PSC motor, the improved motor with an additional speed or two for continuous air flow to really get what Charlie wants, means to me that I think we ought to be careful not to eliminate PSC motors in general. I think that would be a great mistake for the country. It’s my opinion. Thank you.

MR. BROOKMAN: Thank you. Okay. Steve.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, in terms of the up front cost for consumers, just to kind of follow up with what Alex said, if there's a space, it might not be a bad idea to kind of describe what happens, especially in the northern region of the US, combination of the higher furnace system standard AFUE in the north, plus the highest furnace fan standard. Because for new furnaces, the consumer's going to face the cost increase due to both. And the higher the percentage, the higher the likelihood of possible people trying to repair rather than replace. Thank you.

MR. BROOKMAN: Thank you. Okay. Additional comments on this?

MR. JASINSKI: So the presentation as it's posted in the packet includes some slides that describe the next steps. Each is generally just an overview.

MR. BROOKMAN: Paul.

MR. LIN: Paul Lin. Is there a target date that you're targeting to release the NOPR?

MR. JASINSKI: The NOPR? It's hard to say. The statutory deadline is 2013, so it's going to be between now and then, I think.

MR. LIN: That's a forecast we can believe.

MR. JASINSKI: Yeah.

MR. BROOKMAN: Yes, Aniruddh.

MR. ROY: I have a comment with regards to what was said earlier on the components and system level efficiencies. Is DOE planning to do any kind of study on furnaces, for example, let's say there's a high efficiency AFUE furnace that may not be as efficient on the furnace fan side versus something that's very efficient on the furnace fan side but maybe not as high in AFUE, and combining that with the full fuel cycle analysis that you are referring to, is there any plans to do that kind of study in the future?

MR. JASINSKI: Well, a specific study, I don't know about a targeted study, but hopefully as we've shown throughout the analysis, it is something that DOE is concerned with. So any information that we can get through comments, and obviously through our own efforts, we will constantly keep that in consideration to make sure that if at all possible, what we are doing does not negatively impact overall system efficiency.

MR. ROY: Okay. But currently there's no data available to show that, right, that comparison?

MR. JASINSKI: I'm not going to say that there's no data, but we need more –

MR. ROY: I mean in the TSD.

MR. JASINSKI: Oh, in the TSD, there is no data presented in the TSD along those lines.

MR. ROY: Thank you.

MR. BROOKMAN: So we've covered all the material that we came here to cover, and I want to thank everyone and also at this point, provide an opportunity for any final comments from anybody in the room, things that didn't get covered adequately, final remarks. Yes, Craig.

Closing Remarks

MR. MESSMER: Craig Messmer, I don't really have any remarks other than thank you. And, you know, if we ever have a question on clarification on what we've read here, is it possible for us to contact someone and have some sort of discussion, sidebar or something, because, you know, we covered a lot of topics here and I don't think we covered them adequately and had enough of an exchange between the manufacturers and the DOE in this case. So is there another method of talking to you about it?

MR. BROOKMAN: Michael Kido.

MR. KIDO: There's a – you can have an ex parte communication with the Agency. There's actually a process that you can follow in doing that, and if you give me your e-mail, I can just e-mail to you, there's a Federal Register notice that outlines the process, and it’s a very short notice. So basically what that would entail is, you know, there’s a meeting between, say, company X and DOE, and then there’s a certain amount of time that has to – well, within a certain amount of time you have to submit a memo to very specific e-mail address that handles all the ex parte communications between the Agency and outside parties. And that memo essentially just briefly summarizes the nature of the discussion. And that’s just to insure that there’s transparency in the whole process. Everyone knows who DOE has met with and what was discussed. So if you want, I can send you that, and if anyone else wants that, just give me your e-mail address and I’ll e-mail it out to you.

MR. KHAN: Mohammed Khan, DOE. I think your question was whether or not you could hear directly from DOE as follow on about maybe any further interpretation about any of the technical information that was provided, you can certainly do – go through the process that Michael Kido has talked about already. You can certainly contact me directly, and depending on the questions, it may be something I may not be able to respond to from the DOE perspective, process wise, but it might also be something that we can have a discussion on. So it really depends on what the nature is.

MR. MESSMER: Okay. Good. That's what I wanted to hear. Thank you.

MR. BROOKMAN: Yes, Paul and then Aniruddh, and then I will also hand out these evaluation forms. You can pass them down. Paul.

MR. LIN: Could we ask an advocate directly, questions, or is it - or do we have to follow the process for whether it would be Navigant versus DOE?

MR. BROOKMAN: Michael.

MR. KIDO: If it's purely a technical question, you just say, for example, you've got a question about the formula or the basis for the analysis that we've got in the TSD, something like that, you can contact Navigant directly. If it's an issue regarding policy like for example, you know, you guys really should do this versus that, then you're probably going to want to have a discussion with us, and then that will have to be a discussion that'll be subject to the ex parte requirements.

MR. BROOKMAN: Other remarks here as we close? Diane.

MS. JAKOBS: I've got a lot to say and I really enjoyed this discussion today. It's fun to talk to a lot of smart people about an important subject and I’m really encouraged. But I’m also chairman of the AHRI ad hoc furnace fan committee, and there’s so many things that we’re supposed to submit comments on, is there any – I don’t know if someone could give me a hint maybe about a priority things where – you know, it seemed like you said that the X13 curve on the graph was based on one furnace, maybe you need more furnaces. And then we were talking about the drop in sales in ECM motors. Aniruddh said that we could look at sales, that that’s information that maybe AHRI collects. So if there’s some particular question you want to make sure that we don’t miss as our time runs out, you know, please let me know somehow. Thank you.

MR. BROOKMAN: Thank you. Aniruddh.

MR. ROY: As Diane mentioned, again Aniruddh Roy. Under AHRI, as Diane mentioned we have an ad hoc committee that has developed some modifications to the existing or the proposed FER metric, and we will be submitting that in our comments on July 30th. However, it’s just a series of steps that’s proposing the modifications, it’s not the actual test procedure with edits in it. We are going to be starting to work on that as well as we will be providing data sometime in August to DOE to support our arguments. And we feel that the modified FER metric is – it’s significantly less burdensome in form of testing, as well as reporting to the manufacturers. But not only that, it also meets DOE's goals from the preliminary analysis that's occurred, it looks like the FER and the modified FER values are almost the same. And so I think that's something that DOE and other stakeholders will be happy with. So please look out for those comments, and we can discuss it after DOE has reviewed it.

MR. BROOKMAN: Additional remarks? Tom.

MR. ECKMAN: Again, I want to thank DOE and the contractors for spelling things out. I have one comment on the utility impact analysis which we went by briefly. I understand its purpose. I would ask that DOE in the outputs also specify what the present value cost reductions might be from the reduction in capacity required to meet the standards. Right now as change in energy sales and prices, the mix of generation, and the difference in capacity, there's a dollar value associated with the difference in capacity, and I think that should be incorporated in the analysis.

MR. BROOKMAN: Thank you. Steve Rosenstock.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Following up on that, since certain standards will increase the amount of furnace energy use, the fossil fuel use, then in terms of energy production, then if there's any increases on the production needed for fossil fuels, that that should be accounted for as well. Thank you. .

MR. BROOKMAN: Thank you. Other remarks here as we move towards closure? So then, for my part, I thank you. We had a very productive meeting. We covered a tremendous amount of material. You all were very forthcoming with a lot of very, very good information. I appreciate your good humor and your tenacity. I really do. I turn it back to Mohammed Khan for closing remarks.

Closing Remarks from DOE

MR. KHAN: Mohammed Khan, DOE. Very briefly because we went over our scheduled time, and I apologize for that. But this morning I said I looked forward to a very good discussion exchange, and I think my expectations were exceeded. So I appreciate everyone's participation and we look forward to getting your written comments as well. Thank you.

MR. BROOKMAN: Safe travels home.

(Whereupon, at 4:30 p.m., the meeting in the above captioned matter was adjourned.)

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before:

U.S. DEPARTMENT OF ENERGY

In the Matter of:

PRELIMINARY ANALYSIS PUBLIC MEETING ON

RESIDENTIAL FURNACE FANS ENERGY CONSERVATION STANDARDS

Were held as herein appears and that this is the original transcript thereof for the file of the Department, Commission, Board, Administrative Law Judge or the Agency.

Further, I am neither counsel for or related to any party to the above proceedings.

Wendy Greene

Official Reporter

Dated: August 1, 2012