Date: March 27, 2015

Case: The Energy Conservation Standards For Residential Furnaces

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U.S. DEPARTMENT OF ENERGY PUBLIC MEETING

THE ENERGY CONSERVATION STANDARDS FOR RESIDENTIAL FURNACES

U.S. Department of Energy

1000 Independence Ave. SW

Washington, DC 20585

Room No. 8E-089

Friday, March 27, 2015

9:00 A.M.

Appearances for Department of Energy Meeting

John Cymbalsky, DOE
Ashley Armstrong, DOE
Dan Cohen, DOE
Eric Stas, DOE
Michael Kido, DOE
Francine Pinto, DOE
Johanna Hariharan, DOE
Doug Brookman, Public Solutions, -- Moderator
Timothy Ballo, Attorney, EarthJustice
Donald M. Brundage, Southern Company
Adam Darlington, Navigant
Andrew deLaski, ASAP
S. Craig Drumheller, NAHB
Rachel Feinstein, HPBA
Victor Franco, Lawrence Berkeley National Laboratory
John Hodges, Wiley Rein
Diane M. Jacobs, Rheem
Rebecca Kern, Bloomberg
Jeff Kleiss, Lochinvar
Sue Kristjansson, Sempra

APPEARANCES (CONTINUED:)

Daniel Lapato, American Public Gas Association
Neil P. Leslie, GTI
Frank V. Maisano, PRG
Michael J. McCabe
Samuel McClive, Navigant
Charles McCrudden, ACCA
Caroline McLean, AGL Resources
Sarah A. Medepalli, ICF International
Jonathan Melchi, HARDI
Karen Meyers, Rheem
William T. Miller, McCarter & English
Michael Rivest, Navigant
Steven J. Rosenstock, Edison Electric Institute
Aniruddh Roy, Goodman
Robin Roy, NRDC
Harvey Sachs, ACEEE
Dave Schryver, American Public Gas Association
Amy Shepherd, AHRI
Frank Stanonik, AHRI
Rusty Tharp, Goodman

APPEARANCES (CONTINUED:)

James T. VerShaw, Ingersoll Rand
Peeter Vesik, ECCO
Charles R. White, PHCC
Dave Winningham, ALLIED Air Enterprises
Kathryn Clay, American Gas Association
Rosalyn Cochrane, NRCAN
Chuck Foster, EEI
Marshall Hunt, PG & E
Mark Krebs, LACLEDE Group
Douglas Rathbun, DOJ-ATR
Gregory Rosenquist, LBNL
David Schroeder

P R O C E E D I N G S

(9:09 a.m.)

MR. BROOKMAN: Okay please take your seats we are going to begin. Good morning, everyone. Welcome. Nice to see you here on a rainy day in Washington, D.C. This is an Energy Conservation Standards Workshop, a Notice of Proposed Rulemaking Meeting for Furnaces. Today is March 27, 2015 here in the Forrestal Building in Washington. Glad to have you here this morning, nice to see such a nice turn out.

My name is Doug Brookman, Public Solutions, Baltimore. We are going to start this morning immediately with introductions. So looking to my immediate left, and we can get used to turning the microphones on and off, name and organizational affiliation.

MR. MILLER: William Miller, General Counsel for the American Public Gas Association.

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

MR. VERSHAW: Jim VerShaw, Ingersoll Rand.

MR. WHITE: Chuck White, former contractor working for the Plumbing, Heating and Cooling Contractors Association.

MR. MEYERS: Karen Meyers, Rheem.

MR. SCHROEDER: Dave Schroeder, consultant with GTI.

MR. LESLIE: Neil Leslie, Gas Technology Institute.

MR. HODGES: John Hodges, Wiley Rein for the National Propane Gas Association.

MR. KREBS: Mark Krebs, the Laclede Group.

MR. WINNINGHAM: Dave Winningham, Allied Air.

MR. SCHRYVER: Dave Schryver, American Public Gas Association.

MS. MCLEAN: Caroline McLean, AGL Resources.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute.

MR. HUNT: Marshall Hunt, Pacific Gas and Electric.

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

MS. CLAY: Kathryn Clay, American Gas Association.

MR. ROY: Robin Roy, Natural Resources Defense Council.

MR. COHEN: Dan Cohen, General Counsel's Office, DOE.

MS. ARMSTRONG: Ashley Armstrong, DOE.

MR. CYMBALSKY: John Cymbalsky, DOE.

MR. LAU: Christopher Lau, Navigant.

MS. PINTO: Francine Pinto, General Counsel's Office.

MS. HARIHARAN: Johanna Hariharan, General Counsel's Office.

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

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

MR. ROSENQUIST: Greg Rosenquist, Lawrence Berkeley National Laboratory.

MR. DARLINGTON: Adam Darlington, Navigant.

MR. BROOKMAN: And we'd like to have

introductions from everyone else as well, starting with Mike Rivest. Just say your name out loud. As a matter of courtesy, I think we should all introduce ourselves. This will not be recorded, just stand and say your name please.

(Introductions off mic)

MR. BROOKMAN: Okay well thank you and welcome again, nice to see you here for an early start on the day. All of you I hope received a packet of information that will be our principal resource for both presentation and comment and organization as we go through the meeting today. If you look on slide 7 in your packet, there is kind of a general agenda. Immediately following this agenda review are some preliminary slides on the purpose of the meeting, regulatory history and the like. There is an opportunity for opening remarks, brief summary comments here at the outset, hopefully nothing too terribly extensive at the opening but brief opening remarks from anybody that wishes to do so.

Moving on from there we will have some overview slides and from there engineering analysis, and then we will take a break mid-morning around 10:30 or so. Whenever we get to the break, we will take it; probably around about life-cycle cost analysis and subgroup analysis; somewhere in there.

We will then proceed with the shipments model, NIA, and RIA. We will take lunch midday around about noon and then MIA, environmental, employment, and additional research, and then at the end of the day, closing remarks, another opportunity for anybody that wishes to make statements.

This is your opportunity for comment to make sure everything you need to say gets covered during the course of the day today; so that's yet another opportunity for you to comment at the end of the day, okay?

We are going to have some introductory slides and hear from John Cymbalsky.

MR. CYMBALSKY: Thank you Doug; welcome everyone. I'm glad to see such a big turnout for this very important rule. We have been at this rule for a little bit. Just to give a little history on what we have done up until this point: So back in September we released the analytical tools and a bunch of data that supported the numbers you see today in the proposal. We had a public meeting to increase the transparency of what we do in our analytical tools to show stakeholders how to use those tools, and I have to say, that meeting to me was very successful because the comments and the questions that we received ahead of this meeting, to me prove that that meeting was useful because whoever submitted the questions through AGA and APGA I think did a great job of understanding the spreadsheets and asking some very key questions.

Those questions helped us actually frame our presentation today, so as we go through, we are going to do our best to flag these questions in the presentation, and I would ask those who submitted questions ahead of time to please make sure that when we are on that slide and we flag it that we answer your question
because clearly that is what we want to do here; we want to answer everybody's questions to the best of

our ability here.

Some of the questions you know related to how this rule is different than the 2011 DFR [direct final rule]; we are going to show as much data and comparison as we can with that.

For example, the furnace fan rule that was finalized last summer comes into play here because the performance of an X13 motor essentially will be in a baseline furnace come 2021 when this rule would need compliance. So things like that have a lot to do with the changes in the numbers and such, and we are going to go through all of that data as we go through the meeting.

We also met over the past few years; we have had lots of ex parte meetings with lots of different stakeholders. Again, the transparency issues that I think we have addressed here today were brought up. Very complicated issues with this rule including installation cost, venting issues, fuel switching, and so based on that really good public comment, we actually, I think, did a great job in building models and analysis to deal with these very important issues for this product.

And so we are going to go through them today. We know AGA and others have done their own analysis; we are going to compare what we did with what you all did to try to understand those key differences as we go through.

And then I would just like to add, and I know that there are remarks by AGA and APGA, you know, that talk about efficiency and how important it is to both them and DOE. I'm happy to say in our research we found over 50 different gas utilities offering rebate programs to advance condensing furnaces into homes.

There's over 150 different unique programs across the country that are doing this, and so we feel we are partnered in advancing energy efficiency, and we are happy that utilities and other organizations are pursuing the same goals as us, and so with that let's turn it over to opening remarks from whoever. I know we have received a few ahead of time, and I'm sure there're others, so we will pass it off.

MR. BROOKMAN: There's one more small bit of preliminary business. I would ask for your consideration. Please speak one at a time and say your name for the record as you need to. There will be a complete transcript of this meeting made available, so I think you know, if you could, share the air time and be concise.

If you haven't turned your cell phones on silent mode, please do so, and webinar participants we welcome you. The Department of Energy is trying hard to make these meetings totally accessible via the web. Please leave your telephone on mute so we don't get feedback here in the room, and raise your hand to participate in this conversation here. We will unmute you. We should be able to hear you, and you can join in the conversation in real time.

So now let's proceed with opening remarks. I have received a request to let Dave Schryver go first. Microphone on?

MR. SCHRYVER: Okay, thank you. My name is Dave Schryver, I am the Executive Vice President of the American Public Gas Association. We appreciate this opportunity to make this brief opening statement. APGA submitted its complete preliminary comments to DOE a week ago, and we request that those comments, including the questions appended thereto, be asserted into this record of this proceeding.

My opening statement will simply highlight some of the points made in those comments. APGA is the national association for publicly-owned natural gas distribution systems. There are approximately 1,000 public gas systems in 37 States, and over 700 of those systems are APGA members. Publicly-owned gas systems are not-for-profit, retail distribution entities owned by and accountable to the citizens they serve.

They include municipal gas distribution systems, public utility districts, county districts, and other public agencies that have natural gas distribution facilities. APGA, whose members are predominantly located in southern tier States, is concerned that the NOPR, by eliminating non-condensing furnaces from the marketplace, is, among other things, taking away customer choice, discriminating against low-income persons, and participating in fuel switching to less efficient energy alternatives, all to the detriment of the American public.

By proposing a nationwide 92% efficiency standard for non-weatherized gas furnaces, our concern is that DOE has made many of the same errors that affected the 2011 direct final rule proceeding, including as examples: a lack of transparency, failure to recognize non-condensing furnaces as a separate product class, failure to account properly for fuel switching, reliance on proprietary data, data averaging, et cetera.

Of course, until the transparency issue is satisfactorily addressed, APGA and the other interested parties that care about compliance with the Energy Policy and Conservation Act are precluded from meaningfully participating in this proceeding and from informing the record of the seriousness of the problems that may render the NOPR in contravention of the EPCA.

While a prepared statement addresses each of the various shortcomings just noted, albeit in abbreviated fashion, since we currently do not have sufficient information to do the necessary analysis of the NOPR, I want to focus my remarks on the transparency issue as that is really the key to understanding the errors that may underline the NOPR.

I am accompanied by technical experts from the Gas Technology Institute, an independent non-profit technology organization engaged in research and development addressing energy issues. GTI has been engaged by APGA and the American Gas Association to assist in analyzing the NOPR and its technical underpinnings.

The DOE, in its analysis of life-cycle costs and payback periods in the NOPR, relies on a spreadsheet model combined with Crystal Ball software to account for uncertainty and variability among the input variables.

APGA's experience in the 2011 direct final rule proceeding taught us just how complex and opaque Crystal Ball software, as used by DOE and its contractors, can be. In an effort to understand the DOE's use of the Crystal Ball software and simplifications, we have, with the assistance of GTI, submitted questions to DOE.

Prior to the issuance of the NOPR, DOE declined to answer the most important of those questions on the ground that they were involved with the deliberative process and hence could not be answered until after the NOPR issued. The NOPR has issued, and our questions remain unanswered. Our concern is time to comment on the NOPR is quickly dissipating.

We need answers to our questions as soon as possible; hopefully, those may be forthcoming today, but in any event no later than April 3rd so that meaningful analysis can proceed. Thank you for permitting APGA to express its preliminary views on the NOPR process. We are hopeful that a meaningful, substantive exchange will occur today between the DOE technical experts and the representatives from GTI, thank you.

MR. BROOKMAN: Thank you. Other opening statements, comments here at the outset? John?

MR. HODGES: Yes, John Hodges for the National Propane Gas Association, NPGA. NPGA is the national trade association representing the U.S.

propane industry. Its members include small businesses and large corporations engaged in the retail marketing of propane gas and appliances, producers and wholesalers of propane equipment, manufacturers and distributors of propane gas appliances and equipment, fabricators of propane gas cylinders and tanks, and propane transporters.

With membership of approximately 2,800 companies in all 50 States, 38 affiliated State or regional associations, and members of 19 foreign countries, NPGA represents every segment of the propane industry. NPGA appreciates DOE's desire to advance energy efficiency and conservation in relation to residential furnaces, but is concerned that the proposed rule may well have a negative impact on the residential furnace market, both for consumers and for fuel suppliers such as retail propane marketers.

For example, furnaces with a required 92% AFUE would result in positive pressure in the venting systems, thus prohibiting direct replacement for an existing natural draft furnace or entered an existing application such as when a furnace and gas water heater are commonly vented into a masonry chimney. A 92% AFUE furnace would also need a dedicated vent discharged to an appropriate outside area that may not be within close proximity to an existing furnace.

Any of these circumstances would add both cost to reconfigure the venting system and potential safety concerns if in the case of an orphaned water heater, the water heater vent is not properly sized. These could well be deemed unacceptable in the marketplace, and we are concerned that the proposal, if finalized, would result in a significant percentage of fuel switching by furnace owners.

Suffice it to say, the propane industry shares many of the same concerns as the natural gas industry. NPGA continues to analyze the proposal and will provide more detailed written comments by the deadline. Thank you.

MR. BROOKMAN: Additional comments here? Yes please, Kathryn?

MS. CLAY: Good morning, my name is Kathryn Clay. I'm the Vice-President for Policy Strategy with the American Gas Association, and we appreciate the opportunity to be here today to present our views on the Notice of Proposed Rulemaking on Energy Conservation Standards for Residential Furnaces.

AGA and its member companies, as John noted, are strong advocates for energy efficiency in all direct use applications of natural gas. Nationally, natural gas utility-supported energy efficiency programs had investments exceeding 1.1 billion dollars in both 2012 and 2013, and AGA member companies reported budgets of 1.4 billion for energy efficiency programs in 2014.

Through these energy efficiency investments, AGA members have helped customers save 151 trillion BTU of energy, and offset 7.9 million metric tons of carbon dioxide in 2013 alone. AGA is concerned that the DOE proposal to adopt a national 92% AFUE standard for non-weatherized natural gas furnaces will have serious negative unintended consequences. Our preliminary analysis of the information made available to date concerning the rule indicates that it will impose significant economic burdens to American consumers while providing substantially lower actual energy savings than indicated by the DOE technical support documents.

AGA is also deeply concerned by the Department's consistent lack of transparency throughout this rulemaking process. In a number of critical areas, the Department has obscured the assumptions, the data, and the methodologies contained in the technical documents in support of this rule. Despite written inquiries, questions submitted by AGA to the DOE have gone almost completely unanswered. This is particularly troubling given the immense complexity of the proposed rule and the reliance on highly sophisticated and opaque modeling methodologies.

In particular, we are concerned that much of the DOE analysis has relied on the methodologies that are either proprietary or otherwise outside of the public domain, and the Department has failed to provide sufficient information needed by AGA due to all of these factors for AGA or any member of the public to develop a clear understanding of the technical analysis behind this rulemaking, and, as a result, it is impossible to ascertain whether or not this proposed rule actually meets the criteria established by EPCA for establishing new or amended standards.

AGA respectfully requests that the Department provide all information requested to date, especially that that had been previously withheld as deliberative, and in light of the complexity and the delay in access to the information, we also respectfully request an extension in the comment period to allow all parties to have suitable time to analyze the newly provided information in the context of this very complex and sophisticated rule.

AGA, though, has moved forward to review the alluded information that has been made available in the work referred to by APGA, and we have worked in concert with APGA to hire GTI to help us make sense of these very complex technical documents, and based on our preliminary understanding from the work to date, we believe that DOE's economic analysis significantly underestimates the cost to consumers and the other adverse impacts that the amended standards would impose.

We are concerned that the 92% AFUE proposed standards would impose burdensome costs and potentially costs and in fact environmental negative consequences due to fuel switching and other factors. Even according to the Department's own analysis, the majority of affected households would see no benefit, some of them bearing higher net costs under the proposed rule. It is especially objectionable that this rule would place an undue burden on the low-income consumers who will be unable to overcome the initial barriers presented by the higher unit costs of condensing furnaces or costs needed for renovations to retrofit a condensing furnace if at all possible.

According to DOE's analysis, 20% of households nationwide would see a net life-cycle cost increase; 31% of consumers in the southern region would experience net life-cycle cost increases, and, in particular, again, low-income consumers would be disproportionately affected. For example, 39% of low-income consumers in the south, according to DOE, would bear net life-cycle cost increases. EPCA is intended to be a pro-consumer statute, and a proposed standard such as this that makes many consumers worse off should be reasonably reconsidered and should not be reasonably considered to be economically justified.

I would like to note briefly some of the major areas in the technical analysis that we believe, with proper reconsideration, would actually make these numbers and impacts on consumers even worse. Working with GTI and our initial understanding to date of the technical impacts, we note the following deficiencies in the DOE analysis.

First, DOE underestimates the adverse effects of fuel switching as consumers are forced away from natural gas options to less-efficient heating choices.

Secondly, we are concerned that DOE overestimates product lifetime using significantly higher estimates of 21.5 years, significantly higher than industry-accepted estimates of 15 to 16 years. Also, the Department over-estimates the size of the affected market. The impact of this, of course, is that by over-estimating the size of the market, it also tends to inflate the projected benefits of the rule.

And, finally, DOE uses unexplained and inconsistent installation costs in its life-cycle cost analysis. Particularly troubling, these are, on their face, substantially different than some of the numbers used in 2011; no citations or explanations for such drastic changes in the numbers have been included -- why these numbers would change so dramatically over a 3-year period.

In closing, we hope that the Department will act quickly to address these needs and the needs of the public by supplying full access to its data assumptions and methodologies. This is foundational to our ability to assess the full implications of this proposed rule in any meaningful way. Thank you for the opportunity to comment, and I look forward to the discussion.

MR. BROOKMAN: Thank you. Additional comments here at the outset? Andrew, Andrew deLaski.

MR. DELASKI: Andrew deLaski, Appliance Standards Awareness Project. Based on the coalition project, I know many of you. We work with a coalition of energy efficiency advocates, environmental groups, consumer groups, also with representatives from State government in the utility sector. We are active in many of these proceedings for advancing energy efficiency standards.

We have been active in each of the prior steps of this rulemaking as well. I want to first in this opening comment, I want to thank DOE for sticking with the schedule outlined by the settlement in the APGA litigation, so DOE has, as far as I can tell, done a very nice job of proceeding with this process as anticipated by the requirements of the settlement and doing a working group last fall to give folks an early look at the analysis, holding a public workshop that was a very good and constructive step in publishing multiple analyses in support of the NOPR.

I actually found it quite clear the material that has been published, and I think DOE has really gone beyond the usual steps to provide a level of transparency for stakeholders to be able to understand the analysis. Now, I understand people have questions, and I hope the Department will answer those questions to the full extent that you are able to while complying with the law, and I expect that you will.

I don't know if that was typically what you do, but I don't see why it would be different in this docket, and I hope that today we can continue the kind of frank exchange that we have been having to answer those questions, and I hope they can be answered because I think that will help everybody to understand what the analysis shows.

I also want to thank all the stakeholders in the room. This has been a long process, and we have had a lot of public meetings over the years. This is the biggest one so far. I mean, it's not surprising to me to see a lot of folks from the gas industry here.

This standard will save more natural gas than any other standard ever issued by the Department, so it is natural that the natural gas industry is here in force to participate because it is going to save a ton of gas. The closest rule is the water heater rule from 2000.

So it saves a ton of gas, that's a good thing for consumers; it's a good thing for the environment, and that is something that we support. I want to also say a couple of things about the process up until now. There has been a lot of collaboration, as everybody in this room knows. We, the advocates, and AHRI came up with a proposal for a joint recommendation for a standard that was adopted by the Department, and that collaboration, that was very constructive.

It ultimately was overturned by litigation, but it was a good collaborative relationship, one that has been continued since then in open and frank discussions. So there also was good collaboration with AGA in developing an approach to address what was described to us as the small number of consumers who faced very high costs and certain specific circumstances, and we came up jointly with a proposal for waivers that we will share with the Department, but ultimately that process came up against the shoals of the litigation.

So that collaboration, I thought, was quite constructive and would have addressed some of the narrow concerns raised by the gas industry. So I hope that we can continue the kind of collaborative discussions both today and after today that have helped folks to wrap their minds creatively around the opportunity to achieve large savings with new natural gas furnace standards.

It's my hope and my expectation that ultimately we will be able to arrive at a final standard, which is due I think next year, the end of next March, that will achieve at least the savings that are expected by the proposed rule, and I expect that by collaborating, working together, we can increase those savings. We can arrive at a solution that would be even more favorable, and precisely how that is to be done I think depends on the creativity and the goodwill and the ability of the folks in this room to work together to address and identify the narrow concerns and to address them.

With respect to the proposed rule, we support it. We think it is a good solution. 92% AFUE nationally, as I said, it saves more natural gas than any standard in the DOE's history. The net savings is 3.1 quads over a thirty-year analysis period, most of that in natural gas, but that includes the

standby electricity consumption savings, with a net present value that benefits consumers at 3.1 to 16.1 billion dollars depending on the discount rate that you use.

We know that the higher level of 95% would yield even more savings and also be more, more net savings economically for consumers. The net energy savings would rise to 4.4 quads, and the NPV would rise by 5 billion to almost 25 billion dollars in net present value savings to consumers over the analysis period. These are enormous savings, energy savings and economic savings.

We have only begun our review of DOE's technical analysis. As I said earlier, we have found them to be clear, but we have found several items that concern us. It's our view that if these items are corrected, we expect that DOE's analysis will show that the proposed standards save even more energy and are even more cost-effective than DOE has estimated in the NOPR documents.

I'll outline briefly right now some items that we think need correction as DOE moves forward to a final rule.

First of all, manufacturer impacts -- DOE justifies its decision to go with a 92% standard based on the cumulative regulatory burden on manufacturers. DOE essentially says in their walk down, if not for the cumulative regulatory burden we would go to this; 95% looks pretty attractive. We think DOE over-estimated manufacturing impacts really in two ways.

First is that the impacts on manufacturers are primarily driven by the decline in shipments, but where are those shipments going? They are going to heat pumps and to electric furnaces. The way DOE does the manufacturer impact analysis is that it looked at the furnace division of the manufacturers, but the manufacturers who make furnaces are the same exact manufacturers who make heat pumps and electric furnaces.

As we understand it, the economic analysis includes the impact on consumers who buy alternative equipment. We think the manufacturer impact analysis as well should look at the impact across the entire spectrum of equipment that is affected.

The second point is fuel switching. We applaud the Department for including fuel switching in the analysis. It was something that AGA requested that was a priority for AGA, and we appreciate the Department has now included fuel switching in the analysis.

We think that you have over-estimated the fuel switching, the rate of fuel switching. You use a model that depends on evaluating a payback. We think that the model is a good approach in terms of developing an economic basis for switching; however, we think we haven't really accounted for the stickiness, the inertia of consumer decision making.

So if the model was adjusted to account for the consumer behavior that people tend to do what they did before, inertia, we think that you will find that the results will show less switching than what you have estimated. We would note that the switching that has been estimated is about the same as the switching that GTI estimated in their materials submitted to the Department last fall.

With that change in the analysis, you will see increased savings and also reduced impacts on manufacturers.

Third is learning rates -- we believe the Department has understated some of the benefits of the learning rates for equipment, really for two reasons. First is that the learning rates are based on furnaces as a whole as opposed to condensing furnaces, and if you look at the learning rate for condensing furnaces, you are going to see that you are doubling the rate of condensing furnaces faster than you are doubling the rate of conventional furnaces or furnaces as a whole, so capturing the incremental learning rate is the key issue the Department needs to grab.

And the second thing on learning rates is that we think the data is compromised in the years in which there are Federal tax credits in effect. With that correction, you will find that the learning rates will actually increase.

Fourth, installation costs are over-estimated. DOE does not account for new technologies; these technologies are described in an appendix to the TSD, polypropylene vents. Manufacturers like DuraVent and Centrotherm are in the market today providing products. These products are designed to provide venting solutions for some of the various hard-to-vent situations that the gas industry has highlighted, and they will have helped to reduce the costs for those consumers who face those tough installations.

DOE also needs to apply learning to the venting technology and to the practice of venting.

Fifth, this is a small point, but it relates to the stand-by. We think DOE has over-estimated the costs on standby. There is a discrepancy between the cost of the TSD and NOPR which needs to be resolved.

Sixth, we think DOE's baseline market shares for condensing furnaces are too high. We have data from a couple of States. We have compared those to the data the Department has published, and those costs -- the rate of condensing in existing States -- is not as high as the Department has shown it to be in the analysis. We have data from the northwest that shows it to be different than what you have shown. I am surprised to see West Virginia is projected at 95% condensing; that doesn't strike me as correct, particularly when bordering States are lower.

We think the market continues to be first-cost-driven in many States and that that will lead to a lower rate of condensing than what the Department has projected.

And then, seventh and finally, we think the Department has not accurately estimated the distribution of efficiency post-standard. The Department has done a very nice job of showing the distribution of efficiency among condensing products today, and I was pleasantly surprised to see that the most common choice for a condensing furnace in northern replacements is a 95% furnace; yet the Department assumes that everybody who would have bought something below the standard, buys precisely the standard, a roll-up scenario, is a common problem of these rulemakings.

We think a more realistic assumption is that consumers will -- it will be a selection of condensing values above the standard that is ultimately selected and that results in a different estimate than what the Department has shown. The Department often does this type of scenario in its analyses, and we think it should be used as the default scenario in this project.

So thanks for the opportunity to participate, I look forward to ongoing discussions, and I will continue to participate in this important rulemaking.

MR. BROOKMAN: Thank you. Yes, Robin please.

MR. ROY: Robin Roy, Natural Resource Defense Council. We have been long supporters from the very beginning of the Federal Energy Efficiency

Standards/Appliance Energy Standards. We have worked on a lot of them, and we continue to work on them, and we are really thankful for the program, and it's delivered for environmental and consumer outcomes.

Great energy savings and great results generally -- this particular standard has been a long time coming. It's been almost a tortured path, and we are looking forward to an effective and as timely as possible resolution. I also say we work a lot on the other approaches, other tools in the portfolio for energy efficiency for consumer and environmental benefits, supporting State and utility programs for energy efficiency.

We are very thankful of AGA and its members energy efficiency programs, the 1.4 billion dollars I think is very effective, and I would love to see it. It's a fantastic set of tools. Interesting in this case, there continues to be even with those programs, there continues to be an opportunity, actually a need for efficiency standards for furnaces. Only if we had had a few more of those utility programs, a bit more intensely funded, then maybe we wouldn't be sitting here, but such is the case.

There is a large amount of efficiency opportunity that is economic. We haven't heard anybody suggest otherwise. NRDC has been working very intensely on this particular rulemaking over these last few years. We had been talking to many stakeholders. We were very keen to work in that group that Andrew mentioned a moment ago to develop a waiver process that was really targeted to address this issue, which had been raised so many times in our discussions, of the most hardest effected small subset typically associated with difficult installation costs, and I am delighted to see some work and an opportunity to drive down some of those tough installation challenges, and that's very encouraging, and we continue to be really interested in that part of it.

We recognize that there is a continued deep concern about households that may be worse off by several hundred dollars, and that's what it looks like from the analysis -- it's not in this package here today, but you would see it in the technical support document in figure 8.5.1, for example, that shows 5% of households being worse off by several hundred dollars.

We are very interested in what might be done to mitigate that and achieve even greater cost-effectiveness from this rule. We are also interested in looking at tighter standards, for example a 95% might that be brought into effect for appropriate households. To those ends, we have been having lots of discussions with manufacturers, with utilities, with associations, with installers, with other efficiency and environment groups. The kinds of discussions, I think, that are probably hard for DOE to have by the nature of the rulemaking process.

And those have been really quite productive. We have had one-on-one discussions. We have had small group discussions, and just a couple of weeks ago, we had a terrific meeting with, I don't know, about 35 parties from all over the place, and, for those in this room who didn't participate, please see us because we will continue to have these discussions. Let me know if you are interested to see what might be done, particularly for the issues which have been raised before that continue to be raised and are a little challenging for this one.

The 5% tail, I will just use as a shorthand for this hard-off -- these worse-off households. We also are recognizing, as Katheryn mentioned, that there is a moderately or a fairly large subset of households in the south for example, 40% or so, that will be worse off, maybe not by very much, but something. We are interested in seeing if something can be done there too, if it's small amounts of money that's unfortunate, and we would like to address it as soon as possible.

So we are looking to see what might be done with, for lack of a better term, flexibility mechanisms. An example, the after-the-fact waiver and the enforcement rulemaking from a few years ago that several parties in this room proposed and even more of the parties in this room discussed and negotiated, not all coming to an agreement on it.

We think it's interesting. We also see a regional standard as having some merit. It's a type of flexibility which DOE has an opportunity to draw on. We are very keen on the full array of what might be done to make a more cost-effective standard that addresses the particular challenges for the worst-affected households. We think there are some paths to that end, and we would love to get more discussion from DOE on what you might see as the legal or practical challenges to them.

It would be, for example, great to see what your view was on the analog, the in-standards as opposed to post-standard waiver process. You could call it an exemption or something. I am sure there has been a fair amount of legal thinking at GC on those issues, but we can't glean that from anything in the NOPR or the TSD.

But given the history, I am very concerned with those issues. I hope we will see more and be able to glean more of what you are thinking and see if we can work towards solutions that would fit within your view as being legal and enforceable and effective.

Great work, we need to see this done.

There is too much energy opportunity, too much consumer savings, and too much environmental benefit to just let this go, so go as quickly as you can to get this thing done.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. Again I want to thank the Department for having this hearing today. I am going to really withhold most of my comments until we get to some of the issues that affect the electric industry, such as the issue of fuel switching and the emissions analysis and national impact analysis.

But in opening, I just wanted to really say I think we are going to have to remember some of the context here in terms of competitive markets. Right now the standards for heat pumps have gone up twice in the last 9 years, the first time from 10 to 13 [SEER] in January of 2006, the second time as part of the court settlement from 13 to 14 [SEER] and then with corresponding level and the HSPF 6.8 to 7.7 in 2006 and now 7.7 to 8.2 now.

Any analysis that is done in terms of fuel switching really needs to take that in account as well. The market has shifted, the costs have increased on the heat pump side, and by not even talking about that, the current analysis is incomplete, and I will provide more details later. I look forward to the discussion and thank you very much.

MR. BROOKMAN: Thank you, additional comments before we launch into this detailed review. Frank Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. I haven't prepared comments but just a couple of things I do want to bring. First of all, yes, we have been involved with a lot of other people trying to find the, let's say, the appropriate solution that would be acceptable to all parties. I will tell you that the proposed level by DOE is not acceptable to AHRI's members, and I would also just remind everyone that we are looking at the solution that is both saving energy and economically justified, and we should not forget that second part.

And the last point I want to raise is that we are also looking at the energy that might be saved by a rule in comparison to what energy savings occurs in the absence of the rule, and you will see in slides and other places, it is, in this case, for a case of residential furnaces, unavoidable to notice that, first of all, as Steve might mention, there really hasn't been a change in the first rule, depending what you consider the 80% that comes in November -- if you consider that a change okay there's been a change coming in, but I would say there really hasn't been a change since NAECA, and yet without question, whatever the right number is today, certainly the current market is about one out of every two furnaces shipped to the United States and going into somebody's house is a condensing furnace.

So there is a huge amount of savings that the industry has achieved without standards, or without changes in the standards, and so as we talk about this rule, we need to keep in mind we are looking at the savings the rule achieves as opposed to what will happen if the industry just goes along and deals with incentive programs, deals with getting the products where they need to be, where they make the most economic sense.

MR. BROOKMAN: Okay thank you, Susan Stantley joining us on online, Susan we are going to unmute your phone. Please speak. We haven't heard you yet okay. So then maybe she will join us in a moment. Additional opening remarks here before we get into the details? Okay let's then proceed with the slides and back to John Cymbalsky.

MR. CYMBALSKY: Okay thanks Doug. John Cymbalsky, DOE. I am just throwing this up here, this is our usual slide that highlights the issues that we will be expressly asking for comment on. As we go through, you will see these issue boxes, and then we will pause at that point for comments from the stakeholders.

Okay so let's get right into the content here starting with the regulatory authority. So EPCA of 1975 established the Energy Conservation Program for Consumer Products Other Than Automobiles, which covers the furnaces that we will be discussing here today. NAECA 1987, as Frank just mentioned, amended EPCA to prescribe the first standards for furnaces, and it directed DOE to conduct two further rulemakings to determine whether or not amended standards were warranted, and so here we are today.

EISA 2007 amended EPCA to [require DOE to] review standards every six years and also required that standards after July 1, 2010 look at standby and off mode.
Okay, so per the history as I just mentioned, the initial standards were established by NAECA in 1987 except for small furnaces, and DOE published a final rule on November 17, 1989 to set initial standards for small furnaces, and you can see the Federal Register cite.

DOE also published a final rule on November 19, 2007 that amended standards for most classes of furnaces manufactured on or after November 19, 2015, and it did not update standards for mobile home oil-fired furnaces and weatherized oil-fired furnaces.

DOE also published the direct final rule on June 27, 2011, and it amended the AFUE standards for non-weatherized gas furnaces, mobile home gas furnaces, and non-weatherized oil furnaces. It amended the compliance date but left the existing standards in place for weatherized gas furnaces, and it established electrical standby and off mode standards for non-weatherized gas furnaces, non-weatherized oil furnaces, and electric furnaces.

So following the 2011 DFR, we have already heard a little bit about this in Andrew's opening remarks. We went through, and DOE was remanded the rule. The court approved a DOE and APGA settlement on April 24, 2014. Again, DOE was remanded the rule, and here we are in today's proceeding, and, as Andrew mentioned, we are proceeding on schedule with the Court's ruling.

So the current standards for non-weatherized gas furnaces and mobile home gas furnaces were established by NAECA and were effective in 1992 and 1990 respectively. The November 2007 final rule revised the final AFUE standards, and compliance is in November of 2015, and you could see those numbers below.

We had a question from Mark Nayes from Southside Heating and Air Conditioning asking about what this standard we are talking about would do. So it's a manufacturing standard, and his question related to how would people install 80 AFUE furnaces. The standard is on manufacturing, so they would -- the manufacturers would not be able to actually make those furnaces, so I hope that answers your question.

The next slide talks about the criteria for setting standards, and a lot of people have already referred to a few of these in their opening remarks using words like technically feasible and economically justified, so you could see the difference factors in EPCA and how the different DOE analyses address each one of these, but just to hit on a few you know, there are issues of competition, utility, energy savings, operating costs, et cetera.

So I think the slide deck does a good job of going through these today. There is a lot of content, a lot of pretty heavy-duty content, but hopefully, we will get through all of it. We are going to do our best to answer everybody's questions, and as I said in the opening, we are going to flag certain areas of concern as we go through.

MR. BROOKMAN: Okay, thank you John. Suzanne Stantley I think has joined us again, and

Suzanne, we will now unmute your phone. Please say your organizational affiliation as well.

MS. STANTLEY: Good morning, and I will. Thank you for the opportunity to speak today on the Department of Energy's proposed standard for minimum efficiency standards for natural gas furnaces. Again my name is Suzanne Stantley, I am the CEO of Contractor Advisors Business Development out of Chicago, Illinois. I am active in my community, working on a daily basis to find ways to increase economic viability for minority-owned businesses and consistently seeking solutions to create economic opportunity.

I am speaking today on behalf of low-income residents in my community that I believe would be hurt by the rule if it is allowed to go into effect. As I understand it, energy efficiency programs are supposed to help consumers save money on energy costs, but this rule will do the opposite, and it will impact low-income families hardest.

The proposed furnace rule would force many low-income residents to either pay large amounts for condensing furnaces or switch to more expensive electric heating when their existing non-condensing furnaces need to be replaced. Non-condensing furnaces are in most homes today.

The Chicago area already suffers from higher than national average electricity costs, while the city has lower than average natural gas costs. Condensing furnaces cost about $350.00 more than non-condensing furnaces and can cost an additional $1,500 to $2,200 to be installed. Low- and moderate-income families throughout Chicago would be severely hurt by this rule if more of their household income would have to go to pay for basic heating.

Many of these families will have to make hard choices. In addition, the cost increases would further deplete an already strained low-income home energy assistance program, LAHI funding. Nationally, LAHI funding has been reduced 34% from $5.1 billion in 2010 to only $3.4 billion in 2015.

The resulting allotment for Illinois has decreased 31% from $232.09 million in 2010 to only $165.5 million in 2015. This reduction in LAHI funding has already denied over 89,000 former recipients of this desperately needed assistance. The new furnace standard proposed by DOE would push low-income families toward more costly and less-energy-efficient options like electric resistance heating.

That means heating costs will go up and LAHI assistance will be available to even fewer families than it is today, and so I am here to ask the Department of Energy not to move forward with this proposal, as I know the impact it will have on my community and those with whom I work on a daily basis.

As an advocate for energy efficiency and an advocate for economic opportunity, I urge you to find the necessary solutions to achieve energy efficiency without causing residents in the communities I serve to pay more in monthly heating costs and, in the end, operate less-energy-efficient furnaces.

Thank you again for this opportunity to speak today.

MR. BROOKMAN: Okay, thank you. Now let's proceed with the slides and go to the engineering analysis.

MR. DARLINGTON: Good morning, everyone. I'm Adam Darlington with Navigant Consulting. I am going to go over the rulemaking scope and the engineering analysis.

MR. BROOKMAN: Let me make a comment here. There's a lot of content in this package here today. We need to be, I think, disciplined in the discussion segment. We want to hear everything you have to say but let's keep a focus here. Okay, let's try and be concise with our comments as we go along. Do you wish to say something at the outset?

UNIDENTIFIED SPEAKER: Is this available electronically with the DOE webinar?

MR. CYMBALSKY: So we had that question, and I think Alex has emailed a few of them that asked for it, but it generally goes into the docket after the meeting, yeah.

MR. BROOKMAN: Thank you, now we are going to proceed.

MR. DARLINGTON: All right, with that said, we have a lot of ground to cover, so I will go through this as quickly as I can, but do feel free to stop me if you need to ask any questions.

So just briefly, the scope -- basically the scope of this rulemaking exercise is outlined by the definition in EPCA for residential furnace. The key points here we are looking at are single-phase electric units; I'm sorry -- for units that use electricity, we are looking at single-phase units, natural gas furnaces, and that have an input rate of 225,000 BTU per hour or less, and, I think as was alluded to earlier, as a result of the remand agreement, this analysis is covering two classes of furnaces and those are the non-weatherized gas furnaces and mobile home gas furnaces.

So now I am moving to the engineering analysis. The purpose of the engineering analysis is to determine how manufacturer costs and selling price changes with increasing efficiency. For the analysis of AFUE standards, DOE has relied on an efficiency level approach, which means that the analysis was focused on analyzing selected efficiency levels at which DOE estimated the manufacturer production costs and selling prices.

DOE used a reverse engineering analysis which we will talk through in the coming slides and also relied on a variety of information as listed here on the slides. So this slide just shows an overview of the steps in the engineering analysis, starting with inputs from the market and technology assessment going from the selection of the efficiency levels that DOE is going to analyze all the way through to developing industry average, manufacturer selling prices, and so we will sort of talk through each of these steps in the coming slides, so I won't spend too much time here.

So as mentioned, the first step is selecting the efficiency levels for analysis. And so this was informed by product efficiency data collected during the market assessment. DOE analyzed the baseline level, which is 80% for both the non-weatherized gas furnace and mobile home gas furnace equipment classes.

There is correspondence on the minimum standard that was adopted previously in the 2007 final rule. DOE also analyzed the max-tech levels, which are the most efficient products available, and in between these levels, DOE looked at several intermediate levels, mainly at the most common efficiency levels available on the market, also at levels that represent a major change in technology, for example the 90% example for non-weatherized gas, a big jump from non-condensing to condensing.

And so the table on this side shows all of the efficiency levels that were analyzed as part of this analysis.

So this slide talks about the selection of units for the teardown analysis, which is the reverse engineering analysis. DOE selected quite a few units, as shown in this table at the bottom of the slide. The selections span the range of efficiency levels analyzed and were focused on the representative input capacity of 80,000 BTU per hour; so the models that were primarily selected at that input were as close as possible, but we did also look at some units above and below that in order to get an idea of how the analysis would scale to large and smaller units.

And so at each efficiency level, products from multiple manufacturers were chosen for tear down, and this allowed for the direct comparison of efficiency levels for a given manufacturer, and it sort of allowed DOE to key in on the differences in designs and the costs which will achieve the different efficiency levels.

So we were able to look at the manufacturers specific matched pairs of products which represented the cost to increase fuel efficiency. And so as this slide shows, you know, as I mentioned, quite a few units were selected. They were focused around the levels that DOE analyzed, so quite a few teardowns at 80% which is the baseline, quite a few at 90%, quite a few at 92% and 95%,, and then at 98% (max-tech) we had two teardowns there, and basically, there were two manufacturers producing products there, so we looked at both of them at the representative capacity.

So then, for each teardown, basically what DOE does is they physically disassemble the unit into its components, log the parts along with the materials, dimensions, weights, and manufacturing processes to create a spreadsheet of building materials. DOE uses the building materials developed from the teardown to develop the cost estimate for each unit torn down.

DOE also does manufacturer interviews and talks to the manufacturers about its cost estimates to get some feedback and get some help with calibrating some of these estimates. Yes?

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. Adam just a quick question.

MR. DARLINGTON: Sure.

MR. STANONIK: You said something about looking at pairs of something, so I just want to confirm that in all of these teardowns, let's say for every one of the -- obviously you looked at 8 models of rated units at 80%, and I'll just assume there was at least one from each major manufacturer.

Does that mean that you also looked at a higher condensing model from the same manufacturer as compared to the 80% to look at this pair situation?

MR. DARLINGTON: Yeah, that's right, and that's what we set out to do in order to tell what the incremental difference is, so, and then you see a little bit of spread here, you know. Obviously, not all manufacturers are making the 92%, so for somebody with the 93% and compare that to their 80% instead of a 92%, so yes, but yes to your question.

MR. BROOKMAN: Mark?

MR. KREBS: Mark Krebs with Laclede Group.

MR. BROOKMAN: Is your mic on?

MR. KREBS: Yeah, it is. Since I got here, I have always wondered a lot about this teardown stuff, you know, all of those units you bought and tore down. , I assume you purchased those, correct?

MR. DARLINGTON: Yes.

MR. KREBS: Okay, any idea what that cost and total amount of man-hours necessary for the tear down task?

MR. DARLINGTON: No, I have never run the numbers on that, so I couldn't give you an estimate.

MR. BROOKMAN: Jim?

MR. VERSHAW: Jim VerShaw, Ingersoll Rand. So you have purchased the furnaces. Did you take the purchase price that you paid for those furnaces and compare that with what you came up with as an estimate for the cost? Did you ever show that?

MR. DARLINGTON: We don't show that, but it is done to sort of calibrate.

MR. BROOKMAN: Mike Rivest?

MR. RIVEST: This is Mike Rivest from Navigant. I'm the one who has to sign the purchase orders. You know, we are not an authorized distributor or reseller or Trane carrier, so we end up paying very different prices than I did when I was a contractor, for example.

So the prices that we pay are not representative of what the distribution chain would pay, for example. There's a wide variation of what we pay, so we couldn't reasonably compare that to our manufacturing costs and make conclusions unless you guys would be willing to provide that.

MR. BROOKMAN: Back to Adam.

MR. DARLINGTON: All right, so moving on. I just want to note here a very important part of this. An important issue to note is interplay with the furnace fans final rule, which I think John alluded to earlier. So as most of you I am sure are aware, DOE published the furnace fans final rule in 2014, and the compliance date for that is 2019.

The expected compliance date from this rulemaking would be 2021, and so that furnace fan rule will already require compliance by the time this one would. So on the furnace fan final rule, DOE had assumed certain technologies would be needed to be implemented to meet those standards, and those are listed here on the slide for both product classes.

And consistent with those assumptions, DOE assumed that those technologies were going to be implemented at the time this rule takes effect, and, as a result, DOE accounted for those costs in the baseline efficiency level and higher efficiency levels as needed.

And so just going back to what John said earlier about the questions APGA had submitted, I believe this one is a primary driver and the answer to priority question E which was related to the difference in total installed cost between the 2011 analysis and this analysis, and a large factor in that was accounting for these technologies used.

MR. CYMBALSKY: We think this also answers question 2, in the section "Questions asked previously and not answered by DOE.

MR. BROOKMAN: And that document John --

MR. CYMBALSKY: Is in the docket.

MR. BROOKMAN: Okay. It just seems like the key point here, so additional questions, comments related to this slide? Yes sir, please say your name.

MR. SCHRODER: This is Dave Schroder. So you are saying that the larger difference between 2011 and now is furnace fans?

MR. DARLINGTON: Yes, that's right as far as the total installed costs for the consumer changing. I think there are smaller changes, but this is the primary driving factor.

MR. SCHRODER: And why is that change larger in the 80% case than in the higher condensing cases?

MR. DARLINGTON: Well, so at the max-tech -- this applies equally to 80% to 90% and the 92% and the 95%, so as we talk through what we observed design changes were at each level, when we talk about that, the max-tech is a little bit different, so some of these didn't need to be applied there.

As far as comparing the 80% to the 90% --

MR. RIVEST: Mike Rivest, Navigant. Adam, you can only speak to the manufacturer sales price, not installation costs.

MR. DARLINGTON: I was going to say as to the specific differences for that, you know, if there are other differences, we will get to those in the installed costs later.

MR. BROOKMAN: If you wish to comment, come to the microphone. Make sure it is turned on. Please say your name.

MR. MURPHY: Rich Murphy, American Gas Association. Just a follow-up question to the tear

16 down and buildup of the equipment costs and ultimately the markups that are applied -- so Mike from Navigant had explained that they build-up with the manufacturer's cost and really don't have a comparison to see how that resonates with what the manufacturer's costs are, but that is what is used to build up the actual retail price of the equipment that having compared how that works against what you actually pay for the equipment.

MR. BROOKMAN: Mike please speak up.

MR. RIVEST: We will get to that. I mean, so we are building it up from the manufacturing cost.

MR. BROOKMAN: That's a dead spot for that mic.

MR. RIVEST: So we will be building this up from the manufacturing costs, literally the production costs to the manufacturing sales price, and then we will be taking it down the distribution chain all the way to retailer cost, installed cost, and that is -- that will take a few hours as we go through the presentation.

And you know, this is not like a clothes washer, for example where there is readily available retail pricing. Even online, a lot of these products are sold through dealer networks, and you can't just buy a gas furnace necessarily for a lot of these brands of things, and I see Karen Meyers has something to say about that.

MS. MEYERS: So a lot of gas furnaces are sold through contractors at Home Depot. It is available to get pricing that is usually charged based upon the installed cost, so that is not an entirely accurate statement.

MR. RIVEST: It's not, well, I don't think you can get all brands at Home Depot for example, so that would become useful perhaps.

MS. MEYERS: You can get at least three or four brands.

MR. BROOKMAN: Okay, thanks for the comment, Karen, okay. Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. Adam, you indicate here that you are assuming it is going to be a two-stage product in the baseline, and for some of us who were here yesterday afternoon talking about revised test procedure, there is certainly some -- I will say at this point, some uncertainty as to what kind of AFUE number you are going to get out of the revised test procedure for two-stage products. Is that factored into the analysis -- I mean let me rephrase that.

How can you factor into the analysis what the AFUE of this two-stage product will be as the baseline when we have a test procedure that is right now a little bit fluid and certainly might have some effect on what value you get for that particular design?

MR. DARLINGTON: In the test procedure, the conclusion was that the impact would be de minimis, so we went with that here. As far as the two-stage, I think yesterday we heard that sometimes it improves efficiency, but sometimes it would actually decrease efficiency. It just depends on how the manufacturers design it, so yeah, we really assumed that it would be the same efficiency.

MS. ARMSTRONG: This is Ashley from DOE. I think this gets to our discussion largely yesterday about that we believe ratings won't change and, generally speaking, I think we looked at the you know, left that at DOE did some testing. We are going to put additional details of that testing that underlines that conclusion in the docket as requested yesterday, but obviously, we welcome data if someone has it that shows that we need to relook at that conclusion, but generally speaking, we believe that the test procedure proposals that we have made will not change the rated values as you see them on the market today.

MR. BROOKMAN: Keep going Adam.

MR. DARLINGTON: So after developing the MPC estimates for the individual units that were torn down, the next step was to aggregate the individual teardown results into an industry cost-efficiency relationship, and at the baseline, DOE used the market-share-weighted average for each manufacturer to come up with an industry average baseline cost.

So based on publicly-available information and based on feedback during manufacturer interviews, DOE estimated the market shares, and you know, as Frank mentioned earlier in his assumption, we tore down quite a few at the baseline and hit pretty much every major manufacturer, so we market-share-weighted them into an industry average baseline MPC.

So then at the intermediate levels above the baseline, they start at 95% and go up to -- I'm sorry, they start at 90% and go to the 95%, and so to get to 95, DOE observed that manufacturers pretty much universally utilized the secondary condensing heat exchanger, and then within that range, typically the changes were the size increases to the heat exchanger as the driver of the increased efficiency and also the increased product costs.

So within this range, DOE compared the teardown results between the intermediate level and the baseline for each manufacturer individually, to develop manufacturer-specific incremental costs of achieving each intermediate efficiency level, so it was almost like an individual cost-efficiency relationship for each manufacturer, which we then aggregated together to get the industry cost, and then at the max-tech, since we only had two and because the technology there was a little bit different, so to get to the max-tech, we were looking at the products available on the market.

It looked like they increased their size, and then they also switched to modulating, and so, looking at that, we compared the 98% teardowns for the two max-tech units to the 95% to see exactly what changed in that range as well.

And we used an average of those two -- a weighted average, a market-share-weighted average of those two numbers, to come up with the MPC estimate at 98%.

So then for the mobile home gas furnaces, DOE also did teardowns of several models to look at the differences. Mainly, we were looking for differences between the mobile home gas furnaces and the non-weatherized gas furnaces. So when we did the teardowns of mobile home gas furnaces, we had teardowns from manufacturers that made both mobile home gas furnaces and non-weatherized gas furnaces, so we were looking at comparing the same manufacturer with the same efficiency level to see the differences between the models and come up with cost estimates.

So generally, the incremental cost-differences between efficiency levels and the cost efficiency trend and the design changes were fairly similar, so the differential costs at each level for a mobile home furnace as compared to a non-weatherized gas furnace were used along with the industry cost-efficiency estimates for the non-weatherized gas furnaces to come up with estimates for the mobile home gas furnaces.

And the next step was to develop the estimate of the manufacturer selling price. So the manufacturer selling price is calculated as the manufacturer markup times the production cost plus the shipping cost. Shipping costs were calculated based on assumptions about typical trailer sizes and the furnace size at each efficiency level, and those are included in the TSD markups.

Markups are calculated initially based on information from SEC 10-Ks for public companies, and then they are calibrated based on information provided in the manufacturer interviews. And so pretty much, the conclusion of this is that DOE estimated the manufacturing markup to be 1.34 for non-weatherized gas [furnaces] and 1.27 for mobile home gas furnaces.

And so from there, this is what results generally. So as I mentioned earlier, at 80% we have the baseline. From 80% to 90%,, you are basically adding the condensing secondary heat exchanger, and then within the range from 90% to 95%, increasing heat exchanger

size, and above that increasing the heat exchanger size even further and then adding modulation.

And so that brings us to the request for comment about the analysis.

MR. BROOKMAN: Ashley Armstrong?

MS. ARMSTRONG: So this leaves -- and I'm going to turn it right over to you but you had asked a couple of questions, Mark from Laclede, regarding the engineering analysis that you submitted beforehand, and so we believe the slides that Adam just presented more or less answer those questions directly in terms of how we did our approach for the teardown analysis.

We had a question as to what pricing

technology did DOE use for fan motors in the baselines, which was specifically on slide 19, so I just wanted to let you know that we answered your questions on the previous slide, but should you have more, please feel free to note that.

MR. KREBS: Well thanks for that explanation. It really doesn't address my question, but I'll deal with that. I have a couple of other questions in regard to you, sir. You seem to be the guy I should ask about BOM spreadsheets and cost models that were referred to in the TSD, but we can't seem to locate them, can you help us out?

MR. DARLINGTON: We don't make those publicly available. So when we do our BOM spreadsheets, which are the main input to our cost estimates, they contain a lot of sensitive manufacturing information, so we generally haven't made those public. In the TSD, what we try to do, and what I have tried to do here, is to sort of describe what the changes are and what is driving the cost.

So if you need something more to feel comfortable with, you know, I guess the ability to review this, we can talk about it or just -- we don't generally reveal that information.

MR. KREBS: Would a FOIA request get it?

MR. BROOKMAN: Mike Rivest?

MR. RIVEST: I'm trying to be helpful. What is it you need it for?

MR. KREBS: We need it to verify your costs to see how reasonable they are in our opinion and --

MR. RIVEST: Do you need to know like the cost of every component, because when we tear down these products, we literally have the cost of every single component, screw, nut, and these are real products from real manufacturers, and there is a lot of intellectual property and --

MR. KREBS: Let's cut to the chase here. You know my analyst who requested these, Jim Moore from the Laclede Group, is listening in on the webinar. Let's let him call in the question so I'm the interpreter of it, okay.

MR. BROOKMAN: Are there any other questions while he is cuing up here? Any other questions? We have a comment from Tom Archer from Carrier, and his comment is -- is the baseline cost utilized in the analysis a two-stage constant torque BPM non-condensing versus a two-stage constant torque BPM condensing?

MR. DARLINGTON: Could you read that one more time Doug?

MR. BROOKMAN: Yes, is the baseline cost utilized in the analysis a two-stage constant torque BPM non-condensing verses a two-stage constant torque BPM condensing?

MR. DARLINGTON: Yes.

MR. BROOKMAN: Okay, yes. Is your guy going to call in his questions?

MR. KREBS: Yes.

MR. BROOKMAN: Okay. Mark Nayes,yes you are now unmuted. Please speak. I haven't heard you yet. Okay, we are going to keep going, Adam, and maybe he can join us in a little bit. Kathryn, please?

MS. CLAY: Maybe while we are waiting for Mark to join us, I can second the remarks made by the representative from Laclede. Obviously, this issue of the cost of the units is absolutely foundational to an assessment of whether this rule is economically justified. We respectfully request that, given the central nature of this question, that all information pertaining to that decision simply has to be in the public domain for us to be able to reasonably assess the validity of that information.

It seems unreasonable to us that the Department would not be willing to provide that. Without it, we are not able to assess the rule in a meaningful way.

MR. BROOKMAN: Okay, thank you. Ashley Armstrong? No. We have a couple of additional -- I'll go back to Mark since we are on this stream and then to you, Andrew.

MR. KREBS: Jim Moore has his hand up. I suggest you answer him.

MS. ASHLEY: Well, why don't we let Karen speak for a second.

MR. BROOKMAN: Go ahead, Karen, please.

MS. MEYERS: Karen Meyers with Rheem, and we would highly object to all the parts and pieces of our units being made available. However, should you wish to go purchase them and do your own teardown analysis, we will be happy to sell you a unit, but you cannot expect that a manufacturer is not going to object to a complete teardown analysis, essentially making our bill of materials available online, many of which is covered with patent protection and other things such as that.

So that is to me a completely unreasonable request.

MR. KREBS: Which raises the question, just how transparent is this supposed to be?

MR. BROOKMAN: Okay, Mark, thank you. Now to Andrew, I think --

MR. DELASKI: Let me just weigh in briefly. DOE has published the manufacturer production cost. What else do you need to know? Do you need to know the cost of each screw? It doesn't strike me -- For being transparent, the manufacturer production cost is there. The retail price is there. That's what affects consumers.

MR. BROOKMAN: Let's hear from Tom Archer.

Tom, you should now be able to speak.

MR. ARCHER: The comparison was because if there is a two-stage non-condensing BPM product as the baseline, no manufacturer sells that today, so I'm wondering what teardown got us to the baseline cost of that furnace.

MR. BROOKMAN: Adam.

MR. DARLINGTON: I missed part of it.

MR. BROOKMAN: Tom, you need to repeat the first half of your question, all of it in fact.

MR. ARCHER: My question is, if the baseline utilized for the analysis is a two-stage non-condensing constant-torque BPM furnace, it's basically a two-stage X13 80% furnace. No manufacturer has that today, so I'm wondering what the baseline cost is in order to get from that two-stage constant-torque BPM or two-stage X13 80 to a two-stage X13 90, and at the same time, we said the minimum is 92, so if we go from a furnace that doesn't exist on a non-condensing two-stage X13 80 to a two-stage condensing 92 X13 that doesn't exist either, so the two furnaces that we are tearing down and getting a cost analysis on are not existing by any of the manufacturers today.

MR. BROOKMAN: Adam, can you address that?

MR. DARLINGTON: Well, yes. So, I mean, the way the analysis was done, and I'm not 100% sure that that's totally true that no manufacturer makes those, but basically, yes, we do have adders, so we added the cost of swapping out the components, so basically, if you had a PSC motor, you know what's the cost and what's the changeover because we looked at specifically manufactured products with X13 motors and with fully ECM motors to determine the difference, not only to the motor but to the controls and other components as well.

And so looking at that incremental cost allows us to tabulate the cost, if those components were present.

MR. BROOKMAN: Karen, do you wish to comment here?

MS. MEYERS: I just would like to comment that I disagree with the statement that none of those furnaces exist in the market today.

MR. BROOKMAN: Okay, thank you. You standing there, would you like to comment? Please say your name for the record.

MS. SHEPHARD: My name is Amy Shephard from AHRI, but my comment is not directly on this point, so if we want to finish this

MR. BROOKMAN: Okay thank you, Mike Rivest?

MR. RIVIST: Mike Rivest, Navigant. Again I wanted to state that we want to be helpful. If the request can be scoped to focus on the information that is required to make the determination that the costs are reasonable -- so for example, the cost of the secondary heat exchanger in this case, which seems to be an important component, I mean, we can provide that in an aggregated way for different products that you know we do have serious concerns about -- the proprietary nature of the data.

MR. BROOKMAN: Yes, Kathryn?

MS. CLAY: I would strongly suggest that it undermines the integrity of the Department's process to be relying on proprietary data. There is a solution here. If you are not able to release the data, don't rely on it for the assessment.

MR. BROOKMAN: Okay, we have a comment from Mark Nayes who is joining us online. Mark, hopefully you will be unmuted now.

MR. NAYES: Yes, as far as the cost analysis of the breakdown of the furnace, we don't buy broken down furnaces. We buy them all assembled together already, and our cost on an 80% PSC motor furnace can be as low as $350.00. For the 98% ECM furnace, it can be anywhere from $1,800.00 on up, depending on size.

We buy from three different manufacturers, so we have got a pretty good analysis across the spectrum of who makes furnaces.

MR. BROOKMAN: And Mark, who do you represent?

MR. NAYES: We are Southside Heating and Air Conditioning, Incorporated, out of Bloomington, Minnesota.

MR. BROOKMAN: Thank you.

MR. RIVEST: This is Mike

Rivest. I think what's been lost in all of this, and the primary reason that we couldn't rely entirely on rebuild data, is that the volumes that we are talking about here shifts the entire market from the current minimum standard, so the market right now is a mix of 80's and 92's and 95's, and so in this example, 98 represent 2% of the market.

In the world where if the minimum standard were 98, a 98% AFUE furnace would not cost $1,800.00. Everyone would be producing at high volume 98% AFUE. The production processes would be optimized, economies of scale would come in, so that $1,800.00 price point is no longer relevant, so we have to rely on an understanding of the technologies of the manufacturing processes. That's why this is the type of analysis that is required.

Now, I think there could be useful retailer information where the volume's average could collect, you know, so Karen's idea of looking at Home Depot is certainly valid where there is significant sales volume but at 98.

MR. BROOKMAN: Neil?

MR. LESLIE: It raises I guess one of the key questions I would have related to some of this, and that is at what point do you consider the different technology options to be at maturity?

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: This is Harvey Sachs from ACEEE, and what I am sensing here is to force the discussion into a blind alley where nothing can be done because we are at the intersection of proprietary information and demand for increased public information and that's in some sort of a NDA, non-disclosure agreement. I am sensing, and I hope I am wrong, an effort to discredit the entire standard setting process for this and other products, rather than an effort to explore whether the end result is, Andrew's suggestion, the true MPC and the true average retail price for volume products, but that's really the issue. Thank you.

MR. BROOKMAN: Ashley Armstrong?

MS. ARMSTRONG: So we just have a question from the web, and so, Adam, I'm going to read it. It comes from Everett Shorey, and he wants to know, how did you extrapolate from your 80,000 BTU unit to other sizes, and how did you deal with the larger capacities that come out of your further downstream analysis? So if you could explain your extrapolation a little bit, that would be great.

MR. DARLINGTON: Yes, as I mentioned during the selection of teardowns, we selected units above and below our representative capacity as well, so we compared those units to the representative capacity -- what changed, how things changed, you know, how the heat exchanger sizes changed, how the components changed, you know, does it need a larger inducer, does it use the same inducer fan, et cetera.

Does the cabinet get larger, and basically then what we did was we estimated the cost difference to change the size based on which components would change in larger and smaller units, so we accounted for, you know, if it has a larger cabinet or a smaller cabinet, if it has a larger heat exchanger, and which components are the same so that when you have a changing cost between sizes. So that was basically our methodology there to estimate those costs.

And then they were fed into the LCC so

MR. BROOKMAN: I'm eager for us to keep going as you contemplate your next set of questions. Keep going, Adam.

MS. ARMSTRONG: Do you want to bring up your --

MS. SHEPHARD: Yes, I will bring up a point, so I can just make it and then step back. And mine goes back to Frank's point about the test procedure. The DOE Process Rule has certain key elements in it, and one of them is the sequence in which the test procedures relate to the standards that are being developed.

And in that Process Rule, it says that the test procedures will be determined before the NOPR stage of the standard, and that's so [that for] the analysis that is used, we know how you are measuring it. You know what the effects are, and I appreciate the conversation/ discussion yesterday and additional information that is coming out, but when you don't have the measurement finalized and that's what you are using to develop the standards, there's an increased level of uncertainty and, I think, unfairness to folks, and so I would encourage that the test procedure for this needs to be finalized in accordance with DOE's own Process Rule.

And understanding that we have timelines and that those timelines are based on DOE's best efforts, we appreciate the work that is being done, but it is very important to have that process which has been broken down, and [there are] a lot of DOE rules where you

don't have the test procedures correlated in this manner. It needs to start now complying with the Process Rule where we have that done before we use it to analyze these standards.

MR. BROOKMAN: Okay, thank you. Mark, do you want to follow on?

MR. KREBS: First of all, what she said. Second of all, Jim Moore still has his hand up. I urge you to recognize him.

MR. BROOKMAN: Yeah, I didn't receive that. Jim, go ahead and speak. I can't hear you. Here we go.

Now you go.

MR. MOORE: Many people touched on most of my concerns. The one that I think originally was and Mark said a little, what mode of pricing did you assume? You tore this thing down with a PSC in it, and then you came up with some kind of a price for these more complicated motors which have maintenance issues and high costs, and I was just trying to figure out -- I don't even know the price variables -- I was trying to figure out what you assumed for the price of the fan motors [that] was my original question.

MR. DARLINGTON: Yeah, Adam -- this is Adam, so we -- the prices that we assumed for the fan motors, they were based on some of the analysis that was done for the furnace fans rule. As I mentioned, the requirement for the X13 constant-torque BPM and that came out of the furnace fans rule, so those are actually available, both in that rule, and, I believe, we put a table in the TSD that shows what the cost difference would be, so that would be in chapter 5 of the TSD.

MS. ARMSTRONG: So Mark, as a follow up, we will get you the reference you need to look at the fan motor pricing to specifically address this question, and that should do it.

MR. BROOKMAN: Harvey?

MR. SACHS: Thank you. Harvey Sachs, ACEEE, and I have a question for Amy -- follow-up for Amy. For the manufacturers, would you all prefer that this rulemaking were to proceed with the old AFUE rating method with its own problems on these units? This is being proposed as a patch from the old rating

methods, like the water heater.

MS. SHEPHARD: Well, I think the key is the process part of it. Yes, it should be fixed, and that's final, that is, what you use to analyze the standard and, I mean, I think that's why the Process Rule came out of a very similar situation in the 90's where you had a lot of these same issues going on, and I think that what we are feeling is that they are still here, and the Process Rule is the tool to address it.

MR. SACHS: This is Harvey again, and you are being very skillful at not answering the question that I asked.

MS. SHEPHARD: It should be fixed, and it should be fixed for, well I -- as soon as we start talking about test procedures, it gets so technical. , I always defer to Frank so -- but what I am saying is if there are issues that need to be addressed, they are addressed. That is [made] final before the NOPR. That is what is used in the analysis.

MR. SACHS: It seems to me, and I really would -- I certainly don't ask for this now, but I really think that we are getting on in years since we have had a new gas furnace rule, and the questions were, is there something DOE could do that others might be happy with, like say, "Gee, we will give you a waiver to use the new one on the affected two-stage units."

Is there something that could leave you all whole that would not require putting the whole rulemaking on hold for another year?

MR. BROOKMAN: Let's hear from Karen.

MS. MEYERS: Karen Meyers with Rheem, and I think my answer at this point, Harvey, would be no. In my opinion, this rulemaking should be -- we should hit the pause button on it until the test procedure rule is finalized in accordance with what is in the statute, so that's the proper way to do it, and that is the way we Y,ou know, Rheem itself have several issues where this has caught us unaware in the past.

So I'm speaking for Rheem, not necessarily the industry, but we would prefer to see test procedures finalized and then the analysis take place.

MR. BROOKMAN: Jim, go ahead.

MR. VERSHAW: Jim VerShaw, Ingersoll Rand. I think if you look at the test procedure and the discussions we had yesterday, a lot of work on what the difference with the AFUE between the new procedure and the old procedure. But when I ask questions about what it did to burner operating hours and blower run time hours, I didn't get an answer. I didn't calculate that, and if you look at life-cycle costs analysis for this thing, especially looking in the south, a lot of air conditioning hours, what does that do?

Do we really know what the new procedure and if that is more accurate, did they account for that when they did the analysis here, and I think we really don't have a good answer on that, and that's part of this discussion.

MS. ARMSTRONG: So, I do want to follow up on one thing, because one of the things that we did clarify yesterday, and I think Victor is going to speak to it a little bit further when we get into the LCC specifically, was that we did account for it in this rule, so it is consistent, and we can provide you the information at least with what we assumed in this rule for those burner operating hours, and I think you noted even yesterday that's what we did in the previous rule too, just because it's a better reflection of what is currently happening than what is our current test procedure.

So we will get into that a little bit later when we get into the LCC because there is a lot of slides going on there and so, but the answer to your question is yes, and we did somewhat address that yesterday, and we are going to further and completely address it today.

MR. BROOKMAN: Thank you, Ashley. Mark?

MR. KREBS: Yeah, I have the same concerns about homes in the south, and in doing some research on that, I came across two papers from LBNL and the lead author, Victor Franco, was in the room, and he might be able to elaborate significantly on your questions and fill us all in on that issue. Thank you.

MR. BROOKMAN: Okay, we are going.

MR. DARLINGTON: All right, so we will move on. All right, another aspect of this rulemaking is the standby and off mode analysis. DOE analyzed a single standby mode and off mode standard, and the reason for this is that furnaces are typically used along with a cooling system during the non-heating season, so the furnace wouldn't be completely powered off, but it will remain in standby mode for a cooling demand, at least for the --

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. Just a couple of quick questions, and if it was in the technical support document, please forgive me. For these components, what was the -- I know you are assuming that the numbers shown was energy consumptive combination, what was the range of values for the components?

MR. DARLINGTON: I don't know off the top of my head. I could probably look at it and get back to you.

MR. ROSENSTOCK: Okay, the second question I have was when we tested and what was the testing equipment accuracy?

MR. DARLINGTON: I would again have to look at that. So we tested in accordance with whatever DOE's test procedure is, so I think it references the IEC standard, and we used equipment within the accuracy.

MR. ROSENSTOCK: Steve Rosenstock, EEI. When we get to the next slide I will have some follow-ups because I think that's very important in terms of some of the numbers.

MS. ARMSTRONG: This is Ashley from DOE, and like Adam says, we can go back and look at those. Typically, we use Yokogawa,Yokogawa but we can
go back and see exactly what we used.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Thank you very much, but I really kind of wanted to focus in on what the accuracy of the equipment was so that I can plus or minus 5% of it or plus or minus --

MS. ARMSTRONG: If you look up that actual test equipment, it will give you those accuracies that will answer your question.

MR. ROSENSTOCK: Steve Rosenstock, thank you, but okay, I'll make another comment when we get to the next slide. Thank you.

MR. BROOKMAN: Okay, go ahead, Adam.

MR. DARLINGTON: So going back to what I was saying, we did it as a design option approach. DOE established a baseline based on product test data along with manufacturer feedback, so currently there are no ratings, at least that I am aware of, for the power consumption in standby mode. So the baseline efficiency levels were just defined as the most consumptive combination of electrical components for the tested furnaces, and then specific design options were applied to the baseline in the order of cost effectiveness, and here on the side, you can see what we found to be the key driver of the standby mode consumption, which were: the transformer, if a BPM blower motor is present, and, of course, that factors in, and then controls and just other standby consumption with the unit.

So total baseline was 11 watts -- so here on this slide, we are representing our results basically at the baseline and the linear power supply and the standard 40 VA transformer. Efficiency level 1, adding in a low-loss transformer. Efficiency level 2, going to a switching mode power supply, and then at efficiency level 3, adding units switching on the power supply in the low-loss transformer, and that gives you the estimates here of what the standby/off mode power consumption would be as it compares to the baseline, along with the estimates of what that would cost to implement.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, EEI, and here's my point. If whatever the standard test equipment accuracy is, let's say it's plus or minus five percent, well now we are down to tenths of a watt here for this efficiency standard. 9.5 plus or minus 5% is now .5 watts, so, and again it also depends on the range of products out there.

You go from efficiency of that baseline to efficiency level 2 or 3, and based on the range of the accuracy of the test equipment, you may or may not be saving any watts whatsoever. Especially going from efficiency level 1 to 2, you are talking about a .3 watt difference.

And the testing equipment is plus or minus 5%. Well, you might be saving electricity; you might not be, because there is going to be a range depending on the product and depending on the design, so again I think when you are talking about such miniscule savings, you know, you have to account for something, what's happening in the test equipment, and especially if there is a lot of baseline equipment, when you talk about lost energy consumption, if the typical one on the market is already at 9 watts, you know, some people might be saying you are spending ten dollars to save 0.0 watts, excuse me. Thank you.

MR. BROOKMAN: Adam, to the comment box please.

MR. DARLINGTON: So DOE is seeking your comment on basically any aspect of the standby mode analysis, and what fraction, if any, consumers shut off the furnace during the non-heating season. Your comments are welcome.

MR. BROOKMAN: And then the second one relates to any other issues related to methodology, assumption, or results of the standby mode or off mode engineering analysis and all of the foregoing slides. This would be a good place to register any additional thoughts or concerns. Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. And seeing that sentence, I can't tell you how many times about whether consumers shut off during the heating season, and I just have a new question. Aren't we really just talking about furnaces that in fact are not also driving the air-conditioning system, the cooling system?

Because if you have a furnace, whatever percentage of homes have both a furnace and an air conditioner, I would say that question doesn't even apply because the system will always be on 24/7 365. So I guess my point is, is that question really only looking at those installations where the household only has a furnace, heating and cooling?

MR. DARLINGTON: So that's our thinking too, is that it should be on all the time to be on standby for a call for cooling. So the furnace fan standard, I don't think it addressed standby mode at all because DOE had already proposed back in the 2011 direct final rule to cover the standby of the entire furnace, so I guess it can be a little confusing because the active mode of the furnace fan was covered by the furnace fan and stated, whereas the standby mode is going to be covered by this.

So this covers the entire furnace regardless of whether it is a furnace only or whether it is installed with an AC, and the understanding is that almost all furnaces would be -- the vast majority at least, would be installed with an AC, so there would be no distinct off mode. It would be in standby mode year around, so that's kind of what we were --

MR. BROOKMAN: Frank, go ahead.

MR. STANONIK: I think Adam just said they had them, and now I am asking, so why are we asking this question then?

MR. DARLINGTON: Just to confirm to confirm our assumption.

MR. ARMSTRONG: Frank, you can say you agree with the Department, it is okay. It is a rarity, but yesterday we agreed too.

MR. BROOKMAN: Kathryn?

MS. CLAY: As we leave the engineering analysis portion, I just wanted to circle back to our earlier discussion on costs, and I appreciate Harvey's framing of the issue as a balance between protecting proprietary information and protecting the right of the public to be able to analyze it.

Call me a crazy optimist, but I just can't help to believe that there is a way to solve that problem and find a middle ground. I can imagine ways of providing some intermediate level of information either by chunking components into systems so you obscure the individual component costs, or the ended averages across costs for manufacturers but something in between absolutely nothing -- this black box that we are looking at -- and full-on proprietary information data to the last screw.

There's got to be some reasonable information sharing approach that we could come up with working together, and we just appreciate the chance to work with you all to find that solution.

MR. BROOKMAN: Ashley Armstrong?

MS. ARMSTRONG: Sorry, I think that's something that Mike alluded to earlier when he was speaking, so I think what would be helpful to the Department, or We are definitely willing to work with you. Obviously, we want to make our analysis as transparent as possible, and we are really in this to get feedback and incorporate that feedback, so to the extent that there is certain information that you are seeking, like for example, they asked for -- Laclede asked for motor pricing, that kind of stuff that we used in our analysis on -- I think we would welcome that, and if you want to have a conversation further with some of the manufacturers about what level of aggregate DOE would be comfortable with, and we would do it on an aggregate industry basis not on a model basis by any means.

I'm happy to have that conversation, and feel free to follow-up.

MR. BROOKMAN: Okay. Additional comments? Here, Jim, please.

MR. VERSHAW: Jim VerShaw, Ingersoll Rand. You know, I am looking at this switching mode power supply that adds $8.00 manufacturer's cost to save 23 watts or that plus a low-loss transformer for another $9.67 to save a watt. As a standalone, would that make sense for the consumer? Because that is going to add, what, thirty dollars to the homeowner's cost to install the furnace, and it goes to a technology that none of us have experience with in terms of putting it in our product.

And if you have a furnace, the last thing you want is some kind of new technology that is going to go out when it is 30 below zero up in Minnesota or even 18 in Texas. I mean, there [are] a lot of unknowns in there to save, and it says it saves a lot but to Steve's point, it kind of overlaps. [Are] there really savings there, and is it really worth that kind of money with that kind of unknown or reliability to put that in? That's my feeling on it.

MR. BROOKMAN: Thank you. We are due for a break, let's take a break. It's 10:55 by that watch up there. Let's take 15 minutes. Just to remind you, I think most of you are familiar, please wear your badge visible. The restrooms are on both ends of the hall. If you are going to go for coffee, it's on the ground floor. Go quickly.

MR. BROOKMAN: Apologies for starting a few minutes later than scheduled. It was truly clogged up in the coffee shop. Just waiting to make sure everybody got back here before we commence. So we are going to pick up where we left off and begin with the life-cycle cost analysis, and we are going to hear from Victor Franco.

MR. FRANCO: Thank you, good afternoon. My name is Victor Franco. I am from Lawrence Berkeley National Laboratory, and I will be speaking about the life-cycle costs analysis and the subgroup analysis in this next section.

So this slide shows the overall payback period and LCC analysis, a flow chart about the analysis. Obviously, the analysis is pretty complex because of all of the inputs, and I just want to go over it a little bit in detail to try to set up the discussion for the next few slides.

So first of all, as we discussed earlier in the engineering analysis, we come up with a manufacturer cost. We have discussed that already. In chapter 6, we describe the markups to determine the product prices, and that's how we come up with a consumer price. We add this to the installation costs, which we will discuss later, to come up with the total installed cost.

In terms of the LCC and payback, we have to consider the differential between the base case and the standards cases, and that gives us these incremental costs, which is the slide above. In the bottom cells, we describe the operating costs. Chapter 7 describes the energy use characterization to determine the energy consumption. We then multiply those by the energy prices to come up with annual operating costs in terms of energy.

We also consider repair and maintenance costs to come up with the annual operating costs. Again, we come up with these incrementals to come up with these annual operating cost savings between the standard cases and the base cases. Other inputs to the LCC analysis include lifetime discount rate and energy price trends.

With this, we come up with a discounted lifetime operating cost. The total installed cost incrementals and the discounted lifetime operating costs are the main inputs into the life-cycle cost. The total installed cost and the annual operating cost are the main inputs to the payback period.

In addition to this, we have product switching that is incorporated into the LCC analysis. That's the box shown right above the payback period and life-cycle costs analysis, and we will be discussing all of these in subsequent slides.

First, let me go over a little bit more about just the overall LCC calculation. So first, it is important to note that the LCC provides an economic evaluation from the consumer prospective, so that's why we are looking at this in terms of household by household or furnace by furnace.

The life-cycle cost is a total consumer cost over the life of the product. This is shown in the equations that are shown below. The payback period is the time to recover the increased purchase price of the higer-efficiency products through reduced operating costs. We used a sample of households and we will be describing in more detail later [how] to do this analysis.

The equations are shown here. The analysis models with the uncertainty and variability of inputs using the Monte Carlo approach and the probability distributions using Excel spreadsheets which uses a Crystal Ball add-on.

In the next slides, I will fully explain the approach applied to generate the inputs and the probability distributions. The spreadsheet inputs and the application method -- this will also be a good opportunity to answer any questions about the analysis methods in the LCC spreadsheet.

This is next slide. I won't go through it in detail. It is just for the purpose of summarizing all the different inputs, and you can use this as notes as we go through the discussion. Basically, we will be going through all these different inputs in the order in which they are shown on this slide, so first, we will be describing the total installed cost which includes the consumer product price and the installation cost.

Then we will be talking about the operating costs, which will include the energy use, energy prices, maintenance and repair costs. Then we will talk about the other inputs for the LCC analysis, including the discount rates, lifetime, base-case efficiency distributions.

For this analysis, the LCC tools include product switching, and that will be described further on as well.

MR. CYMBALSKY: So this is John from DOE. If people want to pull this slide out from the rest of them because I think this is a good cheat sheet as we go through when Victor describes the different analyses. This is a good map -- key map for the concepts that will be discussed, so

MR. FRANCO: Thank you, John. So this is Victor Franco again. First, then, we will be discussing the product price determination. The product prices are determined by multiplying the manufacturer cost by the markups, which will be fully described on the next few slides, and the price for manufacturer.

As we discussed earlier in the engineering analysis, the manufacturer production costs are developed for each efficiency level. The markups are derived from company direct costs, expenses, and profit. The consumer price is based on MSP for the baseline and higher-efficiency products.

We characterized the non-weatherized gas furnace and mobile home gas furnace distribution channels, and we will be describing that in more detail in the next slide.

The price trends on the historical PPI data are based on the historical PPI data and shipping data. The price trend is a decreasing -- it decreases about 16.5% over the 30-year analysis period. The 30-year analysis period starts in 2021 and goes until 2050. We also consider sensitivity analyses of other trends: a high decreasing -- a higher decreasing rate and a constant trend, and those are provided.

MR. BROOKMAN: Neil, please go ahead.

MR. LESLIE: I'm going to try to re-ask a question. I'm sorry, I'm Neil Leslie with Gas Technology. Excuse me. , I apologize for that. So a little bit ago, I asked a question that related to at what level of shipment for a particular product, such as a 92% furnace, would it be considered a mature product, and so I'm going to re-ask this in context of the default price trend which seemed to be decreasing, a decreasing price trend over time.

And my question is, and I'm not sure who is going to be able to answer this question, how many of the products at the different trial standard levels are deemed to be mature products, such as the 80% product, whose market share has been declining over time remains considered a mature product?

Does the 90%, does the 92%, does the 95%, and does the 98% furnace also qualify as a mature product? If so, what would the rationale be for a decreasing price trend, and if not, why not?

MR. FRANCO: Thank you for that question. I would have to defer that to my colleagues.

MR. CYMBALSKY: This is John from DOE. Let me just take a stab at the context of learning that you bring up here. So what we did here is we looked at furnaces generally, so I guess going back to Andrew's opening remarks, maybe we can rephrase your question in terms of is there -- do you believe there should be no learning for the whole market or do you believe that furnaces should be just aggregated by the AFUE levels to pick out which ones could experience more learning relative to the others?

So I guess when we put that back on to what your thinking is, and then we can better answer the question.

MR. LESLIE: Ultimately it will go to -- this is Neil Leslie -- ultimately it will go to the price trend for the different trial standard levels for each of the individual trial standard levels, and so if indeed there is no distinction among the trial standard levels related to what I would call a learning curve, then my question is, and this is where I am back to it, would that imply then that DOE is assuming that these are all at fairly mature levels of shipments?

MR. CYMBALSKY: No, so I think what we are saying is, based on the data that we had, we created one trend for all the whole furnace market, and so I guess to interpret your question, it sounds like if the level of shipments for say in 98 are much lower relative to an 80, we should have faster learning on the 98 than we should the 80, is that a yes?

MR. LESLIE: I'm not suggesting what is correct. I just wanted to know what you have.

MR. CYMBALSKY: Right, so it's the same and we have been consistent with all of our rules that we applied the learning equally amongst all the technologies. We don't have faster learning in the lower shipment AFUEs in this example. Same for all of the products, but we understand where you are coming from. If we had the data that could support better disaggregation, we are all for taking it in.

MR. BROOKMAN: Mark?

MR. KREBS: Mark Krebs, the Laclede Group. John, as I recall from the DFR, you had a significantly faster learning for gas furnaces than you did for air conditioners, so you know, consider that that is a fact, and although this NOPR is just about furnaces you know, I would say that you haven't been consistent.

MR. CYMBALSKY: No I think -- John Cymbalsky, DOE. The methodology has been consistent. The actual trends are different based on the data for each product, so I don't know off the top of my head what the air conditioner one was, but for example, we have another rule where we look at the data -- same data source but for the different product category out of the data set -- and there was no learning.

There was no observed learning. I'm not saying its air conditioners but so it all depends on the product. The methodology is consistent.

MR. KREBS: Well, I would suggest that it is just another area of controversy that we should probably do without even attempting to factor in learning curves.

MR. BROOKMAN: Andrew deLaski?

MR. DELASKI: Well doing without it is doing without the data. I mean, it's based on a model and data, it's not based on just an opportunity -- from a hat and that's really -- I applaud the Department for coming up with a statistically-driven model that is based on economic literature that is used not just in DOE rulemakings but in other economic analysis for how products evolve over time.

So I applaud DOE for having the data-driven model. I think the challenge is what Neil put his finger on, which is how you apply it to the level that the new standard will be and I encourage the Department to continue to explore approaches that will allow you to develop learning for the incremental technology. The learning concept is driven by for each doubling of production -- of cumulative production, there is a certain rate of learning.

So doubling the cumulative production should be applied to the particular product at the level at which the standard is set, so yeah, I think a lot of learning -- 80% -- has been done but I don't think that as much learning has been done at the higher efficiency level, so the question is, how do you capture that in a statistically driven market? But let's not ignore the data, let's find out how we can use the data to answer that question which I think is a relative question from docket.

We do have the data and it is in the TSD. There's a whole chapter that writes this up quite clearly over a pretty good time series data. I think, thanks to AHRI, I think it is the source on the data, one thing that's happening with that data is that the tail end coincides with some pretty rich tax credits that were applied.

And those tax credits were intended to distort the market, they were intended to try to change consumer behavior market distortion. And the tax credits, I would submit, likely had an effect on prices. Tax credits -- the benefits for tax credits -- are shared among consumers and manufacturers. Some of those costs are passed on to consumers in lower prices, but some of those costs, some of those credits end up in enabling prices to stay higher than they otherwise would.

So I think DOE needs to think about how you disaggregate the effect of the tax credits from what the tax credits were in the learning rates on the price trends over time. I don't have an answer for you right now how to do that but I think it's something that we need to think about to get a better estimate of what the actual learning was.

MR. BROOKMAN: Kimberly Swanson, who is joining us online, has a question or a comment. Kimberly you are now unmuted I think. Nothing from

Kimberly. Maybe you can join us in a moment.

We also have a comment from Everett Shorey, who is joining us online, actually a question. He says, figure 8J31 of the TSD seems to show that the price trend is flattening and is not consistent with the fitted curve. How have you factored that into your analysis?

MR. FRANCO: Thank you for that question. We used that part to -- we fit basically, we do the best fit to that curve, and, as discussed earlier, part of those values are distorted by the market, but we use a longer period of time to come up with the learning rate that should wash out some of those distortion markets.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: Harvey Sachs, ACEEE, and Andrew, I believe the data that you referred to were not from AHRI but from the Census Bureau Producer Price Index, so a very small thing. The broader point that I feel is important to bring up is that for the first couple of decades of these standards, the process DOE did not incorporate learning curves in any significant way that I can remember.

It's been asked for, for the last decade, and has been incorporated. To me, the reason that it was necessary to include learning curves is that DOE's forecast of the retail prices of all sorts of things without that were consistently too high for almost every product analyzed retrospectively.

DOE had predicted a higher price for what would after standards become the baseline product than was actually observed. So the learning curve approach can be argued about in the details but we feel it was an essential compensation reflecting the shift of what had been a niche product into one that was built on the best processes with the newest production processes, and it was a reflection of what actually happened in the market for a range of products, from dishwashers to whatever.

MR. BROOKMAN: Thank you. Go ahead.

MR. FRANCO: Thank you. This is Victor

Franco again. Let's move on now to more detail about the markups analysis. Markups are used to determine consumer prices for manufacturer's selling price for both baseline and high-efficiency equipment, as discussed earlier. The appropriate markups will determine the consumer equipment prices that depend on the type of distribution channels to which the equipment moves from manufacturers to purchasers.

And on this slide you can see the different distribution channels. At each point in the distribution channel, companies mark up the price of the equipment to cover the business cost and profit margin. There is one primary type of distribution channel that is describing the way most products pass from manufacturers to consumers for furnace products, from manufacturer to wholesaler to mechanical contractor to consumer.

DOE also distinguishes between new construction and replacement applications. The new construction applications are expected to include the general contract as shown in the diagram for non-weatherized gas furnaces and includes for mobile home furnaces, mobile home manufacturers and mobile home dealers.

Based on information provided from manufacturer interviews, there's another possible distribution channel that includes the retail store instead of the wholesaler -- in this case the manufacturer sells equipment to the retailer who in turn sells it to the mechanical contractor who in turn sells it to the consumer.

However, DOE does not have enough information at this point to make a separate market estimate for this distribution channel. DOE assumed that the retail markup is similar to the wholesale markup.

The table below provides the references used in the analysis. These references include information for the manufacturer markup as discussed earlier from the Security and Exchange Commission 10K report. This is discussed in the engineering analysis.

The wholesaler markup comes from data from HARDI 2012 profit report. The mechanical contractor comes from two sources, ACCA data in the 2005

Financial Analysis and U.S. Census 2012 -- 2007 Plumbing and HVAC Contractors sector.

The general contractor comes from 2007 Consumer -- Commercial Building Construction sector. For mobile home manufacturer and home dealer, both come from U.S. Census Bureau data. Sales taxes come from 2013 Sales Tax Clearinghouse Data.

MR. BROOKMAN: Yes please?

MR. MCCRUDDEN: Charlie McCrudden, ACCA. Your depiction of the new construction -- you have the mechanical contractor come before the general contractor? Does that suggest that the wholesaler is providing it to the mechanical contractor and he is subbing the general contractor? I'm a little confused by that.

MR. FRANCO: Yes, thank you. It is a little bit complex. Sometimes what happens is you go from the wholesaler to how you are describing to the contractor. The general contractor is the one that connects with the consumer which in many cases is the builder of the equipment so he would be the one that actually marks up the whole equipment.

In other cases, it could be the general contractor purchasing the equipment and then going through the mechanical contractor, so it could be either or. In terms of the actual value it would be similar because you are just multiplying the mechanical or the general contractor.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik AHRI. I'm not exactly fond -- but the general contractor, you are using this Census Bureau commercial building construction and I am going to ask -- I mean is -- I understand those words to mean this is not a residential building and so my first question is, is that a correct assumption that this Census Bureau report is in fact not covering residential buildings?

MR. FRANCO: Thank you. This is Victor Franco. I think that actually is a misprint I think that should say residential.

MR. STANONIK: So you did, okay so you used the Census Bureau report on residential building general contractor?

MR. FRANCO: That's correct, sorry about

that.

MR. BROOKMAN: Do you have an additional question or comment?

MR. CYMBALSKY: I think -- this is John from DOE. To address Charlie's question, to me, the GC on this is, like Victor said, is kind of the home builder in that case, right, so the home builder, if they are building a bunch of town homes, they contract with a mechanical HVAC guy to buy a bunch of them, right. That's the way I see it, but if the order seems backwards, we will take that comment, I think it's correct too.

MR. BROOKMAN: Yes, Frank Stanonik?

MR. STANONIK: Frank Stanonik AHRI. I think well, it is a little bit on point, I mean, and it gets back a little bit to maybe this discussion of price, and Andrew mentioned that in the case of something like tax incentives or tax credits or whatever distorts the market in both the -- or the idea at least is the manufacturer and the consumer shares on that.

And this reminds me but in fact -- and the analysis, does this -- we need to keep this in mind, okay, the ultimate cost the consumer pays they don't -- they, they don't buy the furnace from the furnace manufacturer, okay, they are paying this installing contractor and so the question -- let me rephrase this.

So even if we talk about tax credits and the benefit of the tax credit, you really have to look at, okay, so how does the installing contractor deal with a tax-incentivized product? Does he in fact change -- does he or she change the overall price to the consumer? I mean, that's part of the equation, and I would say we cannot ignore that because, as we will see in many of the slides, that in fact, it is very possible that the cost added by the installing contractor is more than the cost of the product.

MR. BROOKMAN: Okay, Kimberly Swanson is joining us online. Kimberly let's try it again, you should be unmuted.

MS. SWANSON: Okay, am I coming through?

MR. BROOKMAN: Yes.

MR. SWANSON: I am Kimberly Swanson and I am a consumer, and the question actually gets at whether its analysis at all took into consideration if the unit was going to be located in an area of the country that had a carbon trading market or a voluntary program within the market that the unit was going to be located that worked to reduce carbon emission.

MR. CYMBALSKY: This is John from DOE. We are going to get to environmental impacts later, but yeah, I think that gets all baked into the cost of the fuel that it is in the EIA forecast, but we didn't get to that level of specificity in this analysis, okay.

MR. BROOKMAN: Victor.

MR. FRANCO: Thank you again. This is Victor Franco. Going further into the markup analysis, DOE uses baseline markups and incremental markups. The baseline markups relate the manufacturers selling price or baseline equivalent to consumer purchase price. DOE applied baseline markups to the MSP at the baseline level.

Incremental markups relate to increase in MSP of more-efficient products in the increase of consumer purchase price. They cover only the expenses that vary with MSP, such as operating expenses and profit. Fixed costs such as overhead and labor do not scale with increased efficiency. DOE applied the incremental markups to incremental difference in MSP at each level of the baseline.

This slide shows the overall markups analysis, the average values. Obviously, we apply the distributional values for each household depending upon what region of the country they are located in. As you see here, the manufacturer markups are 1.34 as taken from the engineering analysis. The wholesaler markups vary as shown. The mechanical contractor is shown here as well, and then we have the general contractor.

The average sales tax nationally is listed here as 7% and the overall markups from this are shown here. I just have here a correction there's a national account that is not part of this analysis on this table, just before questions the bottom shows the overall average markup that's applied in the analysis based on the fractional replacement and the construction.

MR. BROOKMAN: Another question from Everett Shorey online. Have you done any interviews or collected any data from contractors and/or wholesalers/distributors on their actual markup practices?

MR. FRANCO: Thank you for that question. We use ACCA data, which is a contractor's association that gathers data from contractors and we also use HARDI data, which gathers information -- aggregate information from distributors. We have not contacted directly individual contractors or distributors.

MR. BROOKMAN: Please follow on, say your name.

MR. MURPHY: Yes. Rick Murphy, AGA. I would like to go back to an earlier question I had regarding the method of building up the retail price and the process that is used, if you do a reconciliation or a reasonable test to what your results are with what is actually happening in the market, in this case particularly on the market, I'm sure we will get into a similar discussion on the installation cost.

MR. FRANCO: Thank you so much for that question. In the past we have provided a comparison of retail prices that were found either online or from distributors to the cost. In the case of this analysis, it is a little bit more difficult because the baseline starts with a much higher -- because of the furnace fan standard, much higher, so it is hard to compare baseline prices right now on the market to the assumed baseline in this analysis because of the furnace fan standard.

So we have done that in the past and our results are similar to those either through the retail prices kind of --

MR. MURPHY: So I believe in the TSD that that differential between 80 and 92 based upon this pricing is about $172.00 or so and so we haven't been able to determine how that relates to the actual market with what we are seeing in the market today. I'm not sure of the exact number but that is what I recall.

MR. CYMBALSKY: I'm just looking at -- this is John from DOE -- so if my math is correct we see the MSP markup at 1.21 and then to that you would apply these factors, so that gets me into the several hundred dollar, 350 --

MR. FRANCO: Yeah, this is Victor Franco. I'm just looking at the TSD right now, so it's in chapter 8, table 8.2.7, you can actually see the values rise, the incremental from going from 80 to 90% is $163.00 it's around what we gave you before.

MR. MURPHY: So we haven't been able to evaluate that against what we are actually seeing in the market for that increment?

MR. FRANCO: No, and it's complicated because of the furnace standard.

MR. BROOKMAN: Frank Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. Just a follow up on what you just said. Okay, so in this analysis, my baseline would still be the 80 with a, what do you call an advanced motor, okay I will just call it an advanced motor, and so also the 90 whatever product is also going to have an advanced motor, so in the analysis, in that case, for these markups other than the manufacturers, are you using the baseline markup or the incremental relative to the motor?

MR. FRANCO: So how we applied it in the analysis, we apply it to the whole baseline so it includes the furnace fan as part of the 80% level. The incremental, which is just the condensing going from non-condensing to condensing, is the incremental.

MR. BROOKMAN: Another question from Everett Shorey. The question is -- I guess it's a comment - well, there is a question and a comment. A question from Everett Shorey -- so you have no data to show that the incremental markup concept is absolutely congruent with real practices in the field?

MR. FRANCO: Thank you again for that question. In the past when the comparison has been more straight-forward, we have found that our analysis matches with real data. Again, in this case, because of the furnace fans the standard it is a little bit more complicated, but we do assume that because it has been consistent with the analysis in the past, our analysis is consistent now. We will look in that for more detail. Please provide comments.

MR. BROOKMAN: We also have a comment from Mark Nayes who says, the price of the installation of our furnaces are based on costs, of which a tax credit is not one. Our costs of installing a furnace is typically 2 to 6 times the cost of the furnace. Yes, Aniruddh?

MR. ROY: Aniruddh Roy, Goodman. So to follow up on Frank's question, this analysis essentially on the markup side does not account for PSC motors.

MR. FRANCO: Just to clarify we are mainly dealing with non-weatherized gas furnaces, that is correct for non-weatherized gas furnaces. For mobile home gas furnaces baseline, it is a PSC motor because of the furnace fan standard but for non-weatherized gas furnaces, you are correct.

So let's move on if there are any other comments about the markup analysis or anything that we discussed. So now let's move on to installation costs. So this is obviously a part of the analysis which includes a lot of inputs so I will go through it as early as I can, please ask questions as we go through this.

This flow chart is supposed to serve as an introduction to the installation model. Again we start with household sample. From that household sample we determine location of that household and other characteristics of the household. Based on that, we use those characteristics to further determine the installation costs for that household individually as follows.

So first for the installation costs we look at kind of starting for the right side of the part, there are basic costs, installation costs -- these are the green boxes -- venting installation costs, and condensate withdrawal installation costs. The condensate withdrawal would be mainly for condensing for this, only for condensing purposes, and the venting installation costs are related to non-condensing. We will go into more detail about the venting costs. I won't describe that area because I will describe it more in a couple of more slides.

So these three components give us the individual household installation costs. Our data sources included RS Means to come up with these costs, the Residential Cost Data Book from 2013 and we have done this analysis in the past -- we also reference 2011 DFR, the 2007 furnace and boiler final rule, and we have -- we used manufacturer literature as well.

So because it is an important component of the installation cost, I will describe it a little detailed with this flow chart how we determine the location of the furnace. So first we have the RECS household. RECS does not provide directly where the furnace might be located, there is no question in RECS that gives us that answer, but it does provide what characteristics the household will have.

For example, it asks whether the household has a basement, whether the household has an attic, what year it was built, whether it has a crawl space or a garage, so we use all of these characteristics to try to come up where we would think the furnace is located.

If a furnace is in the basement for example it is assumed that if the household has a basement for example we assume that the furnace is located in the basement. In that example we also have information from RECS that provides us whether it is a finished or an unfinished basement and then we use that information as well.

As you can see, we have different criteria for the other parameters, indoor or a garage or crawl space. This slide provides the result -- we have a question?

MR. SACHS: Harvey Sachs, ACEEE. On your attic bullet there is a term HH and I didn't catch its meaning.

MR. FRANCO: Sorry about that, I tried to go quickly through that slide. The HH is supposed to represent household.

MR. CYMBALSKY: So we think this might address question 4 in your installation question relating to how does it account for installations where more than one furnace is necessary.

MR. SCHROEDER: Closets not separated out.

MR. BROOKMAN: Dave, please say your name.

MR. SCHROEDER: Sorry, Dave Schroeder.

MR. BROOKMAN: I will repeat the question.

MR. SCHROEDER: So closet installations are just installations that there is no differentiation between closet and --

MR. FRANCO: That is correct, yes, for our analysis we just use indoor and that does include closet and other situations indoors. I just forgot to mention to respond to the comment that for households with multiple furnaces, a fraction of the time the same household will be analyzed with the furnace in the attic or indoors or in the closet in the second floor. And another fraction of the time the furnace will be analyzed as in the closet or indoor space on the first floor or in another location such as the garage. This would address that question from HH.

MR. BROOKMAN: Charlie?

MR. MCCRUDDEN: Charlie McCrudden, ACCA. What are the numbers in the blue sort of oval cells in the bottom?

MR. FRANCO: Yes, the numbers, sorry, I went through this rather quickly because there are a lot of details. The numbers that match the installation location key that is used in the LCC spreadsheet, so number one represents the condition basement, you go to the LCC spreadsheet and try to figure out what is one in terms of the installation location, what that means.

MR. MCCRUDDEN: So that's the rank, the most?

MR. CYMBAKSY: No, it just keys up to the spreadsheet, so if someone wanted to go and look at the numbers in the spreadsheet, you can go to one and that represents conditions B. It's just a mapping key for the spreadsheet.

MR. FRANCO: We will go over the fractions in the next slide. This slide just presents the results that are also provided in the TSD in terms of the installation location. These results are just aggregated by region as well as national. As you can see there's differences in terms of a region which is incorporated into our analysis.

So let's go into the installation costs. So we can consider basic installation costs as installation costs that are applicable to all efficiency levels. This includes a trip charge, this includes removal of the existing furnace in the replacement case, putting in place and setting up the furnace, unit start up, checkup and clean up. Gas piping, electric hookup, removal or disposal fees, any additional labor required for attic installations, and the duct work costs.

The duct work cost was accidentally removed in the basic installation costs while reformatting the spreadsheets; it is actually not included. This will be added back in the next phase of the analysis since the basic installation costs are the same for all efficiency levels and are also applicable for equipment switching options, electric furnace and the heat pump we will be discussing later.

Adding this cost will not impact the difference in the final result between the efficiency levels. This addresses one of the questions from APGA.

MR. CYMBALSKY: This would be question one from the installation cost questions in Appendix 8D.

MR. BROOKMAN: Do we have comments here? Jim, please?

MR. VERSHAW: Jim VerShaw, Ingersoll Rand. So I'm looking at this, how many man hours are included in that typical installation?

MR. FRANCO: Thank you for that question. This is Victor Franco. It depends on the input capacity. I believe it is on average either 4 or 5 hours, that's the actual kind of unit startup, removing, replacing, and if it is in the replacement situation you have to have the removal of the existing furnace, so that is approximately half of that.

MR. VERSHAW: So the 4 or 5 hours, Jim VerShaw again, includes removing the old furnace?

MR. FRANCO: No it does not. I would --

MR. VERSHAW: 2 more for that, 2 or 3 more for that.

MR. FRANCO: For that. Overall it probably takes about 10 hours.

MR. VERSHAW: So it's interesting that the north is so much more expensive than north -- national and rest of the country. What's the difference between national and rest of the country, that's another question, and why is the north so much more expensive on replacement than the other parts of the country?

MR. FRANCO: Thank you for that question.

MR. BROOKMAN: Do you live in the north?

MR. VERSHAW: No, I used to.

MR. CYMBALSKY: So the national is just the average of the two below it, so the north and the rest of the country -- not north, you weight the average and you get the top number.

MR. VERSHAW: So is California north?

MR. FRANCO: No that would be rest of country in this picture Frank.

MR. VERSHAW: All right, so do you have listed somewhere the labor rates that you assumed?

MR. FRANCO: Yes, these are listed in appendix 8D.

MR. VERSHAW: If I read that right, it was like $60.00 an hour for a plumber and an electrician and $50.00 an hour for a technician, something like that. Was this overhead profit?

MR. FRANCO: That is correct, yes, and the rates are different between the -- for example in New York it is expensive, Georgia --

MR. VERSHAW: I have been doing a survey around the country for people that work for our equipment. It's higher than that, so we will do something on the comments for that, or we will do it through AHRI.

Now to go back to what did you do to validate your number of hours are correct, and you took the dollar per hour from RS Means, right?

MR. FRANCO: Yes, that is correct.

MR. VERSHAW: What did you do to validate that that was actually real? Did anybody in Navigant or DOE have a furnace installed or get a quote just to see what you would see and then compare that with what this is to see if the real world matches up to this, because it's an awful lot of assumptions. Everything is based on the RS Means dollars for installation.

MR. FRANCO: That is correct, thank you so much for that comment. We do try to look at that kind of data. There are data sources that provide from either the homeowner or contractors what they have actually spent and there are national averages, so we try to look at that data and compare that data to our data.

Obviously that's a mixture of high efficiency and lower efficiency so we try to weight that and compare it to our values and our values are comparable to those.

MR. BROOKMAN: You are next, your name please?

MR. MURPHY: Rick Murphy, AGA. I had a similar question and I appreciate that response. We are also in the process of trying to work with our members in their respective communities that they serve to get specific proposals from contractors in the area to have more intelligence, and hopefully, if that is a value to you, we can certainly share that.

I do have a question and maybe it is not appropriate here, it may be for the product switching section, but this approach here, is this assuming that every -- in the replacement market, every installation has an opportunity to install a condensing piece of equipment and it is just a matter of cost, or do you also take into consideration households or structures that it is almost impossible to install the equipment?

MR. FRANCO: Great. Thank you so much for that question, but we will get into more details regarding the installation of condensing a little bit later. We do assume that you are able to install it even though the costs might be really, really high.

MR. BROOKMAN: Mark Krebs, do you have a comment here?

MR. KREBS: Well, just to answer the gentleman's question. Laclede people have gotten bids for actual replacements in their actual homes and we are going to -- we did that for the DFR, we commented upon that and we are going to be repeating that for this NOPR.

We also have a huge database of appliance efficiency rebates that we have provided to people who have done this and the results of those were also commented upon in the last DFR and to make a long story short, yeah, it seems like DOE kind of low-balled the total installed prices.

MR. BROOKMAN: Okay, Mark Nayes online, Mark you are now unmuted.

MR. NAYES: Okay. Yep, we are essentially in that northern zone, we are in Minnesota, and for a non-condensing furnace, our total installation cost, not including the furnace, is at least double that number. For a condensing furnace, we are looking at triple that number. We are kind of a middle of the road company. We are not the most expensive guys up here but we are not the cheapest, and that includes permits, materials, electrical, gassing, everything that is involved, the insurance overhead, both of those numbers we see as being low.

MR. BROOKMAN: Okay, Mark, that's helpful, thank you. Okay, we are going to proceed.

MR. FRANCO: Thank you so much. Let's proceed. So we've already discussed the basic installation costs. Now let's go into a little bit more detail of the venting installation costs. So we do consider some situations where replacing a non-condensing furnace with a non-condensing furnace

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requires some venting modifications.

These could include chimney lining for the replacement, vent mount modification in case of replacement, and the new metal vent in the new construction, and we will go into more details in the next slide.

For condensing furnaces, we have to consider installing a new PVC venting. Also, there are cases where you orphan the water heater in terms of the replacement, and we also consider the additional combustion air for direct vent and concealing vent pipe. I'll be discussing that in more detail in subsequent slides.

Since one of the most important components are the vent length, this slide -- it's a little bit overwhelming -- does provide the methodology for determining the vent length. I will go over it briefly and as carefully as I can, but essentially, we do take into account a lot of different factors in determining the vent length.

For example, we take into account the floor height. Typical floor heights are about 8 feet -- 8 to 9 feet. RECS provides us with whether there's a high ceiling or a cathedral ceiling, so we take that in account. Also, the number of floors are taken into account, so for example, if we assume that the furnace is in the basement and the house is two stories, then we assume that the venting has to go through two stories if it is vented vertically.

In terms of horizontal installations, we also take into account the installation location's square footage so we need to know through what wall and how far the venting has to go to vent horizontally. So we take an average wall length and we have a distribution that accounts for the furnace being not by the wall that it is going to be vented through, but maybe in another location, so potentially the furnace is in a wall and maybe it is by the wall but it can be vented through that wall.

Maybe the situation might be that there is a -- it's sharing a wall with the neighbor or that wall is the wall that's the exterior wall. So we assume that on average the furnace is more or less in the middle of the building and then we assume a vent length. There is a distribution applied to that so there are some cases where the furnace does vent through that wall and there is to the furnace and it is the short length.

There are other situations where it has to vent through the full building and those would require the greatest vent length. In terms of horizontal venting, there's an additional component which is the horizontal in terms of horizontal there's an -- horizontal and vertical, there are additional for horizontal and vertical distances that need to be taken into account and these are the last few boxes. So for example, if you are venting vertically, you need to account for some horizontal distance. We assume about three to six feet.

In terms of the horizontal venting, we also account, for example, if it is in the basement, you have to go at least three feet above ground and to vent horizontally, and that would be the vertical distance, well at least part of the vertical distance.

So let's go into a little bit more detail about what we mean by non-condensing in the replacement cases venting installation costs. So first there are some masonry chimneys that require re-lining. There are a number of households, especially in the north, that have a chimney. The furnaces that were installed before 1995 were built before 1995 are assumed to not be applicable to the latest national gas code and might require relining of the masonry chimney.

DOE does also consider vent resizing and vent connectors that are required. This is the case mostly of installations where you have a furnace that is a natural draft furnace that is installed in the household and so we assume that if the household has a natural draft and non-weatherized gas furnace that might fall into that category.

We also consider whether the unit is going to be replaced before the standard in 2021. Once it is replaced, obviously it will be a natural draft furnace and if the chimney has been relined.

Here are the fractions of the existing masonry chimney and venting installations that come from GTI survey done in the 1990's. They are disaggregated by different regions. As you can see there's a significant regional variation.

MR. BROOKMAN: Marshall Hunt?

MR. HUNT: Yes, one of the things -- Marshall Hunt, Pacific Gas and Electric Company. One of the things we were looking at in California is there is a lot of tran-site asbestos-based sedimentacious flues out there so how -- where would you place them in this analysis?

MR. FRANCO: I'm sorry I didn't catch the first part of your question?

MR. HUNT: A lot of flues in the older homes are asbestos-based transite, that hard pipe, where would you include that in this analysis?

MR. FRANCO: Well, it is currently not part of the analysis. Please submit any data that you might have about that and we will definitely look into that, thank you so much for that comment.

One thing that's important to know, and it's a part of this analysis but it is not here, is we also take into account the fraction of commonly vented water heater and furnace situations by region. It's a similar table to the one shown here, it's in the TSD, it's table 8D.2.8 and it is also based on the GTI study done in the '90s, and the results from that are about half of commonly vented installations -- those commonly vented installations becomes more important in condensing cost analysis.

MR. MCCRUDDEN: This is Charlie with ACCA. Marshall I wanted to ask a follow-up. You mentioned the word asbestos pipe or something, I just heard asbestos. What are the implications of your question essentially on an installation?

MR. HUNT: Our friends at So-Cal Gas are concerned about the added cost for installation.

MR. MCCRUDDEN: So is there a remediation that is required, what's --

MR. HUNT: It's potential, so we will get more data.

MR. MCCRUDDEN: Okay thanks.

MR. BROOKMAN: Yes Andrew deLaski?

MR. DELASKI: Victor, you mentioned relining. Is there relining in the base case in some instances?

MR. FRANCO: This is Victor Franco. That is the case, that is what we are trying to describe in this slide. So we are going from a non-condensing, maybe like a natural draft but it could be also a non-condensing current furnace to a baseline and non-condensing furnace, 80% furnace, so that is the baseline.

MR. DELASKI: Okay, got it. Thank you.

MR. BROOKMAN: Okay, Mark?

MR. KREBS: Victor, Mark Krebs with Laclede Group again. I don't want to mess up your delivery here, but when would be a good time to talk about the ductwork issues that we discussed yesterday, you know, and the fact that typical duct work really means bad duct works because, commonly, more often than not, they are bad duct work -- they cause a lot of static pressure that has a lot of implications for electricity consumption.

When could we get into that or can we?

MR. FRANCO: Yes, we do get into that in the electricity use. DOE does not assume in its analysis that there is any installation costs related to improving the duct work, it just assumes that there is an increased use if you have the situation of bad ducts in its analysis, similar to what we did for furnace fans and what we have done in the past.

MR. KREBS: I tried to get a feeling, maybe if you would help me, if you guys could break out, you know, what portion of that electricity comes from the added static pressure of the condensing furnace compared to the remainder that comes from the duct work system, you know.

If there is a way to break that out, I think we could have a better opportunity to dig into it and come back with some meaningful comments.

MR. FRANCO: Thank you so much, we can go into that in electricity use in a little bit more detail.

MR. KREBS: Okay I'll hold you to it.

MR. FRANCO: Thank you so much and remind me if I don't.

MR. BROOKMAN: Jim VerShaw?

MR. VERSHAW: Jim VerShaw. A quick question on the existing non-weatherized gas furnaces less than 75%, are you saying that in your analysis that 3/10ths of the installs would be that way? 3/10ths of a percent, I don't understand the fraction impacted column.

There's another column in the TSD that was probable and that had been impacted and they were two different numbers, I wasn't quite sure how you used that. Because, if you think about it, come 2021, that will be 29 years after we pretty much got rid of atmospheric furnaces, and I think furnaces are known to last 21 years, so they probably should be looked -- I would think that there would be almost none out there at that point. Is that what that says?

MR. FRANCO: That is exactly true and that's why we take into account if there have been installations, so just to clarify a little bit in more detail. RECS does provide the age of the furnace, so we know if the furnace, for example, has been installed after 1990 or 1995, and then we can assume whether those would be natural draft. But then we would have to assume what happens between 2009 when the survey was conducted to 2021 so obviously in 2009 there's a larger fraction.

By 2021 there's a much smaller fraction. This is what that represents, on natural draft furnaces.

MR. BROOKMAN: Chuck?

MR. WHITE: Chuck White with PHCC. So I don't know if it is going to be wrapped in here somewhere but first I would like to comment, the common water heater and furnace I think your 50% probably low, but PVC venting, do you have consideration for maximum point for piping equivalent, like fittings, in consideration of termination of where those can be: not over public right-of-ways, not related to open windows, forced air ventilation, going through multi-family, multi-story buildings, traversing other property lines, exceeding maximum vent heights, going through multi-story buildings, I can go on.

MR. FRANCO: Thank you so much for that comment. The next slide actually provides that and I will be going into that in more detail, and obviously if that is what you are more interested. Let me just point out before going to answer your question, the last thing on this slide, it does provide the average cost for all of these different situations and is noted the different fraction of impacted units.

So let's go more into a big piece of the installation costs for condensing furnaces. So there is a situation where you would go from a non-condensing furnace, either potentially natural draft, but most likely currently available 80% furnace to condensing furnace, and so we take a lot of the factors that you have described into account as much as we can for each individual household.

So as described before we take into

account the furnace where it is actually an installation location. So as I tried to describe it before in that complicated flow chart we are trying to assess what would happen in each individual home which is pretty complicated.

There is a situation that a fraction of the households where you could potentially have a furnace as I mentioned in the wall, the easiest would be to have the venting through that wall horizontally but for whatever reason you can't have that. So there is a situation where you might have to actually go through all the way as far as possible to say for example if you are in this corner diagonally all the way to the other diagonal.

And in addition to that you might go through multiple walls because that might be a wall that's a room that you have to drill a hole through that and then go through another one and then you have to account for the verticals, you might have to drill holes through vertical floors potentially and then go horizontally. So it does take that into account in terms of installation and these are all fractions obviously.

There are fractions of installations where you can just drill through that wall. Maybe it's a closet and that's a perfectly good wall so that's why we do that because we understand that there are many situations where because you are going up for example from the basement that wall potentially has a lot of windows, and you can't go and drill a hole through a window or close to a window, you don't want to have those flue gasses going through there.

MR. BROOKMAN: Yes, Neil?

MR. LESLIE: Neil Leslie, GTI. Just to make sure that we understand the specific numbers that are used you said there were some average costs. Now when you get to an individual house in the 10,000 runs you have incremental costs attached to that individual house configuration, is that right?

MR. FRANCO: No, the cost to each individual house or the cost of that specific house installation so for example, lets go back to that very complicated installation household. So it's in the wall, kind of in the diagonal and you have to go through multiple walls that cost is applied to the household installation cost.

For another household potentially it just goes through to that wall and so it's a very small cost to do the venting so it is individual, household by household.

So, I kind of described already some of these points, but just to reiterate, we do go and account for ceiling height, number of floors, the distance from the wall or roof, whether it can be vertical or horizontally installed, so there are some situations where you can actually have vertical installation and it might make the most sense for a condensing furnace.

And finally we take into account the vent termination. There are a couple of points here for this that describe some comments that we have received, so I will go through those in a little bit more detail related to these two lasts points.

In terms of wall penetration, there is no electrical work required in this PVC venting installation work. DOE estimated the cost of drilling a hole into a wall to install PVC venting based on similar work required for drilling holes and for electrical work for our estimates, and this is common practice. Sometimes there are costs and ours means in one area or another, and it is assumed that the costs are similar to, for example, doing that electrical work.

In the 2011 TSD, there was a $35.00 value that was added to the material costs associated with drilling a hole. This cost was incorrectly reported in the TSD itself. It did not exist in the spreadsheet analysis or in the analysis in 2011 or in this analysis in 2014, so that is related to a specific question we received.

In terms of vent terminations this is addressing we were asked a specific question -- and this is related to the vent termination. How we deal with it. DOE assumed that, for all horizontal vent terminations for condensing furnaces, require adding a three feet of PVC above ground level and a 90 degree level elbow as a proxy toward the termination count, assuming that this was equivalent to an average requirement for installation -- what is commonly called a snorkel type vent termination -- so you can imagine you going up vertically about three feet then horizontal and then you have a termination so it makes kind of like a snorkel, so that's what is meant by the snorkel termination.

The venting termination takes into account the closest wall that might be appropriate to install, as we described earlier, so it takes into account the issues of the windows, doors, decks, overhangs, sharing of walls with other as we have described earlier.

MR. CYBALSKY: So, this is John from DOE, so, the last two points were questions two and three from the APGA submittal under the installation costs section.

MR. FRANCO: So I will very briefly go through these next few points because we will have subsequent slides. We do take into account combustion and air vent for direct vent installations and we will go through the fractions in the next slide.

We do go through concealing vent pipes for indoor installations, so this is the case where you might have your furnace installed in a closet, you have to go through some other part of the living area, and that might not be something that you want to do, so, you want to conceal that somehow so that it's architecturally not something that's not that beautiful, or good.

The next thing is, we take into account orphaned water heaters. So there are some installations that require relining of the chimney or resizing for the condensing weatherized that replaces an existing non-condensing, non-weatherized furnace. In that case the orphaned -- what is called an orphaned water heater, might not have the appropriate venting to vent by itself, and so, in that case we do consider additional vented costs just for the water heater.

MR. BROOKMAN: Mark Nayes has a question from online. He asked: have you taken into account gravity vent furnaces that are still found in old homes?

MR. FRANCO: Yes, thank you so much for

that question. Yes, we do. Sometimes the terminology for that is natural draft but that is what we mean by natural draft gravity forced furnaces, thank you.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: Age before beauty.

MR. BROOKMAN: Impetuousness before looks.

MR. WHITE: I'm neither. This is Chuck White. I'm not sure, I think what your online caller might be referring to is gravity furnaces not gravity vent, not gravity draft where you don't have an indoor blower, you have large duct work and there is going to be significantly larger change out costs and I'm putting words in his mouth but I think that might be what he is talking about -- not natural draft.

MR. BROOKMAN: Okay thank you. Harvey go ahead.

MR. SACHS: I have followed industry work recently on the orphaned water heater issue. As I have done that I have tried to find unsuccessfully some simulations done in the report issued by GRI sometime I believe before 1990 and if I am remembering this correctly and I think it needs to be updated, there were two things associated with it.

One of them was that in the South was impossible or extremely unlikely to cool even an outlying chimney and they would likely have back drafting from gas water heater on very cold days in the orphaned situation and even as you move North it was much more likely to be a problem depending on the position of the chimney.

If it was an external chimney, masonry chimney that is one three sides exposed, you have a lot more cooling effect than if it was a central chimney that descended through the center of the house and had the last few feet through an unconditioned attic. And I don't want to delay this but I think that we need to have this kind of granularity to handle the problem of orphaned water heaters.

My own instinct is that it is a less frequent safety hazard than has been estimated in worst case efforts. Others may feel that we need to err on the side of safety, but I think that, in the absence of good field data, an updated simulation that breaks out locations in heating days is important.

MR. BROOKMAN: Jim?

MR. VERSHAW: Well, there's been a lot of work done on venting of natural draft appliances and a lot of work was done and created the venting guide that's in the national fuel gas code and we all apply it to our products. I think that you could look at the type of product and look at the heating and firing rate is and tell you what size vents you need.

And what happens is when you go from 50,000 plus 100,000 to 50,000 it's so big they can't draft so it has got to get smaller. And then if you have single wall many times you have to go to double wall on the connector.

MR. SACHS: I understand that, I have done the relining for orphan water heater according to code myself not often.

MR. VERSHAW: I've never done it, so...

MR. SACHS: I have more field experience then but I am just saying that this is an area, and you are absolutely right that quite often you will need at least a single wall vent but I think that we need to understand the orphaned water heater problem a little better than I have and also look, and I hate to bring up -- no I enjoy bringing up the learning curve where again we have seen a fair amount of work based on international experience leading to the hypothesis that common venting solutions are quite likely to be available and I think we need to understand those better as well.

MR. BROOKMAN: Thank you, we are going to press on.

MR. VERSHAW: While you were talking I read ahead and I think I answered it so I think I'll wait on it.

MR. FRANCO: Thank you so much. We will go through here are the more details about the direct vent, PVC venting. Here on this slide the motion points are the fractions that we are assuming for direct vent depending on the installation location so, as you can see, they vary from 100% in the garage to 33% in unconditioned basement and crawl spaces.

This comes from a consultant report that's available in Appendix 8B of the 2011 DFR. This whole report is fully available in that appendix. This answers again a question.

MR. CYMBALSKY: This is John from DOE. So there was in the section entitled questions not previously answered by DOE question 8 so that we point you to where you can get that consultant's report. We will also put it in the new docket, the current rulemaking docket.

MR. FRANCO: Just the next few rows give you a sense of the fraction of installations by region or nationally of these different installation locations, so don't mix these two numbers up but if some products, for example, the fraction of direct venting installations by the North fractions of installations you would get the resulting 58.7%, that is direct vent.

So that's in the North on average we have applied 58.7% of the installations we have applied direct vent. Again this cost is individual to the household and so if the household does have direct venting, the cost is applied, if it doesn't, it won't be applied. This number -- results for the rest of the country and the national so about 60% of households are about roughly 59% of households have direct vent.

This is --

MS. ARMSTRONG: This is Ashley from DOE and we have a question from online from John Gibbons. He wanted to know did you take into account freeze protection of condensate removal and how much did you include in the cost impact? Were you mindful of many municipal codes that do not allow condensate draining into simple sewer lines?

MR. FRANCO: Thank you so much for that question. We will be addressing that in a couple more slides so I will just address that when we get there.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. I guess I am just going to ask confirmation. So if the unit -- if it is in a basement, the assumption is that 67% of those will be direct vent installation for a condensing product, right?

MR. FRANCO: That's correct.

MR. STANONIK: And you are assuming that

same percentage if it is installed essentially indoors - which might be a closet, alcove or utility room -- which I would venture in many cases is going to be I would say centrally located in the residence as opposed to anywhere near an outside wall or whatever.

I guess I'm trying -- how did you come to the conclusion that it is likely that a condensing furnace installed in an indoor location like a closet, alcove, and so on is as likely to now be direct vent as one that is in a basement? To me, how did you get to the conclusion it has the same likelihood, I guess?

MR. FRANCO: Yes, thank you for that question. Note that the basement has a conditioned space which is the 67% that they are referring to so this would be similar to an indoor location because you assume that it is conditioned so maybe it's like a game room or some other -- had some other use versus a basement that is in an unconditioned space which has a different fraction 33%.

So the assumptions from the consultant was if this is in the space that is kind of the conditioned indoor space, the fraction would be a lot higher so it would be 67% in those cases for example the condition a basement, or indoor or attic which are also in the conditioned attic.

When it is in the unconditioned space, such as in a basement which is unconditioned, or crawl space of an attic which is unconditioned, the same fractions are 33% so we assume that is lower.

And then the garage-- we assume that's 100% because of potentially the gas.

MR. STANONIK: Frank Stanonik. But so the conditioned basement right, but again if well -- I think about conditioned basement and I still think of a fairly open space. At least most basements actually when you get down in the basement it is not for the compartmentalized, even conditioned ones into small rooms and stuff, and yet again the indoor installation of use as you have described it there, those are essentially, to a large degree, a confined space and so to me with that very simplistic view the likelihood of getting a direct vent installation into a confined space installation of sorts -- compared to this conditioned basement which I consider a wide open space, I am still having a hard time saying that those would be the same.

MR. FRANCO: Thank you for that no, we really appreciate your comments. Please provide detailed description of what you would think we could refine in terms of those fractions because that would be really helpful. Obviously, there aren't any surveys available for what these fractions should be and these are assumptions currently based on this consultant report so any feedback would be really, really appreciated, thank you so much.

So, I will go kind of quickly through this one. This relates to the concealing of the vent pipes so we do take that into consideration. That impacts a fraction of the installations that are located in indoor locations. We assume that 50% of indoor locations would have this impact so the fraction impacted overall is 9%. The average cost is $360.00 obviously this is a distribution of costs depending on the vent length so if you have a short length that you have to conceal the costs would be much lower.

If you have a much larger space then the length they have to conceal, its cost would be much larger.

This next slide summarizes the venting that's required both in the non-condensing and the non-condensing to condensing and to note that in the non-condensing to condensing this mainly just deals with the orphaned water heater. So let's go take a look first at the non-condensing to condensing.

These are the fractions of installations which is fairly low that are impacted by having to redo or resize the venting going from non-condensing to non-condensing. So the fraction impacted is about total fraction is about 2.2% and is based on the assumptions we have described earlier.

In terms of the fraction of the impact by orphaned water heaters the fractions and the differences are described here and the overall impact is close to 20%. Most of the impact is having to resize the orphan water heater or the last row and this is just an assumption that we are making that 40% of the time that has to be done and that impacts

18% of installation.

The costs are also provided. Again, these are average costs for the individual households. These costs can be very, very different. In the case just of the orphaned water heater, because this is vertically vented, these costs could be fairly large. If you are going through multiple floors, you have to do

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potentially the relining of those. We also take into account the installation costs to new construction and new owners. New owners would be people that are potentially installing this equipment for the first time in their home, doing maybe a major remodel or people that are switching to another equipment that didn't have a gas furnace previously.

These installation costs for non-condensing include adding the whole vent system, and if it is commonly vented then adding the vent -- the commonly venting from the orphan water heater from the commonly vented water heater.

For the condensing non-weatherized gas furnace we do account also for the PVC venting -- as we have described earlier -- and we account for the plan installation of the non-condensing commonly vented gas water heater that now needs to be orphaned. So we take into account that difference in cost.

MR. BROOKMAN: We have a question from an individual on the line. I believe his name is Michael Strom. Michael asks, how does collect seal venting system fit in the analysis both in a configuration as relining on a b-vent with a liner and using the b-vent as air duct and a new pre-fab co-axial system?

MR. FRANCO: So thank you for that comment. I believe that is something that we will be addressing later in the later slides so when we come to that point watch.

MR. BROOKMAN: Okay, I'll pull this out and re-raise it later, keep going.

MR. FRANCO: Thank you so much so let's go to the next slide. So now we are moving on to the last component of the installation cost. This only impacts condensing furnaces and this relates to questions raised before about the condensate withdrawal.

This flow chart represents our overall methodology again this is done for each household depending on different situations that occur. First we take into account where the household is located if it is location in a for example -- it's located in an attic we do take into account freeze protection in the case of a non-weatherized gas furnace.

If it has a central air conditioner we take that into account in terms of whether we consider if it has a condensate pump or not. The central air conditioner might already have a condensate pump in that location and an additional one might not be required.

In the case of a condensate pump or heat tape which is the case when we are dealing with condensate freezing we do also apply the cost of the electrical outlet. All of these different costs, including the condensate piping and the drip pan, are what are part of the condensate removal costs.

To address one of the specific questions that we had earlier, we do take into account the condensate neutralizer in terms of neutralizing the condensate acidity and this is applied a fraction at a time. Costs are also added and this deals with locations where this is a requirement by code.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. All right, so if I am understanding your little flow chart there, the only time you are considering the cost of the condensate pump is if the house doesn't have air conditioning, central air conditioning?

MR. FRANCO: That is correct, that was --

MR. STANONIK: And so that's a fundamental error. That's an error, okay. I'll tell you right now in this area where we live, where I live, where everybody living in this area okay -- my air conditioner the condensate is just drained outdoors because it can be, it's not going to freeze up in the summer.

But my condensing furnace because it cannot take that condensate outdoors because it will freeze had to have a condensate pump so it could pump it to a place where I could drain it. So the issue is not simply whether or not the house has a central AC, but it is an issue of whether a household is located in a climate zone where the condensate will freeze and so it cannot use the same line as the central AC might as you might incur in the South.

So I think you are underestimating on the installation costs.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: This is Harvey Sachs and I happen to live in North Virginia as I believe you do and I do have a condensate pump which carries the condensate from both the air conditioner where the condensate drain is next to the furnace cabinet and from the condensing furnace. I believe that that will be typical for all houses for almost all houses which have the equipment in the basement because you have to pump it anyhow and in that case I don't know if it is code approved or not but that small amount of condensate is joined with the air conditioner condensate and it moves to the common sewer. I had to do the pump for the air conditioner so I am using this end pump for the furnace.

I suspect that that is far more common in basement-equipped houses than we are assuming from your remarks.

MR. BROOKMAN: Frank?

MR. STANONIK: Frank Stanonik. For a point of clarification, a point well taken. In fact my house you walk out and it's multi-level so I can walk out of my basement out the back so, in fact, I do have a free wall where my air conditioner does simply drain, the condensate does just go outside.

But if it was totally a basement surrounded by earth on all walls you are correct.

MR. BROOKMAN: We have questions and comments from, I believe, Jerome Ryan, and he says because of the complexities of installing high efficiency furnaces, has DOE contemplated the costs of contractor education needs associated with this ruling and how many contractors may need this training and continues -- were these overhead costs inputted into the model and can you comment about the efficiency gains lost with its poor installations?

MR. MCGRUDDEN: This is Charlie with ACCA and I am being looked at by Ashley and John but I think the question was to you so I would like to hear what you have to say first.

MS. ARMSTRONG: Perhaps you can address the first part of the question which is more of a, you know, what kind of training do you have today with condensing furnaces and you know is there a need for further training because I'm guessing that you are currently giving training to your different contractors or at least providing them that opportunity so I guess what would be the differential or would there be one?

MR. MCGRUDDEN: So this is Charlie, I think a lot of the manufacturers through their dealer networks, through the wholesalers provide a lot of training especially on new equipment and new technologies. We certainly do a lot of training for quality installation and that looks at more than just -- that looks at how to install the box properly duct ceiling, sizing and on the case of CAC and heat pumps, refrigerant charge and things like that.

So you know, again, that's what I was sort of looking to see what DOE had contemplated in terms of what might be the costs or how would training play into the analysis here because you may have a whole subset of contractors who have never touched a condensing furnace because they never had to.

MR. BROOKMAN: Okay, I think we should keep moving on. For those of you that are interested, and probably all of you are, shortly we are going to pause for lunch in say ten minutes or so.

MR. FRANCO: Okay thank you yes, we are almost finished with the installation costs so a few more slides.

MS. ARMSTRONG: Just Charlie to your point, I mean, I think that we didn't account for any training that would be necessary, so I think what we would be looking for from you and/or the other contractors on the phone in and around the table today would be you know what if any that delta would be in terms of what is being done today versus what might need to be done in the future.

MR. MCCRUDDEN: And this is Charlie with

ACCA again and we will certainly put something to that effect in our comments.

MS. ARMSTRONG: Thank you.

MR. BROOKMAN: Thanks Charlie, Harvey Sachs?

MR. SACHS: This is Harvey and gee I'm looking around the room for John, he's assured me that a great deal of training on all sorts of products is being done by his members.

MR. BROOKMAN: Okay again proceed here.

MR. FRANCO: Thank you so much for all of those comments. We are going to now summarize. This simply summarizes the condensate removal in terms of the fraction impacted and the average cost of supply. Obviously there is a distribution. This is available in the TSD if you have any further comments please let me know right now.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. For the condensate pump you are saying 25 and this is in the replacement, 25% of installations without AC is that central AC is that what you are referring to?

MR. FRANCO: Yes, I can give that clarification that's central air conditioners.

MR. ROSENSTOCK: And again thank you for that Steve Rosenstock, EEI and then are you assuming that number stays static over the next 20 - 30 years because most new homes are built with central AC so wouldn't that percentage go down over time?

MR. FRANCO: We do segment our household sample between replacements and new construction. In terms of new construction, that fraction is already lower. In terms of the current stock, it would be higher so that is already taken into account, thank you for that comment.

MR. ROSENSTOCK: Thank you.

MR. MCGRUDDEN: Charlie with ACCA. On the -- some of these I guess - adders, you call them -- have an electric use implied themselves, is that factored into the analysis?

MR. FRANCO: Thank you so much for that comment. I was actually going to bring that up, I forgot to bring that up earlier. For example heat tape and the condensate pump do have in fact electrical components that we will be discussing later. They also have components in terms of actually doing repair and maintenance to them and those are accounted in the repair and maintenance as well, thank you for that comment. Let's move on to the next one.

MR. BROOKMAN: Let's wait right there, we are moving on to a subject matter there so we should pause and we have a comment from or a question from Mark Nayes who asks, condensate pumps are far less common in Minnesota. Mostly the AC and furnace condensate drain to a floor drain, is there a worst case scenario for installation costs?

MR. FRANCO: Thank you for that comment.

MR. BROOKMAN: And Rick?

MR. MURPHY: Victor thank you for this and I understand there is another phase of the life-cycle costs we haven't gone into but just thinking about what we have covered thus far, equipment costs, installation costs, and how this comes into play and the life-cycle cost analysis. I am looking at the life-cycle cost spreadsheet that was provided by DOE.

And the sensitivity that I think I'm drawing from this on how important this information is and good data, and it appears that installation costs are a sizeable component of the overall installed costs so when I look at the life-cycle cost savings of a 92% versus an 80% of $39.00 over the life of that piece of equipment increases in the installed costs and equipment costs by $39.00 could have a direct impact or additional savings or reduced costs in equipment or installation costs could actually increase that.

I just want to make sure I'm following the logic here because to me that's a message to our industry to ensure that we get these installation -- these data on installation costs particularly right because it can have a really important change in the way the life-cycle costs actually comes out.

MR. CYMBALSKY: This is John from DOE. Yeah, we agree. We think all the data that is part of this is important to get your feedback on so that is why we are here today. If you have comments on the data, what the values should be please submit the data and we will consider.

MR. MURPHY: Thank you John, Rich, Murphy again. I guess my point John, was with installation costs and equipment costs, those are zero dollars right so it is a wonderful impact to the life-cycle cost savings in the present value analysis is that correct?

MR. CYMBALSKY: Right so they are upfront costs that's right and those time you get the savings back at a discounted format, that's correct.

MR. BROOKMAN: Final comments on the foregoing slides? Mark?

MR. KREBS: I was just wondering at what point would it be good to discuss the discount rates?

MR. BROOKMAN: That's going to come later.

MR. CYMBALSKY: If we click to the next slide you are going to see why we are going to take a break, so we are going to all eat and we are going to get ready for this one when we come back.

MR. BROOKMAN: I am going to propose, we usually take an hour for lunch but we -- I'm worried we are not going to get through all of this, I am going to propose we do this in 45 minutes. It's now 1:00 which means we resume at 1:45. For those of you who are not familiar with the Forrestal Building please make sure you have a badge, this room will be secured. There are restrooms on both ends of the hall, there's a big cafeteria down to the ground floor.

(Whereupon the meeting recessed for lunch to reconvene at 1:45 p.m.)

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

MR. BROOKMAN: So we are now by my reckoning on slide number 51 and we are going to proceed with Victor Franco life-cycle costs and payback period analysis, installation costs by market segments.

MR. FRANCO: Thank you so much, this is Victor Franco again. Welcome back -- thank you. So I'll start this slide -- this slide is an eye sore obviously it is a little bit better in printed form hopefully you can read a little bit. It is not meant to go over all the details it is just meant to kind of be an overview of what we have discussed in terms of the installation costs for non-weatherized gas furnaces.

The main purpose here is to --

MR. HUNT: Is that in the technical support document somewhere?

MR. FRANCO: This is correct I was going to point that out. This chart is in appendix 8D.

MR. HUNT: Thank you, Marshall Hunt.

MR. FRANCO: And there is a further

description about what this all means and everything. I just wanted to point out a couple of things in this to kind of summarize installation costs. One main thing is that we disaggregate the cost between the different markets as I have described earlier, the building sample kind of has some of the disaggregation.

So if we start from the REC sample which is the yellow box then we consider whether the house is going to be installing a condensing furnace. In terms of whether the condensing furnace is already in the house or not that's taken into account in these boxes and there are fractions that you can actually read and see what are the fractions that are the segmentation of these -- again this is very detailed and a lot of details is in Appendix 8D.

So the main point is that we do have a new construction installation cost that is included, we have the new owners, fractions and we have replacements so it is all included in the analysis and the fractions are provided here.

MR. CYMBALSKY: So this is John from DOE.

We are going to move on because in the interest of time but this is kind of take home homework for everybody where you can read it better and look at it. We tried to do I think of every type of installation possible and we have it on this flow chart so this is for your comment in the open comment period.

MR. BROOKMAN: Mark?

MR. KREBS: John Mark Krebs, did our end time get extended to 5?

MR. CYMBALSKY: 5 o'clock, we have always had 5 o'clock. It's hard to stop at 5 though just so you know.

MR. FRANCO: Thank you. So I'll move on. This is the mobile home gas furnace this explains the cost that we used. We did take into account venting and condensate removal where the condensing -- where the descriptions are in appendix 8D and show how we applied this for a mobile home, because this is further answers any questions?

So now we are moving on to a new topic, this is the energy use characterization. Some of these slides are moving a little bit quicker than others. This is just kind of the purpose and method so we are trying to determine the annual energy consumption of non-weatherized gas furnaces and mobile homes for the LCC analysis and payback period. This is the equation to focus on because we are going to be discussing these two parameters.

So first the pool energy use is segregated between the fuel use and the electricity use so we will be discussing these separately in the next couple of slides. Before going into more detail about the fuel use and we have already discussed this a little bit, one of the most important components for the energy use is the building sample.

RECS and c-becks which is also used in this analysis does provide the energy use of the building or the household and the -- we use that in our analysis. They actually provide the heating energy use. So to determine whether a household in this survey falls under our analysis we use this process.

First we determine if the furnace is used for space heating or the household uses a furnace for space heating. If it doesn't, it's out of the sample and we also see if the household is in a building or a residential household that is less than 10,000. That's our criteria for whether it is a commercial furnace or something else and a residential furnace at this time.

Finally we take into account the fuel type -- whether it is gas or something else. Obviously, if it is gas, it falls into what's currently being analyzed and in terms of mobile home and non-mobile home RECS provides what type of household it is. So obviously the households are manufactured homes or mobile homes fall into the mobile home gas furnace.

In terms of statistics, it is important to point out that RECS 2009 has a lot bigger sample size. It is about 12,000 households that are being sampled from. Out of these 12,000, 5,700 fall into households with a gas furnace and these are the statistics that you can see here and the number of buildings that represents. That represents almost 54 million homes in terms of RECS.

This gives you a little bit more detail about how we do, in terms of adjustments to the building sample, so I'll go through this a little bit quickly because in the interest of time but essentially the one issue that we face is that obviously RECS 2009 was the building sample RECS in 2009 and we wanted to adjust that for the conditions in 2021.

So what would be the distribution of these furnaces in 2021 and also we are trying to adjust these in terms of shipments so we are more interested in terms of individual furnaces and where the distribution is. So we make adjustments to the building sample in terms of whether the household is sharing a furnace -- this is the first one. The buildings will -- multiple furnaces we take into account as I have described.

Any growth in the market shares up to 2021 and we match the historical shipments that we have. AHRI provided previously from 19 -- I believe it was 1992 or '91 to 2003 shipments by state. So we used this data to -- kind of -- that's our basis. We don't have any further shipments data segregated by state after that.

We also take into account that there is a fraction of households that is reported in RECS that are actually weatherized gas furnaces which are not part of this analysis so we tried to take that out of the sample as well or weight them appropriately so we don't overestimate.

And that's further discussed in -- actually this is in appendix 7A. So the next is kind of an overview of the whole energy use analysis.

MR. BROOKMAN: And we have a question here. How did you handle the cost to remove a non-condensing MHGF and install a condensing MHGF with new venting and condensate removal? That's from Terri Emol.

MR. FRANCO: Thank you so much for that comment. We actually passed that quickly just going back to that slide 52. As you can see there's the condensate removal that is taken into account. Further details about the venting which is a little bit different in mobile homes is described in the appendix 8B which is described installation.

Basically the venting in the mobile homes is very short. Usually it vents up through the roof, the condensing furnaces usually do the same thing except that it is classic PVC usually and it uses some type of concentric for the direct venting all mobile home furnaces to be directly vented so those are consideration that we are taking into account and they are fully described in the appendix 8D.

So obviously I'll be describing this in the slides just to give you a sense of all the different factors that are taken into account and I will go through these all in detail.

Again if we start from your right hand side there's a fuel use and an electricity use, which I will be describing separately.

Just to note that we do have a separate standard for standby and we take that into account as well. That's part of the electricity use component and all of these different factors and data inputs are part of this model. One of the main inputs again is the RECS energy use data and we will be talking about that in more detail in the coming slides.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. I'm sorry Victor, can you go back just for a second to slide 55? So the very last bullet there are you saying that this fact that DOE multiplied RECS by weight of households so are you saying that for every household in the North that had a furnace you are assuming that 97% of those also had an air conditioner, is that what that means?

MR. FRANCO: Yeah, I'm sorry. There's probably -- it's not very well written in terms of what that means. That is in relation to weatherized gas furnaces and that's supposed to represent is that in the North only 3% of furnaces are weatherized gas furnaces so it's 3% of furnaces that have central air conditioners.conditioners Based on shipments that AHRI has provided we kind of --

MR. STANONIK: Oh it's only weatherized?

MR. FRANCO: Only weatherized.

MR. STANONIK: Okay.

MR. CYMBALSKY: What is says is that there is all of these furnaces 97% are non-weatherized.

MR. FRANCO: Correct yes and I'm sorry it's not --

MR. BROOKMAN: Dave please?

MR. SCHROEDER: This is Dave Schroeder. On the flow chart you have the AFUE of existing furnace which looks like it is controlled by RECS and historical shipment data, can you describe how you make the determination on an individual home basis what the AFUE existing furnace will be?

MR. FRANCO: That's actually a very good question and that's a very important detail actually from that analysis. So first, we actually have quite a bit of historical data provided by AHRI about historical shipments of condensing and non-condensing even by efficiency, different efficiency levels.

Going back to I believe 1976, 1976-1977, we used that data to kind of tell us what the different levels would be of fraction of say in 1970 it would be 65 AFUE types of homes that have 65% AFUE units. More recently we actually have segregated also between condensing and non-condensing by region.

So what we essentially do is we select the household and based on all of that data that's regional. We say, for example, you are in a region in the North and RECS says that your household furnace is 10 years old, so that would mean that it was purchased in 1999. So there's a lookup table it goes from 1999, and then it selects based on the likelihood that it would be one of those efficiency levels -- so say, 1999 -- 20% or 30% of furnaces are condensing.

So then it would select 30% of the condensing, 70% at a time non-condensing. If it was in the South maybe it is only 10% condensing and 90% uncondensing.

MR. SCHROEDER: So is that the same as the way the base case AFUE is assigned? With the exception of this is now not old furnaces -- this is current or future.

MR. FRANCO: That is absolutely correct. Then in the base case which we will be describing later we are projecting those fractions to 2021 by region.

MR. SCHROEDER: Okay thank you.

MR. FRANCO: Thank you for that question. Obviously, provide any more detailed questions in your comments as I said we are going through this very quickly.

So fuel uses, obviously the most important component, this is our methodology. Basically we have multiplied burner operating hours by the input capacity. To determine the input capacity, we base that on the household characteristics, historical shipment data of the input capacity and the model availability in the AHRI directory.

Essentially we size the household to different input capacity. To determine the burner operating hours we basically determined the building's heating load and divide that by the useful output. What we mean by useful output is in terms of the actual output that is the furnace in terms of the fuel. For those of the electrical components give off some heat and this is all based on the proposed federal standard that we discussed yesterday, all of these equations.

Details about this can be found in

appendix 7B of the TSD. Let's go into more detail about the building heating load. So we are calculating this for 2021. Just focus the most important component is the actual what is listed here as QYR which is the energy use that is provided from RECS.

Let's see the energy use of the heating component. We make adjustments to that later that I will be describing.

We multiply that AFUE of the existing and we add the blower heat which is the main heat useful heat that is provided by the electrical components. We do some adjustments which I will be describing and we divided by the furnace count: some households have multiple furnaces, so say if a household has two furnaces their heating load is calculated to be serving -- 50 million BTUs, we assume that each furnace will be 25 million BTUs.

And if we are in a case where the furnace is shared between multiple houses we multiply that by the number of units served.

MR. BROOKMAN: Frank Stanonik?

MR. STANONKIK: Frank Stanonik, AHRI. Victor, I appreciate you might now be the RECS expert but so RECS actually surveys a certain number of households, actually surveys them right. Do you know does RECS ask the question as to whether the household has had significant, I'm going to call it, envelope improvements?

MR. FRANCO: Thank you Frank for that question. It does actually. It has quite a significant, yeah, number of questions that I would ask, yep.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. I guess especially kind of following up on that for the building shell efficiency especially for the new homes built between now and 2021, what assumptions are you making in terms of the improvement in terms of building shell efficiency for the new homes?

MR. FRANCO: That is an excellent question that leads actually to the adjustment factors. So in addition to what I have described there are adjustment factors which is the adjustment factor.

One of them is actually to the building shell efficiency which is the second bullet so if you go down to adjustment factors we adjust for the building shell efficiency which essentially comes from the AO 2014 what they are assuming between what is in RECS 2009 and what would it be in 2021 and so there is an adjustment and further details are on the TSD about how the magnitude of that.

MR. ROSENSTOCK: What section of the TSD I'm sorry, I just wanted to double check.

MR. FRANCO: This would be in chapter 7 and the full actual information is in appendix 7B.

MR. BROOKMAN: Yes, please?

MR. WHITE: Chuck White, I just wanted clarification. You talk about shared units so we have multiple occupancies with a single furnace serving say two or three apartments so there are different occupancies.

MR. FRANCO: That is correct, yes. The

RECS has a variable that says if the homeowner has knowledge about the building if the furnace is shared between multiple units that is very common in multi-family situations it could be two or three units.

MR. BRUNDAGE: Don Brundage, Southern Company. Your line here says adjusted for changes in building shell efficiency and climate change in 2021. Is that the change in the climate zone maps from ASHRAE and ANSI or is it something different from that?

MR. CYMBALSKY: This is John from DOE. So all it is doing is taking the AEO forecast for heating and cooling degree dates, well in this case heating degree days and it is tracking population migration over time.

MR. BRUNDAGE: So it is adjusting for climate migration and percentage in each climate zone not changing climate?

MR. CYMBALSKY: Correct.

MR. BRUNDAGE: Okay, thank you.

MR. BROOKMAN: Yes please.

MR. WHITE: One quick follow-up I've been encouraged to say. This is Chuck White, PHCC. I am pretty sure sitting here I don't have the books in front of me but the mechanical codes prohibit mixing return air from sleeping quarters from other occupancies so if you have multiple apartments with a common furnace then you are going to replace this according to code, then you are going to have to now put in three furnaces and three systems and I am pretty sure without my code books in front of me but I am pretty sure that is the case.

MR. BROOKMAN: Okay thank you.

MR. FRANCO: Thank you for that comment. So the last adjustment factor here to discuss is that we are adjusting the climate conditions in 2009 to average climate conditions which we basically assume to be the last or more recent 10 year from NOAA data climate based on the heating degree days so each RECS household has a heating degree days and we had just got on the region to the 10 year average.

MR. ROSENSTOCK: Quick question Steve Rosenstock, EEI. So are you including 2014 -- the polar vortex -- in this analysis?

MR. BROOKMAN: Thanks for the question Steve.

MR. FRANCO: This goes up to 2013, 2014 wasn't available for this analysis.

Okay so this slide actually summarizes the results that are coming in for the fuel use. So here I just wanted for you to see visually the comparison in the table between the RECS, CBECS data in terms of the fuel use that is reported there versus our calculated values in 2021 for the baseline.

So this would be for the 80% furnace. So as you can see there is a significant difference decrease because of these adjustments that I described earlier including for example, building shell efficiency. I also provided the median in value to get a sense of the distribution but as you can see there is this distribution is pretty wide, kind of has a long tail, you can kind of get a sense of all we are dealing with a large building sample and it provides this distribution.

MR. BROOKMAN: Paul Haydock from Carrier, who is joining us online, asks a question and the question is how is blower heat determined?

MR. FRANCO: I'll be addressing electricity, which will deal with a little bit the blower heat in the next -- so I just discuss that in the next slide.

MR. BROOKMAN: Okay.

MR. FRANCO: Thank you for that question. Blower heat in terms of -- basically we take into account the furnace fan electricity use. We assume that -- as well as the current test procedure assumes that all of the electricity use coming from the blower is useful heat so we incorporate that into the useful heat component of this calculation for the fuel use.

Next we will be describing the electricity use. So there's two main components in terms of the electricity use. There's the active mode and the standby. So what this means is the active mode is when the furnace is on, the standby is when it is off. The standby component is important in terms of the other standby and off mode standard.

So let's separate those two. First we have the active mode. So we have three main components, we have the electrical components that are part of the furnace these include the blower, the inducer fan, the electronic condition, those components. We also include auxiliary components and this relates to the question that we had earlier.

This is -- we include the heat -- the condensate pumps in here as well. Finally we take into account that there is differential electricity use of the fan during non-furnace operation. What this means is that if the fan is used during the cooling period or as a continuous fan or as kind of providing some air the circulating fan, it is also taken into account.

We made the same assumptions as we did for the 2014 furnace fan final rule to determine this, so it is consistent. Going back to the electrical component because this was the question before -- in terms of the furnace fan, we make the same assumptions that we did in the 2014 furnace fan rule and we take into account that there are a lot of -- a significant number of households that have high static pressure and their electricity use is significantly different than would be assumed if you would just use for example the test procedure assumptions about static pressure.

So that's already taken into account and that is consistent with the 2014 furnace fan rule.

MR. BROOKMAN: Victor we have a question and a comment from Mark Nayes who is joining us online. Mark, we probably have you unmuted at this point.

MR. NAYES: Yes I was just going to make a comment again on the multiple -- the single furnace serving multiple occupancies. That is against code, it is a health safety issue that you are not ever going to see that.

MR. BROOKMAN: Okay thank you, echoing Chuck's comment thank you.

MR. NAYES: Yes he is absolutely correct.

MR. BROOKMAN: Thanks, Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. And again I am going to apologize, I am going back one or two slides. So you did recognize that, if you will, that the heat coming off the blower is useful heat but I'll say certainly for a non-condensing furnace that's actually installed in the conditioned space shouldn't you be counting any of the electric consumption that occurs during operation as heat to the space?

MR. FRANCO: That is correct, that is accounted for in the analysis that is further described in appendix 7B.

MR. STANONIK: Oh okay, so okay, I can talk lower okay.

MR. FRANCO: Yes sir, I just wanted to focus on the blower because it is the biggest component but you are correct.

MR. VERSHAW: Victor, Jim VerShaw, Ingersoll Rand. I have been trying to figure out how -- what you used for blower power. I saw on the earlier flow chart it was average blower power and how you determined what it was in heating and cooling and standby. I couldn't quite figure it out.

I looked at table 7B.3.1 that says furnace fan motor consumption by product type and furnace fan size. Is that heating or is that cooling or what?

MR. FRANCO: The furnace fan power has to be determined both for the heating use for the cooling, usually it is higher for the cooling and for the continuous fan so there is actually three operating modes that we are considering. We did the same assumptions as we did in the 2014 furnace fan rule so the -- we take into account the sizing of air conditioner, the sizing of the heating and what the power would be.

MR. VERSHAW: So if you took a range of static pressure is that right?

MR. FRANCO: That is correct.

MR. VERSHAW: You took a range of static pressures and then you must have checked typical furnace that would give a certain blower, so if the cooling -- so how does 7B.3.1 -- how does that work into what you did? What are those powers?

MR. FRANCO: Right, yes. Thank you for that clarification. These are just for the heating because --

MR. VERSHAW: So these are heating.

MR. FRANCO: These are just heating yes.

MR. VERSHAW: Okay now we are talking about using the new AFUE test procedure which if you have a -- and that's for 2-stage if you have got more than the 58% ratio, you are only testing low speeds so it should only be low speed. There's no way in the world that a 5 ton can almost have a thousand watts at low speed heating.

Is this what you used for heating? I think we can get a lot, lot, lot, lot, lot lower than that. Longer hours but a lot lower.

MR. FRANCO: I appreciate it and it is actually -- it should be listed they are both the high fire and low fire. What's listed here and it is not quickly labeled, it is just the high fire. The low fire would be --

MR. VERSHAW: High fire doesn't make any difference.

MR. FRANCO: It would be significantly less in the X13.

MR. VERSHAW: Well what went into the

analysis?

MR. FRANCO: So similar to what we did in the 2014 analysis we have two values, we have the high fire and low fire.

MR. VERSHAW: Is there any way we can get that?

MR. FRANCO: That's up to --

MR. VERSHAW: I have another. Now, you guys are saying that there is a 5% higher power usage by condensing furnaces over non-condensing furnaces, but yet the FER rule says it's 7% or 8% if you look at the two curves, you know the intercepts are about 8% apart and I am wondering why you chose 5% here.

MR. FRANCO: That's the -- I would have to look at what you are comparing to.

MR. VERSHAW: Remember the rule is FER is equal to .44 times something plus a number and the other one was non-condensing and the condensing was .44 times capacity plus a different number, so these same slopes, the curves are apart by 8% -- 7 or 8%, but you just said it was 5% more for condensing and these are supposed to be kind of averages, I don't understand though how those two are different.

MR. FRANCO: I really appreciate that. What we need to do is we need to clarify that section a little bit more. It's very condensed so we can provide other details. Everything is consistent with the 2014 if you go to that rule you will see all of the numbers actually the actual values of what we used for different --

MR. VERSHAW: And those are actually in the technical document?

MR. FRANCO: In the technical document --

MR. VERSHAW: In the technical document spreadsheets?

MR. FRANCO: No it is in the technical documentation but we could provide that.

MS. ARMSTRONG: We'll get it back to you.

MR. FRANCO: We will get that back to you.

MR. BROOKMAN: Mark Krebs?

MR. KREBS: Yeah this is the one I told you I was going to hold you too Victor remember, okay I'm holding you to it. So in order to answer the question basically we have to bring in the whole furnace fan rule which I guess I just want to express at this point you know how frustrating that is.

It is no longer bifurcated it is trifurcated or maybe it is quadrifurated I don't know, something like that. But it certainly, you know, the complexity of this rule is just, you know, compounded because of those factors and just for the record and in that record for the furnace fan rule AGA submitted testimony that shows comparison to 80% furnace and a 93% furnace okay, that's not 92 it's 93 so you know a little difference there so what they are saying is that electric uses and kilowatt hours for the 80% was up 191 and the 93% it was 687.

Now that's a little bit more than 5% I estimate without breaking out my calculator but you know and I'm not saying this is a typical case. They are not saying it either what they are saying is it came out of the AHRI's database and you know and on top of that is this whole issue of static pressure and the duct work, the typical duct work as you call them that really you know reads crumby duct work because typically they are crumby.

And so what is that impact you know if you could lay it on a table, what would in some average worst case average and best case maybe as far as the static pressure component from the condensing furnace itself that is additive to that static pressure component of the duct work you know and your papers you did you know good, average and typical or something like that.

You know something similar where it is laid out to where people can see what is happening so we don't get frustrated, having to resort back to the furnace rule and that TSD, you know, I think 957 pages of TSD is sufficient in my opinion so I would like to keep it there.

MR. FRANCO: Thank you for that comment, we will definitely clarify that.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. I am also looking at table 7D.3.1. There is a part that says furnace fan size ton I think you are saying that is really the air conditioners size that's combined with it so three tons is typical kind of shipment weighted average. You are saying 467 watts for non-condensing, not weatherized gas furnace and then 490 watts for the condensing, that's at the high value right, that's at the maximum heating load?

MR. FRANCO: That is correct.

MR. ROSENSTOCK: And for the low speed or the low load what are the values, half of that, one-quarter of that, what are we talking about just in terms of relative and then I will have a follow up question.

MR. FRANCO: Okay, they are almost half they are about 60% of that. If you had access to the spreadsheet there is just to point out if anybody has access there's a worksheet that is called Energy Use Calcs and in that sheet there is a table that lists those values.

MR. ROSENSTOCK: And then I just want for point of comparison for the fans that they are replacing, for the older fans you know for the -- I'll say the floor standards, what percentage savings are we talking about in terms of wattage for both high and or low you know? How much of a reduction already for -- I know you are talking about fuel switching but even this rule itself is significant reduction in electricity uses so I am just kind of curious of a general ballpark percentage.

MR. FRANCO: Just to clarify, you are comparing a furnace with a PSC motor currently on the market compared to the 2014 standard?

MR. ROSENSTOCK: Yeah I'll say a 2019 motor versus a 2015 motor, what would be the relative savings about 20%?

MR. FRANCO: On average it was between 30 and 40%.

MR. ROSENSTOCK: 30 and 40%, thank you. So these values are already down, thank you.

MR. FRANCO: Yes, correct.

MR. BROOKMAN: We have a comment from Paul Haddock, maybe it's a question. How are the blower on and off delays handled between non-condensing and condensing furnaces? The 103 standard designs shutter off delay for condensing that it does for non-condensing.

MR. FRANCO: Yes we do have blower on/off. I'm trying to take a look if I can answer the question. We will get back to that in the future.

So here are the standby and the standby takes into account the burner operating hours, according to operating hours and also the continuous fan operating hours as well. So here in terms of the non-weatherized gas furnaces AFUE standards this is the overall result in terms of fuel use and electricity use. We have decided the results between the national North and rest of country.

So I'll stop a little bit in case there is any questions because this is kind of the conclusion to the energy use.

MR. BROOKMAN: Jim?

MR. DELASKI: I don't understand why things go down like they do and then back up but I think that I don't know enough about what went into it and so once you get me that maybe I will understand it or I will be able to ask a smarter question.

MR. FRANCO: Yeah let me point out one

that might be an obvious -- you can see 98 there's a negative value there. That's a different technology. We are assuming that that is already at kind of the max tech ECM multi-stage modulating that usually more operating hours associated with electricity and that's why you see a negative value on that one.

We will try to clarify so you can provide comments.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Well, this particular slide this will be the first opportunity so I am going to raise the question. So in the NOPR in the description of the trial standard levels as presented there is identified at the trial standard levels 1 and 2 looked at the North and rest of the country separately and then when you get to trial level standards 3, 4 and 5 it appears that it only looked at national average.

And yet, if you look at this slide, the rest of the country which I will choose to call the South the estimated consumption of just the fuel use is about 70% of what is the national average and so I guess I am trying to understand why trial, well basically based on the way the trial standard levels are presented why didn't DOE do the separate analysis of the effect of condensing furnace requirement on the South?

MR. CYMBALSKY: They did.

MR. STANONIK: But that is not what the standard levels are.

MR. CYMBALSKY: Frank it is a national standard but it is evaluated you know North, South and everything but it is a national 92 it is not an 80/92.

MS. ARMSTRONG: This is Ashley from DOE. So it's just how we are talking about the levels right, it is the difference between the first couple that you mentioned there's a regional standard in there which would have different requirements for different regions of the country versus a national standard.

It doesn't necessarily mean that national averages were used, they are still built off the same fundamental analysis but it is the difference between the TSL considering your regional standard versus a national standard.

MR. FRANCO: This is Victor Franco.

MR. BROOKMAN: Michael McCabe?

MR. MCCABE: Michael McCabe. Victor is there any rebound effect build into the life-cycle cost analysis that is the different efficiency levels, the building heating load the same?

MR. FRANCO: Thank you for that question and in the LCC analysis we do consider rebound effect. We assume that the economic benefit of the increased comfort is equivalent to the energy consumption so we don't think in terms of economics, that into account when we go to the NIA analysis we do take into account the rebound effect and we will talk about the magnitude of that when we talk about the national impact analysis.

MR. MCCABE: Would you repeat again what is central to life-cycle costs? Because when you start talking about the economic benefit --

MR. FRANCO: Thank you, what I mean by that is a consumer is using the furnace longer to provide greater comfort. One way to actually put it in economic terms what that consumer benefit is, is just to say that it is equivalent to the actual energy cost.

MR. CYMBALSKY: So this is John from DOE -- let me step in. I think what Michael is asking is will people adjust their thermostats if they buy a more efficient piece of equipment is that your question? The rebound you are looking for?

MR. MCCABE: Yes.

MR. CYMBALSKY: Did you use an adjustment factor?

MR. FRANCO: Not for the LCC but the NIA.

MR. CYMBALSKY: So not in the LCC.

MR. MCCABE: Thank you.

MR. BROOKMAN: Dave?

MR. WINNINGHAM: This is Dave Willingham with Allied Air. Just to clarify on the electrical consumption -- until you get to TSL4, electrical consumption appears to be going down as given the fact that fan energy goes up with higher efficiency and you have condensate pumps and heat tape on 90%

can you explain that?

MR. FRANCO: Yes, thank you and I will be clarifying that in the documentation but that is an important question. What actually happens is that we are assuming that the input capacity of the furnace is constant for all of the efficiency levels, so the actual operating hours decrease once you get to higher efficiencies so just to put that in more concrete.

Say you have an 80% efficient furnace and you are 80 million BTUs, your output is 64. Once you go to a non-condensing we are assuming that you are using the same input capacity. In this analysis and that is the reason why you kind of see this effect.

MR. WINNINGHAM: This is Dave with Allied. Just a follow up question -- you know the load is the load is the load and wouldn't you size it according to output capacity not input capacity to -- I mean if your heat load is whatever it is you will size it according to the output that is needed to maintain the load not the input.

MR. FRANCO: Thank you and please submit

comments in that regard. We would really appreciate that. What is happening in this analysis we have gotten some contractor feedback from the stakeholder input that contractors what they do is they generally just size based on what's the product so please put your comments that so if we need to correct it we will correct that.

MR. BROOKMAN: Neil go ahead.

MR. LESLIE: Neil Leslie, GTI. I would like to get a little more clarification on that last item related to the use of a rebound effect in the NIA but not in the LCC. Could you explain -- first of all, do I have it correct that there is no rebound effect included in the LCC analysis spreadsheet is that -- I just want to make sure I'm hearing it correctly.

MR. FRANCO: That is correct yes.

MR. LESLIE: And there is a rebound effect 17% I don't remember what it is exactly, whatever that rebound effect would be somewhere in that part of town in the national impact analysis, I just want to make sure I have all of that exactly correct, right?

MR. FRANCO: That is correct, yes.

MR. LESLIE: Okay whatever that number is, I don't necessarily care exactly what it is but so I would like to know why it is in the NIA but not in the LCC?

MR. CYMBALSKY: Let me try to tackle the consumer choice here. So if I am a consumer and I am evaluating an efficiency of 80 and an efficiency of 92 and I'm comparing what the energy use of those two will be, I don't think I'm factoring in the fact of I am going to adjust my thermostat higher, around 92 versus 80 when I do the math in my head, so I think fundamentally that's why you would separate that.

Now once the unit is in your house you could react to the fact that your marginal cost of heating your home has changed and then mentally you will go and say wow it's a lot cheaper, maybe I'll inch it up a degree or two. So fundamentally that's why you would do it that way.

MR. BROOKMAN: We have a question from Everett Shorey from online. His question is why is the mean electricity use in the ELs 1 through 4 727 to 957 kilowatt hours per year while the median is 330 to 355 and the mean for EL0 is also 349 (referring to the numbers in the LCC model on the website).

MR. FRANCO: I didn't fully get the first part, could you just repeat that?

MR. BROOKMAN: John Cymbalsky is saying we need to get back on that one and then another question from Paul Haddock. Is the blower power consumption of 90% the same as 92 the same as 95% or does DOE add additional power needed for higher AFUE levels?

MR. FRANCO: So that's a great question. We do have higher power use in terms of going from non-condensing to condensing. We don't have in terms of going from say 90 to 92 a difference in the electricity consumption but it is higher between non-condensing and condensing.

MR. BROOKMAN: Thank you. Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. I'm going to follow up Neil's question and I understand what John said but if in I would say in just the same way and I don't disagree with this that DOE is looking at RECS data to kind of see okay what is consumption that actually occurs in the field, I think that in terms of life-cycle cost if in fact that consumer when they do get a more efficient furnace decide that they want to have their house warmer they in fact have changed what they will pay on a monthly basis for the fuel they have changed the relationship of the benefit in cost of reduced energy cost compared to what they paid for that product and I disagree with the conclusion that well that increase comfort has a monetary value which we will just assume totally balances what they have accepted as a higher bill.

I think that's a little bit subterfuging the life-cycle cost analysis because that consumer in fact whether they knew it or not they just extended out how long it is going to take them to pay back what they paid for their new furnace, the higher efficient product.

MR. BROOKMAN: Andrew deLaski?

MR. DELASKI: I disagree with you Frank. If a consumer chooses to pay $10.00 for something it is because they value that something at $10.00. In fact economic theory will suggest that that is the minimum they value it at. In fact if we are able to do some willingness to pay evaluation I would find this is a very conservative number.

People turn their thermostat up because they value that. If Gary Fernstrom was here who has been at many of these proceedings, he has made this point time and time again in these proceedings that when a consumer chooses to use something more because it is more efficient because the consumer values that.

And for us to say well in the consumer economic analysis say well we are just going to throw that out and ignore that value would be a disservice to the consumer for getting a value. Now as an energy efficiency advocate I wish we were getting the energy savings but the fact is that consumers when things are more efficient they use them more.

We can debate the rebound effect. It exists undoubtedly. The size of it is widely debated. The Department says 15% in this proceeding. I think it's probably too high. Steve Nadel's work says it should be 1 to 12% is the range that is discussed in the TSD but to say that that has no value to consumers, because they are now warmer you know that's just ignoring the practice of consumers and I also think it's ignoring the fact that it is probably a very conservative estimate because they probably evaluate more but they didn't have to pay more.

MR. BROOKMAN: Jim?

MR. VERSHAW: Jim VerShaw. I guess the reason it comes up is we are looking at energy savings that we know aren't exactly right because of the rebound effect whether it is whatever and --

MR. DELASKI: And that's why I think that it is proper that the government accounts for it in the NIA. So when we talk about the quad saved we are not counting it.

MR. VERSHAW: So when you do the simple payback or the payback for the home owners, does that include the rebound effect or not? I was making a point by asking a question, so it's not in there so if you look at that, if I remember right we are in the 7 to 8 year payback for this rule not including the rebound effect. So it's really 1 to 15% longer than that, whatever that would be.

MR. DELASKI: I disagree because they are getting value right, they are getting a value in improved warmth. They are choosing to select.

MR. VERSHAW: Show another column with how much they are spending more.

MR. DELASKI: And some consumers think that's election and some don't so this is an average value.

MR. VERSHAW: And they have a Crystal Ball attachment for this thing they can do that.

MR. BROOKMAN: Yes Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. I'll just looking at EL2 for the national number going into this. We talk about on the fuel use side 55 million BTUs for natural gas at a dollar a therm that's $55.00 a year. On the electricity side 13.9 kilowatt hours that's about 12 cents, national average it is about $1.74 per year.

So you add those up it is about $56.00 a year. What percentage will consumers give back in terms of rebound effect, that's a question I don't know. I am sure there are a lot of studies that show numbers all over the map like Andrew was saying but in terms of will it make energy savings, cost savings? No. Will it vent it? Yes.

How should it be accounted for? Right now and in other rulemakings you know again I don't think they accounted for rebound effect for like heat pumps so you know to account for it here and not know their products doesn't make, it's not really analytically consistent.

MR. BROOKMAN: Yes, Aniruddh?

MR. ROY: Aniruddh Roy, Goodman. Victor, on this table with the 80's, are they all using the BPM, the constant torque BPM motors?

MR. FRANCO: This would be actually X13.

MR. ROY: X13?

MR. FRANCO: X13 yes, okay. So moving on, this is I think we had sufficient discussion.

MR. BROOKMAN: I think we have covered these materials sufficiently we are going to move on.

MR. FRANCO: So there are three slides, in terms of energy prices. If we could limit the questions to the last slide in terms of energy prices that would be good but let me know if you have any questions. So basically this first slide provides the references that we are using in terms of this aggregated energy prices that we are using in the analysis.

What I mean by that, is we have energy prices for each household based on the region of the country they are at and by month. The energy prices that we use in terms of calculating energy savings are marginal in terms of electricity and natural gas and the values will be described later.

All the references in terms of getting these values come from EIA data as it says here and it is also in the TSD and the baseline -- the year that we are using to start with is 2012 that's the latest data that is aggregated by state for all of these prices. Next after we have that disaggregated we use EO 2014 data to project the values into the future from 2020 to 2040.

Then we use trends after that to project the values after 2040.

MR. ROSENSTOCK: Can we comment?

MR. BROOKMAN: Please.

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. For all the people here in the room, this chart is showing an estimate of the real prices, not the nominal prices. These are in 2013 dollars, so it is assuming that prices are going to increase above inflation from 2015 to 2040 and I have issues with that, that's another story.

MR. FRANCO: Thank you for that comment.

MR. BROOKMAN: Mark?

MR. KREBS: Yeah I have issues with that too.

MR. CYMBALSKY: This is John from DOE. So these are straight from the AEO, so you know we are not forecasting prices that's not what we do in the shop so you know this is the government projections on energy prices which is what we use.

MR. BROOKMAN: So anybody that had additional thoughts on this or their own projections they can send them forward, Mark?

MR. KREBS: Yeah, well, you know the issue is marginal costs, you know, these are marginal costs and what you call marginal costs really aren't marginal costs either. You know Steve Rosenstock and I were in the room along with the President of APGA Bert Kalisch when in 1998 when the whole concept of consumer marginal energy rates was first hatched.

DOE draft report was issued and never really published. LBNL has a web page on marginal energy rates and you are still not doing it right. It's tail block rates we are talking about okay, they are mentioned in some of these papers that Victor helped to offer but that is the right way to do it and I understand it is difficult to do, you know to track real tariff filings and look at the tail block rates and how a change in consumption is -- comes across to consumers in their utility bills but that is the way to do it.

You know you have time to tear down 30

furnaces I think you have time to do this.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: Mark, this is Harvey Sachs. I certainly understand where you are coming from. Your advocates have chafed with the AEO forecast for many years and I guess we sort of became reconciled to the fact that they are on average equally detrimental to everybody and that it is sort of -- well one of the rules of the game like it is not 90 feet along the baseline.

MR. KREBS: We had an advisory committee you know that I was on and Steve was on it and you know this is one of the things that we actually concluded you know and came across you know all in favor of doing this and it hasn't been done, you know and that was 1998. I think it is time to start doing it.

MR. SACHS: Its past is so mundane.

MR. KREBS: I appreciate you trying to inject some humor in this but what I am talking about is looking after my customer's best interest, okay it is a big deal you know. We are talking you know marginal true tail block rates are about 50% of what DOE has forecast and then those get inflate for 21.5 years, it is a major impact okay and I don't think it's doing consumers any favors at all.

MR. SACHS: I understand that but I want to make one other comment. This is Harvey. We have seen some major churn in how rates and tariffs are set, particularly on the electric side over the last couple of decades and that is the inherent uncertainty as we try to look forward to those two decades and we have been comfortable and I am happy to look at that analysis and would appreciate the chance to read it because I know it has changed my life.

MR. BROOKMAN: Okay, we are moving on now.

MR. FRANCO: Thank you for all of those comments. So just one to go to the next slide. This is the average prices applied in the analysis. As you can see the average is very different for the marginal cost and appendix the energy price of -- which I believe is appendix 8E we do provide comparison between tariffs analysis we did get from

APGA some tariffs and we do a comparison of those to our analysis so if you want to read on that please provide comments in that regard.

Next we will be discussing repair and maintenance costs of repairing different components in the furnace. You do this by different components for example the fan blower is one of the components we consider, failing during the lifetime of the furnace. The cost and frequencies come from various sources including RS means, manufacturer literature and a survey from American Comfort.

MR. BROOKMAN: Yes Jim VerShaw?

MR. VERSHAW: Jim VerShaw. So Victor, are the 2252 for a 90% for all the 90's 90 plus furnaces, that's the adder each year that you just assume this furnace will have for 21 years?

MR. FRANCO: That is correct.

MR. VERSHAW: So it's $22.52 a year times 21 and that is what they will spent on the air?

MR. FRANCO: And this is an average value again, some households, if for example, their furnace fan fails and that is a significant cost. Some others --

MR. VERSHAW: What would the failure rate that you assume for the furnace fan and for the controls and all of that, do you have that, is that written out?

MR. FRANCO: That's written out in the TSD I believe for furnaces it is around 40%.

MR. VERSHAW: You actually didn't have it for furnace fans unless I had to back out -- you had how much of a cost to fix the fan blower $274.00 and 3.43 hours of labor but it doesn't say what the failure rate would be. Maybe it would be nice to know what that considered because I did turn in failure rate numbers on the difference between PSCs and DC motors under the FER and these are actual numbers that we are seeing and also I turned in what I thought replacement motors should cost and I'm not sure you can get a replacement X13 motor for $274.00 as a homeowner.

And I turned in that information also and you might want to look back at that and see if that's matching that. And then the other thing that I am wondering about is we are using a brand new power supply in this level, in the TSL in the 92% level or maybe all of them. What was the failure rate on that?

And if it fails how much does it cost to replace it, is that factored in?

MR. FRANCO: In terms of the fan component --

MR. VERSHAW: Switch and power supply.

MR. FRANCO: So we don't have that --

MR. VERSHAW: We don't have it as a product we only have a transformer.

MR. FRANCO: Yeah, we don't have it as a separate component.

MR. VERSHAW: I'm really -- whenever you use new technology you probably have a learning curve right. And probably how steep do you want the price of it, well it is going to be way up here and a high failure rate at the beginning and it is going to get better over time so I think you need to take a look at that. I don't even know where they are used or what they are, to tell you the truth I'm not a double

EE so it would be interesting to find that out.

MR. MURPHY: Can I just go back to marginal prices for a second and something that Victor you mentioned that you had said that you had use of tariff information that you got from APGA. AGA also submitted a marginal cost study as well that actually indicated about a 25% differential between average and marginal. Did you incorporate that in your analysis as well?

MR. FRANCO: We did do the comparisons for our results between those two sets of data, yes, it is included.

MR. BROOKMAN: Frank Stanonik.

MR. STANONIK: Frank Stanonik, AHRI. So on the maintenance cost you do talk about additional maintenance costs associated with condensate withdrawal. So to my very limited knowledge in this area I do not believe that the condensate pump that in some cases will be required because of the installation of a condensing furnace that the lifetime of the pump is the same as the lifetime of the furnace so does this include in fact some point the full replacement of the condensate pump?

MR. FRANCO: Yes, it includes both the condensate pump and the neutralizer filter in the main --

MR. BROOKMAN: We have a question from online: Terry Small asks why is the repair cost for manufactured housing gas furnace so much lower than for non-weatherized gas furnace?

MR. FRANCO: We'd have to get back to exactly the reason. One reason is they are actually using different components which is there is a PSC motor instead of X13 motor as the baseline, that's probably the primary reason.

MR. BROOKMAN: Yes Dave Schroeder?

MR. SCHROEDER: This is Dave Schroeder. It looks like from the TSD that proprietary data was used to determine maintenance frequency across the board. Is there any way that that source data can be made available?

MR. FRANCO: Thank you for that question I was actually going to get to that. So we do use this 2008 American Home Comfort survey data to --

especially for the maintenance cost. We try to use as much publicly available data as possible. In this case this was the only source. We do in the appendix related to the main sensory -- we do put in all of the data that we actually use so these are aggregate values that are coming from the data.

We do publish those we are allowed to publish that. We don't have access to the raw data but that is what we use is published and how it is actually used in the analysis. We combine that with RECS data which actually gives us how often an owner for example will maintain if he does maintain the furnace regularly or not and how we use American Comfort survey is kind of just aggregate that in terms of years. So once RECS tells us if the owner is going to maintain it regularly American Comfort survey kind of gives us a sense of is that yearly, is that every couple of years is that every five years.

MR. BROOKMAN: John Cymbalsky?

MR. CYMBALSKY: John from DOE. So there was a question that was just asked was part of the APGA submission and that's under questions 1 and 2 under the related to maintenance costs so that's the answer to those two questions.

MR. BROOKMAN: We have a question, a double question from Jim Moore, Jim who is online, Jim Moore asks has DOE used more frequent fan motor failures with the move away from PSC motors or are you using PSC failure rates with the new motor technology?

MR. FRANCO: Thank you for that question. We are actually being consistent with the 2014 furnace rule and we are having an increased failure rate and that is consistent with the final rule.

MR. BROOKMAN: Okay Rick?

MR. MURPHY: Victor just going back to the reference to [American] home comfort study and I recall trying to look through it in my notes that there was a reference that in its cost and other areas of the home comfort study that we are trying to gain access to but I believe there was also in addition to the [American] home comfort study that relied on energy consultants to develop some numbers so what I am trying to get at was it strictly the data or the home comfort study or was it a combination of that along with other input and if so how do we get access to the intelligence that came out of that.

MR. FRANCO: I really appreciate the comment. Whenever we get input for example from expert consultants or some consultants, we do publish what their assumptions how we use that data. In the case of maintenance it is mainly to validate more or less based on the understanding of the approach.

It is not in terms of providing any additional data. In terms of the actual methodology as described there as I described we used American comfort surveys for data, we use directly from that survey we did publish there and data that we are getting from RECS which is publicly available we do publish the fractions as well there so we try to not have anything that you can't get access to as much as we can.

But please provide any comments if you find something that is -- you think that is not well understood and we will try to answer that.

MR. BROOKMAN: Neil?

MR. LESLIE: Neil Leslie, GTA. There's one part of that question, the first question I just want to make sure I don't remember hearing an answer to and that is why was only one year of the study data used when there were four years of data used in other parts of the analysis.

MR. FRANCO: And I appreciate that question. We had direct access during that time to just one survey of that data when we looked back and looked at the other surveys the data was very similar, so potentially it could be used multiple years. For this we only had access for that one single year the data for this particular variable.

So now we are going into the inputs lifetime and discount rates. So first, let's discuss lifetime. We use a distribution of lifetimes we use the method that uses survey data that comes from American Housing Survey and RECS. American Housing Survey provides how many furnaces are installed in the U.S.

It's fairly robust survey that is

conducted by HUD [Housing & Urban Development] and Census every couple of years so that gives us a better number in terms of total furnaces that are in the nation and we use also RECS data in terms of the age of the equipment that is currently being installed to give us also a sense of this distribution.

We combine that with manufacturer's shipment data. The manufacturer's shipment data is data that has been provided by AHRI throughout the years and also is publicly available on their website.

For this analysis we actually did a modification based on the previous analysis. In discussions with AHRI we were able to understand better what the shipments included. The shipments of the AHRI do not include weatherized gas furnaces so they actually provided for about a 6 or 5 year period. Recent period they provided weatherized gas furnace shipments.

Adding those shipments to the overall shipments give us a slightly lower value in terms of annual lifetime compared to the 2011 DFR and the

Census question from AGA partly.

MR. CYMBALSKY: This is John from DOE. So this would be question 8 from the APGA docket material relating to the switching logic.

MR. FRANCO: In addition to that we provide an appendix in the lifetime appendix we do provide the different references that we used to compare. These are 15 references that we compare this lifetime value and we believe that this is an agreement to those other references consistent with this value.

This is in appendix 8G. Next we discussed the discount rates. So discount rates are used to convert operating costs, lifetime operating costs into present value. We use another publicly available data source that comes from the Federal Reserve Board it's called a survey of consumer finances. For this analysis we used multiple years from 1995 to 2010. It comes out every three years.

We disaggregated these by -- the discount rates by income for this analysis. This is different from the 2011 analysis, as you can see they vary.

This is the average, we do have distributions and the distributions are available in the discount rate appendix in chapter 8.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, EEI please refresh my memory the highest income group is 1 or 6 just out of curiosity?

MR. FRANCO: Thank you for that clarification. The highest income group is 6, low income is 1, the lowest income group.

MR. ROSENSTOCK: Thank you.

MR. FRANCO: These are percentiles just to clarify so income group 1 represents zero to 20% and the highest income group is 90%.

Next we will be discussing the base case efficiency distribution. There is actually two slides for this.

MR. BROOKMAN: Mark?

MR. KREBS: I apologize but this is another big one on my list and the last big one for the record. Discount rates, okay there was in the furnace fan rule which I did review, at least the filed comments, there was a very interesting one from George Washington University regulatory study center and she took a look at discount rates in depth and with a bunch of economists that she cited showing discount rates that should be like in the range of 100% maybe higher.

And these rates totally reverse the aggregate or individual consumer savings, however you want to cut it and you know you go back to 3% and you go back to 7% you know but as I recall you know and you quote the OMB but as I recall OMB circular 8094 also recommends using other discount rates to show the sensitivity of the estimates to the discount rate assumption.

That's a direct quote out of my Laclede's comments for the DFR. And my question then is you know how have you actually looked at you know these situations for a growing part of American population who is dropping out of the middle class it seems. You know where is that?

MR. FRANCO: Thank you so much for those comments. So just to clarify I think the 3% and 7%

that you are referring to is what is applied in the NIA analysis and we will be discussing that later. In terms of what is supplied in terms of the LCC the consumer level, these are the rates derived from this analysis for the descriptions in the TSD of how that is derived. There is a distribution so there are some households that have in the low income group very high discount rates that are applied when their household is sampled.

You can look at the distribution and you can see that it's significant so there is a distribution but these are just average values.

MR. KREBS: Okay so the worst case kind of gets blended in with the average and everything is averaged.

MR. FRANCO: No, no, every household is applied a specific discount rate so there are households that have 100, 150% discount rate.

MR. KREBS: All right.

MR. BROOKMAN: Mark Nayes who is joining us online has a question or a comment, Mark go right ahead.

MR. NAYES: Yes going back to that filter and maintenance replacement for the costs -- if I put in a high efficient you know standard filter that is supposed to last a year that's $50.00 right there, that's more than we have got down for the maintenance cost. How am I supposed to pay a guy to go out there and perform maintenance on the system?

MR. BROOKMAN: Okay, okay Mark thanks.

MR. FRANCO: Thank you.

MR. BROOKMAN: And we also have a comment or a question from Everett Surey. It is how do you deal with the fact that the AHS survey data if analyzed by the NAHB shows that the average tenure in a house is under 20 years and well under that in the South and West.

MR. FRANCO: We don't -- we analyze just the furnace in terms of the person occupying it could be over the years multiple owners, some of your comments.

Okay so moving on to the next topic. The base case efficiency distribution is a major component of the LCC and this is the last in terms of the LCC components before going to fuel switching which will have a huge amount of slides so there are two slides here. The first describes more or less the process that we are using and the data sources.

So, the base case efficiency distribution describes -- reflects the projected market shares of products at different efficiency levels in the absence of standards. This absence reflects that not all consumers purchase products at the current minimum efficiency level and that it recognizes that some consumers already purchase products at a higher efficiency level.

DOE projected its market shares for 2021 based on historical shipments data. Some of it provided by AHRI, also we have the sources here also Energy Star shipments for the years that we didn't have data from AHRI directly, we had historical data from 1980 to 2009. From 2009 we used Energy Star data, 2012 and also we disaggregated between efficiency levels of the condensing side from the latest AHRI certification directory.

So the results are shown here in terms of disaggregated base case efficiencies for different markets. You can see that there are differences between North and South and between replacements and new construction. We did get feedback from manufacturers in the manufacturer interviews but there were differences in terms of new construction in terms of the venting market share so there is a larger fraction of furnaces that are below 95 as you can note in the North in the new construction versus the replacement.

So for example here you have 32% in new construction and 15% at 92 level. The overall fraction of condensing is fairly close between the two but distribution between the efficiency is different.

MR. CYMBALSKY: Okay so we think this answers from the docketed questions priority question A and then questions 1 through 4 related to the base case AFUE efficiency from the docketed APGA questions.

MR. BROOKMAN: Thank you John. Frank Stanonik?

MR. STANONIK: Frank Stanonik, AHRI. The one thing I am not tracking here in the previous slide so you had shipment data from us non-condensing condensing for quite a few years. I understand you had historical shipment by states from us back up to 2003 or something like that but then you slipped in here that you are still using somehow our directory listings as a basis for shipments distribution. Where does that fit into this table?

MR. FRANCO: Sure thank you for that. I went really quickly through that. Basically we have all the information about the fraction of condensing versus non-condensing. We don't have for a lot -- I think we only had one for 2002 - 2003 year -- a disaggregation between the different efficiency levels in terms of condensing so to disaggregate between them we used the latest AHRI directory.

MR. STANONIK: So are you presuming that the same distribution of listings by efficiency translates to shipments?

MR. FRANCO: Partly. Let me explain it's more detailed in TSD but maybe I can do it simply here. For the North replacements we do exactly but then we do modify that for the North and the South. The Norths new construction and the South as well because of manufacturer input in terms of those markets.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. I'm just kind of curious you know I am looking at the 95% numbers and it says replacement 45% in the North and 5.5% for 90 AFUE and you know but you look in the South and the numbers are a lot closer. They are flipped for some reason and I am just kind of curious the reason for the 95% market having such high market shares is that because of an incentive program or is that because they already have 95% AFUE furnaces existing by 2021?

MR. FRANCO: That is correct. One of the main drivers we think in the future especially is the Energy Star program. Energy Star currently has 95% levels for the North and 90% level for the South.

So the South is mainly in the lower AFUE in the North you are going up to 95 because of that incentive to go to 95.

MR. BROOKMAN: Aniruddh?

MR. ROY: So on slide 68 you mentioned the AHRI directory as being the source as well as the shipments collected by AHRI so how were you able to purge in your shipments analysis the PSCs and the 80's and forecast the shipments past 2021 based on that data? Because that data also captures that market.

MR. FRANCO: We are only considering in terms of condensing market and yeah there are some PSCs but we are only looking at the AFUE in terms of that. We assume that the market still will be just the AFUE would be similar distribution, just looking at the AFUE of those units, not the motor.

MR. BROOKMAN: Mark Nayes has a comment and he is joining us online, Mark go right ahead.

MR. NAYES: Yes I was just going to comment on those percentages on replacements in the North. At the time we had the very large federal tax credit and we also had some very nice gas incentives for high efficient furnaces and those are very accurate to what we have been seeing but I am just kind of wondering in the last couple of years they have had a much more robust selection of 98% efficient furnaces and we are moving much closer to a 20% replacement rate on those styles.

MR. FRANCO: Thank you for your comments.

MR. BROOKMAN: Yeah, appreciated that.

MR. NAYES: You are welcome.

MR. ROY: Aniruddh Roy, Goodman. Just a follow up question so even though historically there hasn't been a slight downward trend in the shipments it still is showing an upward curve from 2021 onwards without any factoring of any dip in shipments.

MR. FRANCO: Let me go back to the next slide I think it will help explain and it will also deal with part of the AGA's comments in this regard. So let me show this is the projected base case efficiency distributions during the analysis period as again we are starting at 2021 so if you can see from here from the historical data there is a trend. The trend increases more dramatically between 2005 say and about 2011. After that there is a decrease. Now between 2011 and 2012 is based on Energy Star shipments and we don't -- Energy Star doesn't actually have all the shipments so we had to actually scale those shipments up so those numbers might be slightly lower than they are so if AHRI has more accurate data that would be great for those two years but based on Energy Star data our current assumptions in terms of the regional values.

We are using the projections between 1992 to 2004 which we assume is the period before incentives. We are not using to project in the future the -- we are not using the data between 2005 and 2011 because we believe that has a lot of incentives which might not translate into the future and this is the result of that.

MR. BROOKMAN: Okay Rick?

MR. MURPHY: Rich Murphy, AGA. Just don't understand the logic where this has significant debt from 2012 is it to 2013 and I believe the information that was shared established attributable during a period of time where there were incentives in the market. Is the conclusion that there was no market transformation impact of those incentives during that period of time?

MR. BROOKMAN: I see Frank Stanonik has a comment.

MR. STANONIK: Well I will let him answer first.

MR. FRANCO: Yes there is but there is still -- this is a fairly large lifetime for furnaces to do a full market transformation so there is kind of evolving but it is fairly small in our projections, but at least comment if you think that is accurate.

MR. STANONIK: Okay Frank Stanonik, AHRI. You probably think you need to recognize that from 2009 to 2012 the data comes from the shipments collected by Energy Star. Okay, so in fact, 2009 before 2010 -- so they were collecting the peak and then it looks like the bottom dropped out right so the question I have is in that period in that -- what is it 4-5 year period -- did you check because I don't know myself -- were -- did the Energy Star program always have the same number of furnace manufacturer participants?

In other words were you getting the data for those 4 or 5 years from the same group of manufacturers?

MR. FRANCO: Thank you for that question and this is a great point. So as I mentioned it had to do some assumptions especially for the data between 2011 and 2012, let me explain. In 2011 Energy Star changed their criteria for the North to 95% so they don't have any shipments data for instance sold in the North between '90 and '95 and basically their assumptions are just for the 95.

They also changed the criteria in terms of a fan efficiency so that dropped a lot of furnaces that were sold as condensing but didn't meet efficiency requirements. In addition to that they also added some constraints in terms of the cabinet losses so that further decreased so actually the value in 2012 that we got the data from Energy Star was only 9% from that and previous data we increased that we believe to I think it was 34% based on what we think the market in the North and everything.

We would appreciate more accurate date if it is available.

MR. BROOKMAN: Frank keep going.

MR. STANONIK: Frank Stanonick, one follow up, two points. So in fact that drop there in a sense may represent a worst case but in fact it is without question incorrect okay. But the other point I want to make and again I'm not going to contest the question about we had this huge peak the years preceding 2011 or so no question some of that was driven by significant tax credits okay.

But in terms of this chart okay, so I had let's -- again I'm not going to have the exact number. Let's just say that in the last '08 through '10 or '11 I -- these tax credits introduced an additional I'll just make up a number 5 million condensing furnaces to the market okay. So I'm looking at this chart let's say 2010 so I start to think in 2030 those extra 10 million or whatever number I said furnaces are going to be replaced and I would say that the correct assumption is that once you have got that condensing furnace into that consumer's home that is what they are going to put in again, okay.

So even though I would certainly say you can't take that line to say my thing is going to do this I would say in your future projections you have got to account for that blip because that blip will in fact in this case raise the boat a little bit, rising tide raises or something like that.

MR. BROOKMAN: Dave Schroeder?

MR. FRANCO: I appreciate that comment, thank you.

MR. SCHROEDER: Hi, this is Dave Schroeder. So I understand certainly the rationale for pulling out data during that incentive period as being influenced by something outside of the market but it seems like there are some very good reasons to exclude the points immediately after that period as well so if you extrapolated 2005 through or sorry 2000 to 2005 out into the future by the time you get to 2021 it's essentially impossible to sell a non-condensing furnace in the northern part of the United States.

Any way my point is I don't really understand the rationale for including those two data points that are after the big peak particularly because you have had some inconsistencies it seems like in the source data.

MR. FRANCO: Thank you for that so we are in terms of the growth we are just considering 1993 to 2004 in terms of the growth and our starting point is 2012.

MR. BROOKMAN: Dave Schroeder has a follow-up.

MR. SCHROEDER: Another comment and this relates to both this chart and back to discount rates and forward to discount rates actually. So you could count every house you analyze, you calculate an LCC savings done before correct. So from that that actually implies also a discount rate that consumers would tolerate and that number is going to be significantly different possibly than the discount rates you assigned in the previous maybe two slides ago and I think you are about to tell us that you used the payback period of 3 years for switching options which applies another discount rate so you actually have homes, one individual home with three different discount rates what it look like.

MR. FRANCO: I believe there is only 2, there's the 1 to bring back to the present value and then we will discuss the fuel switching I didn't understand the third.

MR. SCHROEDER: So payback period or payback periods that consumers would tolerate and aren't inherently related to discount rate you have assigned discount rates a few slides ago. The LCC numbers in combination with these shipment numbers imply a second discount rate, right because you have got a payback period from the LCC analysis and then in switching you have a 3 year payback period so that implies a different discount rate. So one home is 3 discount rates.

MR. FRANCO: Please submit your comments.

MR. BROOKMAN: Dave? Neil are you in the same contents stream?

MR. LESLIE: I am in the draft in this part of it.

MR. WINNINGHAM: Neil could I just interject one note on Dave's comment as a follow on?

MR. LESLIE: Mine is a clarification more than anything else. I am very confused as to what is AHRI data and what purported over to the EPA data on that chart. There's a 2013 data point diamond shaped and you are saying to 2012 I don't know where the 2013 data wound up coming from and I don't know whether the 2009 data point is from AHRI data or it is from the EPA data so I would just like to understand the source of the specific data points on that chart, that would be very helpful to me.

MR. FRANCO: Thank you so much, let me clarify again. Data before 2009 was provided from AHRI in terms of the fraction of condensing and non-condensing and that was actually provided by region. After 2009 --

MR. LESLIE: Wait on 2009? For the 2009 data plan it shifted, so up through 2008 is AHRI data? I just want to make sure.

MR. FRANCO: Up through 2009, 2009 so that's the relation to the previous rulemaking AHRI provided data up to 2009.

MR. LESLIE: Up through 2009?

MR. FRANCO: Yes.

MR. LESLIE: Not up through 2008? So 2009, 2010, 2011, 2012 and 2013 then become a shift in data sources to the EPA data source. I just want to make sure that I have that.

MR. FRANCO: Let me clarify 2013 is a projection number. 2012 is the last number that we got from Energy Star, I'm sorry if I misspoke.

MR. BROOKMAN: Dave, thanks for being patient.

MR. WINNINGTON: Yes just to kind of follow on to Frank's thoughts -- and I believe it was the 2010-2011 timeframe -- EPA made a significant change to their program that put a lot more burden of testing as well as product use supplied so there may have been some influence here that people just dropped out and didn't report.

MR. FRANCO: Thank you for that, I did mention that about the 2011-2012 values that's why we needed to adjust them because of that.

MR. CYMBALSKY: This is John from DOE so we have manufacturers and others in the room, are there data that exists that we can get provided to us? I mean I know the data exists so --

MR. KREBS: That's what Neil was trying to ask but you know he's not really educated.

MR. CYMBALSKY: He's more polite than me.

MR. DELASKI: I would just comment, this is Andrew. The AHRI data is wonderful data and it will be wonderful to have it up to date. I would just encourage the industry to manufacturers, the associations to submit up to date data and that would really help the analysis undoubtedly. In the absence of updated data, the Department has to do the best they can with what is provided in the public realm so I would encourage I see Dave nodding, I would encourage all the manufacturers who are here to work for the good of the Association to provide up to date data.

MR. BROOKMAN: I believe Harvey is next.

MR. SACHS: Harvey Sachs and Dave Schroeder I think about my own life. I think that the switching thing is entitled to a different call it payback it is a virtual number that is a proxy for our uncertainties about the stickiness in consumer behavior. I have done something very non-cost-effective the last several years in keeping my cable connection so the stickiness may well have a different value than the capital investment decisions and I would defend DOE for trying to develop a proxy which I am darn sure is not perfect.

MR. BROOKMAN: Mark Krebs, I mean, pardon
,
me.

MR. KREBS: Close enough, we are among friends. Einstein is credited with saying you know solutions to problems should be as simple as possible but no simpler okay and that's kind of where we are at I think. You know I am looking -- I see all this stuff and part of it is from this data base, part of it is from another data base, you know I realize that those big rebates for high efficiency furnaces impacted this stuff, I realized that the crash, the great recession whatever they called it had an impact on shipments but why don't we just get the raw AHRI shipment data for this period, for the period that we know of and then we can deal with it.

Then we have something to talk about and we are not you know, it is not all piece-milled apparently like it is now.

MR. BROOKMAN: Well we have heard an additional treaty for the data to come forward somehow.

MR. KREBS: It's just another way of reiterating what Neil tried to say.

MR. BROOKMAN: So now we are moving on there, keep going.

MR. FRANCO: So this is a major piece of the analysis there's quite a few slides to go through in this analysis.

MR. BROOKMAN: Okay let's start back up. I understand here at the outset Victor has clarification.

MR. FRANCO: Thank you yes there was a question from N.J. in regard to the base case efficiency distribution. Application in the LCC spreadsheet and there was a spreadsheet there it is disaggregated by 30 RECS, designated regions. Actually RECS provides 27 to be more accurate. We disaggregated an additional three, one of them is West Virginia because the North has West Virginia disaggregated so that is separately.

In the actual spreadsheet we list West Virginia as part of another region but that was just a misprint, West Virginia is a separate region.

MR. BROOKMAN: So I just got the word from Brenda that we need to leave this room at 5:00 sharp so I want to encourage everyone's commenting to try to keep their comments especially succinct so we can make it through all of this material and so now back to Victor.

MR. FRANCO: So there are a number of

questions related to this part of the analysis and I will try to answer as many of the preliminary questions as possible and your questions as clearly as I can. I will focus on three slides mostly and I will go through the other slides fairly quickly.

So kind of the setup of the analysis is that we did do product switching for this equipment. In the analysis we assumed that --

MR. BROOKMAN: Thanks you, guys. Keep going Victor.

MR. FRANCO: In the analysis, we assumed that there is potential for switching when going from the current standard to the 90 or above standard levels. In that case, we would be going from potentially from non-condensing situation replacement situation we are going to condensing weatherized gas furnaces is one of the options, the primary option.

And alternative options are electric furnace and heat pump in terms of the electric heating. In terms of cooling because of the associated cooling and heating equipment you potentially -- if you have a central air conditioner you potentially could go to a central air conditioner or you could go to an air handler plus a heat pump.

In terms of water heating, there is also the potential for switching if you have an orphan water heater we also analyze the potential for going from a gas storage water heater to an electric storage water heater.

MR. BROOKMAN: Yes Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. As much as I would love to think that the electric options were the only options that is not true. I will try to be as brief as possible for what Doug said. In my view, looking at this and looking at the support document this is an incomplete analysis.

There are other options that consumers can choose from for example, oil fire non-condensing furnaces, other alternative direct heating equipment, room by room heating equipment, biomass, wood type of heating system if they really wanted to spend a lot of money.

In terms of the water heating system

there's oil fired water heaters, there are solar water heaters, there are instantaneous water heaters. This is a very limited analysis assuming that consumers only have basically one option or two options at most and just simply is not true.

Therefore a lot of the numbers it is really incomplete because it is assuming that consumers will look at no other technology whatever in terms of any sort of other -- all the impacts that they only have a choice of these two and there is nothing else out there and well there's other -- all the other associated side effects. So most of this section, anything on fuel switching in my mind this is a totally incomplete analysis and all the results, assumptions and results are erroneous thank you.

MR. BROOKMAN: Dave Winningham?

MR. WINNINGHAM: This is Dave Winningham with Allied Air. Very quickly and it may not fit here but is there an extended repair versus replace of product considered in this methodology?

MR. FRANCO: Could you clarify what you mean by extended?

MR. WINNINGHAM: People would choose to repair their old inefficient product so to speak, replacing heat exchanger versus incur the cost of a new more efficient product.

MR. FRANCO: Thank you for that clarification. In this analysis we did not model an extended repair as an option, please provide that in your comment if you believe that that should be added, thank you so much for that comment.

MR. BROOKMAN: Okay.

MR. FRANCO: The next two bullet points are related to slides that would be more specific so I won't go into those until we get to those two specific slides.

MR. CYMBALSKY: I just want to point out I think on this slide we tried to set up answers for priority question C and question 4 in the related to switching logic.

MR. FRANCO: In relation to that actually I forgot to answer one of the questions. One of the questions was if we modeled going from switching from a non-condensing to a non-condensing in the base case in the LCC analysis and we did not model that.

We believe that for various reasons some consumers in the base case decide to remain even though it might not be the best option in going from non-condensing to non-condensing so that answers one of those questions.

The next few slides are basically just the options, so I will just go really, really quickly through these. As you can see these are the same that we have described earlier just in graphically. This further disaggregates how we use the analysis. We consider whether there is commonly venting or not. This is fairly complicated, it's -- I believe it is fairly well explained in the appendix related to fuel switching and please provide any comment.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Then I will ask it a different way, why didn't you consider other options that are out there for consumers?

MR. FRANCO: At the time we collected the analysis these seemed to be the options that were -- that most that would potentially be the ones that consumers would go to the most. Please submit comments if you think that we should consider others.

MR. ROSENSTOCK: Steve Rosenstock, EEI. What's that based on?

MR. CYMBALSKY: This is John from DOE. So in your remarks before you mentioned that at least for a couple of technologies that were the I'm using your words, "very expensive options" so if the idea of fuel switching is that you are doing it to save money which the economic rationale would present here I guess my question is why would you switch to "very expensive option" relative to this and include that as a viable consumer option.

MR. ROSENSTOCK: Steve Rosenstock, EEI. In certain cases that very expensive option might be the same price or lower price than what you might have to do inside the house based on your configuration of the current system. So for some consumers it might be a more expensive option but for others based on what they might have to do to meet the new standard it might be the same or a lower price so again it is all relative to what a consumer is facing with its current system.

MR. CYMBALSKY: Okay, in that case, we will ask you to provide the data on the cost of switching to oil including the environmental and tank issues that exist with that and then if you have any data on switching to wood from gas -- and then you mentioned, I think, direct heating equipment -- that's fine, we will take the data that you have on that.

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again, thank you for that but again I was just saying there's so many options out there and it just seemed like you were just totally you know not considering all -- I'll stop there thank you.

MR. BROOKMAN: Okay thank you Mark Krebs?

MR. KREBS: I won't stop there I have got a couple more to add to Steve's list. One of them is if you are really poor and you can't afford to replace your furnace that you just turn on the range and try to heat your house that way. You know, another option is if you go down to the dollar store or somewhere you know and you get an electric resistance heater, you know maybe you get a whole bunch of them and plug those in because that's the only choice you have got, either that or freezing to death.

So there are other options and yeah they should be considered.

MR. BROOKMAN: Okay let's proceed with the analysis that is here.

MR. FRANCO: Thank you for all of those comments, please provide written comment. These are the options in the graphical the next presents the same in a tabulated format. As you can see there's six combinations that we start with there are non-condensing with certain other combination air-conditioning or water heating combinations.

This next slide presents the actual tabulated numbers in terms of how many households belong to these criteria, the most common is a non-weatherized gas furnace with a gas water heater and a central air conditioner which represents about 66% of the sample.

I'll stop on this one and be more detailed because this is one of the one's we receive a lot of comments on and please provide --

MR. BROOKMAN: We have a comment from Mark Nayes on line who says a question in fact, does this switching take into account the complete inability to install a condensing gas furnace in place of a non-condensing gas furnace and are required to install a different form of heat?

MR. FRANCO: Thank you for that question. Would you repeat that --

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Yeah again it might be in the weeds here I was trying to see -- as part of this decision making matrix I am just wondering especially on the water heater side was there any factor considered for age of the water heater versus the furnace for example if albeit an equation if the age of the water heater is less than half the age of the furnace are people really going to make that switch or less than one third?

I mean you are an excellent salesperson, you convince someone to take out a 5 year old gas water heater when they are replacing a 20 year old furnace.

MR. FRANCO: Thank you for that comment, yeah that is described in our TSD we do take that into account. We assume that for example the furnace is fairly old it is more likely that they will replace it. If it has just been replaced only a few years then it is less likely, the description is in the TSD. Question?

MR. BROOKMAN: Yes please?

MR. MURPHY: Doug and John, could you direct us to where we could find more information on where those situations where that previous question -- about where it is impossible to install a condensing is included in the fuel switching?

MR. FRANCO: Okay yes let me -- this was related to installation costs. Before, I mentioned that what we do in our analysis is we assign very large costs for some of these households with assigned, sometimes it's a very, very large cost because you are going to have multiple laws in a very large ventilation.

MR. MURPHY: I'm sorry this is Rich

Murphy, AGA. I think the question I'm not sure but for instance if there is a condominium project where they do not allow penetrating an outside wall, how is that considered in the analysis?

MR. FRANCO: We do have it different for example for multi-family kind of condominium situations and situations sometimes referred to as row houses. We do account for them having to penetrate multiple walls, the cost is usually significant that usually that requires some analysis or it is a significant cost that's associated to that.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: Harvey Sachs. Since this has come up several times for the use of generally fairly low rise buildings we are seeing the introduction into the market of who the stack solutions for venting condensing furnaces vertically rather than horizontally.

MR. FRANCO: Thank you for that comment. So I am going back to the fuel switching so this is how we conducted fuel switching it is based on economics in terms of the household so as described before there is a payback associated with this analysis. We do this analysis household by household as described before some households have very different installation costs total install costs and very different operating costs because how a different region of the country where natural gas or electricity prices are very different from other households so all of that is taken into account what we are doing if you follow this flow chart.

After that we do a payback calculation related to the -- comparing the non-weatherized gas furnace option of the 90% or above versus the electric furnace or heat pump options. If the payback period with that comparison is above 3.5 years we assume that a homeowner would choose to switch. If the payback is less than that then we assume that the homeowner will remain with non-weatherized gas furnace.

This payback criteria is based on this analysis data and RECS 2009 data. We will go through the explanation of how that is calculated.

We had a question again about this analysis data which is this American Home Comfort survey about the availability of the data.

We don't for many of these have the disaggregated data by either different housing incomes, the raw data but we do have a little bit of sense of the distribution by region in terms of that would give some results. The data that we actually did use from that are these aggregated values and we provide those here in this table and they are available in the TSD.

We do not use any other data that is provided from this survey, only the data that is reported here.

MR. BROOKMAN: Dave Schroeder?

MR. SCHROEDER: This is Dave Schroeder. Did you ask decision analysis if this aggregated distribution level data was available?

MR. FRANCO: Yes they do have this aggregated data. It might not be all different factors that you might want to consider but I'll go through the payback you have to match that to what is available from RECS so that's what's the complexity in terms of matching that data to the RECS data.

It's about choosing to match the aggregated data as shown.

MR. BROOKMAN: Steve?

MR. ROSENSTOCK: Steve Rosenstock, EEI. Again I'm looking at this diagram. Shouldn't it say that the payback is less than 3 years if they are going to switch or are they more than 3 years?

MR. FRANCO: I'll go into that. It's a little bit counter-intuitive and I'll go into why that is as we go, thank you sorry.

MR. MCCRUDDEN: Charlie McCrudden, ACCA. Way back on slide 29 sort of at the beginning you had a payback period life-cycle cost in yellow right here. This one has payback period of a 3.5 years, that's some kind of determination. How did you come up with 3 years and is that a payback period that DOE looks at or is it just --

MR. FRANCO: I'll go through in more detail about the actual calculation what that means and hopefully that will explain your question, thank you.

MR. MCCRUDDEN: Okay.

MR. FRANCO: So the decision analysis or home comfort survey data is provided here on this table on the -- on your right so essentially the nominal values are what they represent is the answer

to this question. The question is what are consumers willing to pay for 25% higher efficiency equipment so this could be, this is HVAC equipment so this is the central AC gas furnaces, any of that type of equipment.

Responses, obviously there is a distribution -- in terms of the responses this is the aggregate value that they are willing to spend compared to not having this 25% efficiency. We use as much data as available, these are all the surveys that are available from 2006 to 2013 and we convert that to 2013 dollars.

Next we compare that to what's the average cost that people pay in terms of energy costs, in terms of central air conditioning and heating in RECS 2001, 2005 and 2009 that matches this period as well.

We convert that from nominal dollars to 2013 dollars and we get this 906. The equation to calculate the 3.5 year payback is provided here below and this results says you can see it is 792 which is what consumers are willing to pay for 25% higher efficiency, 25% of that value in terms of energy costs and you get a 3.5 year payback so that is the basis for the 3.5 year payback.

That's how much they are willing to pay to go to higher efficiency non-weatherized gas furnace. In the analysis I know there's a question, in the analysis therefore we assume that if the payback is higher than that there will be switching so that is why the payback here is greater than 3.5 it is when they are switching.

If it's less than 3.5 there is no switching so hopefully that clarifies that question. When you bring two additional conditions then to this to finalize our analysis. The first condition is that the total installed costs of the alternative needs to be less than the non-weatherized gas furnace installation cost. So if that isn't the case there's no switching so that's our first condition. So this alternative has the total installed cost has to be less than that.

The other condition is that if the payback is below zero meaning that the alternative actually has greater savings in terms of energy costs, there is also switching. This is the case for example if you are in an area with low electricity rates compared to natural gas and then potentially your heat pump will be more cost -- there will be more cost savings from the heat pump option.

This describes this and I know there are a number of questions so I will stop here and answer your questions.

MR. BROOKMAN: Mark?

MR. KREBS: Yeah in the opening page or so of the official federal registered NOPR you know it shows a simple payback of 7.2 years you know along with an average life-cycle savings of this $305.00. You know I'm just suggesting maybe in league with Einstein's definition of doing things as simple as possible would DOE consider just straight going to a payback criteria? You know I mean and if something is better than a 3 year payback, you know I for one I'm not going to contest it, I am going to consider that in my customer's best interest and stay away from DOE you know.

Is that a possibility to consider you know that we go to something totally different than this life-cycle costing thousands of pages of complexity you know, can we do that?

MR. BROOKMAN: Thank for the comment Mark.

MR. KREBS: No, I appreciate you know is it doable is it within -- is it even within -- I mean as the secretary determines with that language, isn't it within your capability of doing this or are you prohibited from doing it?

MR. COHEN: This is Dan Cohen from the General Counsel's office. There is an authority within EPCA that allows us to do it -- essentially what you are saying is a three year simple payback?

MR. KREBS: Well I know there is a rebuttable -- I know that and here's 3 1/2. In the spirit of compromise I am willing to go to 3 years.

MR. COHEN: But just to be clear that already kind of goes around the other 7 factors in the statute right, it's just a simple determination honestly your payback.

MR. KREBS: I'm just -- you have the flexibility to do it if you want, that's what I am hearing unless you tell me different.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: Just an observation, I mean, I guess I'm sitting it is probably irrelevant, but I am scratching my head saying okay you posed the question or you presented this as willing to pay for a 25% higher efficiency okay. Well if you go -- if your baseline is 80% AFUE and you go to 92 that's 12 point gain over 80, that's a 15% increase in efficiency so I am trying to think, okay, so why this particular question when in fact the situation we are analyzing or trying to analyze is much closer to what would the consumer be willing to pay for a in my example of a 15% increase in efficiency?

This just strikes me as odd.

MR. FRANCO: Thank you very much for that comment. Just a reminder we did not design this question and this is just a question that was designed not on our intent and this is what they asked in terms of the 25%. There isn't a survey that would go into that detail. There are other surveys that provide -- sometimes you ask people if maybe the energy cost is less than that. Usually, the payback if it is a little bit less they are thinking that they need to pay usually greater.

So this might be conservative, potentially in that sense looking at other surveys, but this is the survey data that we have and we feel that we have found that it has the most data. Please provide a comment in that regard to --

MR. STANONIK: I'll provide a comment now, I mean I don't envy the task that DOE has okay and we have certainly gone back and forth about how you would like to have the best data you could get and some of that might be in our hands and some of that we can share and some we can't or whatever, but my comment is, okay, so in some cases if you don't have good data then I don't necessarily agree that in all cases then you grab whatever might be there because, say in this case, this is the question they asked and I would say but this question really doesn't have relevance to this rulemaking and so I think in some cases my comment would be sometimes then don't use whatever is the available data because it just doesn't fit.

Don't pound a square peg into a round hole.

MR. CYMBALSKY: This is John from DOE. So I disagree with the foundation of your statement that this doesn't apply. This is actually just saying what the willingness to pay for efficiency is. If it says 10, 5, 15, it gives a number right, it's normalized so it's perfectly reasonable.

MR. STANONIK: I was asked to give a comment so I was. And by the way I wasn't good enough to -- I wasn't staying for that comment either.

MR. CYMBALSKY: Thank you for that comment, we only thank you for good comments.

MR. BROOKMAN: Dave Schroeder?

MR. SCHROEDER: That's a difficult question to follow but I am curious why in all of the rest of the LCC's spreadsheet and the NOPR the word payback means what I believe to be the traditional definition of payback, meaning the time after which you start to recover money and in this case if you follow the logic in the LCC spreadsheet that is not what payback means.

Payback in this case means the time after which consumers begin to lose money to operational cost increases relative to the baselines, so could you comment on why you mixed those terms? I mean, even within this one spreadsheet they are mixed.

MR. FRANCO: Thank you for that comment. I appreciate that, we will try to define that better and I can see that could be misunderstood because they are using the same term we will correct that, thank you.

MR. CYMBALSKY: So on this slide, Dave just pointed to the questions we think we have addressed. So we think priority questions B and D and questions 1, 2, 3, 5, 6 and 7 in the related to fuel switching have been addressed so if not, please --

MR. BROOKMAN: Dave Schroeder?

MR. SCHROEDER: This is Dave Schroeder I think --

MR. CYMBALSKY: I think we are going to get to C eventually.

MR. FRANCO: Yeah let me know if I don't get to it in my next slide. This I think has a couple of responses. This provides -- this is the next slide to kind of go over a little bit about detail, not too much due to the time constraints, but this presents the summary of all the inputs. There are more details in the TSD compared to what is shown here. This gives you the -- how we determine the cost for the electric furnace, central AC and heat pumps, the price trends of these two, all the installation and maintenance costs that we assume when we got that information in terms of the value in terms of the energy use, we are using the latest energy efficiency standards that would be applicable during that period of time 12/21 and also the lifetimes.

As you can see, most of the data comes from previous rulemakings that DOE has conducted for this product. There were a couple of questions in relation to these, which I will go through in more detail, that are related to first electric furnaces. For electric furnaces we didn't have direct data similar to what we do in terms of the manufacturer cost.

We have a value that comes from RS Means and there was a question why we multiply that times 3. We assume that the markup for that equipment would be around 3 and so we divide the RS Means value by 3 to get the manufacturer, the manufacturer production cost.

After we get that value then we use our general markup distribution to that value, that single value to become comparable to the other values, so that is the answer to the first question. There was another question related to the electric water heaters in terms of the differences between natural gas water heaters and electric water heaters. Usually the market, if you are purchasing between electric water use and gas water heaters, electric water heaters are usually cheaper in terms of the manufacturer costs.

Here though, we are considering the case where we are having to switch from natural gas to electric water heaters so we have to include the fact that the major cost is due to the fact that we have to do installation costs in terms of potentially adding electric outlet, potentially doing some work in terms of the electrical panel, and those costs are added in.

In addition to that, when you are going from natural gas to an electric water heater you might have to size that a little bit to a larger size. For example, if you start with a 60 gallon gas water heater you might have to go to a 50 gallon water heater because you want to get the same output out of it, say to take your showers.

So an electric water heater would be 50

gallons, natural gas would be 40 gallons. We take that in counter analysis as well. The details are provided in the TSD. Please submit anything that you feel that needs some further clarification.

MR. CYMBOLSKY: So I think on this one for the docketed questions we think we have 3, 6 and 7 from the questions asked previously and not answered by DOE.

MR. FRANCO: Do we have any questions?

MR. CYMBOLSKY: If we didn't, please ask it.

MR. BROOKMAN: Neil go ahead.

MR. LESLIE: This is Neil Leslie, GTI. Maybe you did, so the simple question I guess, why was the uniform distribution chosen for remaining lifetimes for cooling and water heating equipment?

MR. FRANCO: Yes, thank you for that. That question actually relates back to how we account for the remaining lifetime of the water heater. There is no data in terms of when the furnace fails -- what's the age of the water heater -- so we assume kind of a uniform distribution -- we assume, well it's between

1 and 13 years once the furnace fails.

If you feel that maybe something else could be better to represent that please let us know.

Thank you, so now this is the final slide for product switching in terms of the result -- so these are the results of the switching and as you can see here they vary between North of the country and between the national standard levels. So as you go to a higher efficiency standard levels the switching goes up, which follows what you might think.

You also get switching to electric furnaces and heat pumps that are disaggregated in these figures. All the way at the bottom there is also the switching that occurs between the gas storage water heater and the electric storage water heater and those values are there.

MR. BROOKMAN: Don Brundage?

MR. BRUNDAGE: Don Brundage, Southern Company. I think your numbers on switching to electric furnace are unrealistically high. Even in the South, meaning rest of the country, it is rare at my company to have a destroyed electric furnace.

They have actually been banned in single family housing under the building code for about 10 or 12 years. What is especially puzzling is the percentage numbers looking at these between electric furnace and heat pump, it appears to be about the same percentage in the North picking electric furnace over heat pump compared to and rest of country and with the higher heating loads that would seem to be very counter intuitive.

I would expect lower numbers choosing -- much lower numbers choosing electric furnace over heat pump in the South and very minimal choosing electric furnace over heat pump in the North, thank you.

MR. FRANCO: Thank you so much for those comments. Let me just go through two additional things that might help on this. We did assume in the energy use the efficiency of the heat pump to vary between regions. In the North, even though the sea level is the same in the North, efficiency drops because of the climate conditions.

In the South the efficiency would be

greater so that it counts for some of the numbers how they play out. Also you need to consider that these numbers are aggregate for the North. There are some situations in the North where electricity prices are fairly competitive with natural gas.

One such situation is in the Pacific Northwest, so those are considered if you look at the actual disaggregated numbers by region. For example, in the North you would see that as well.

MR. BROOKMAN: Rick Murphy?

MR. MURPHY: It's Rick Murphy, AGA. Victor this chart here do you also have that broken up between replacement and new construction?

MR. FRANCO: This between replacement and construction, yes. I think it is in the appendix D -- if not, it would be D and I but I think it is in the appendix and broken down as one of the actually, that's one of the major inputs to the NIA analysis, we put it down by new construction and replacement part.

MR. KREBS: Victor Mark Krebs again with Laclede. In this chart especially are we looking at

-- we are looking at replacements and clearly it says so right there, you know what about new construction because I think fuel switching is a really different scenario in new construction because they don't have all of these, they don't have to do a lot of work upgrading their electric service panel, you know.

They just simply go with the next bigger size you know, they -- by your own calculations I think you show a savings in construction costs by not having to build a constructive flue so you know I think that the switch might be total, you know is my point. Heat pumps with electric resistance or heat pump water heaters perhaps you know and everything else you know there will be no gas service in which case what are the environmental impacts of that.

I guess you know raise that as areas that you know it is kind of hard to determine how you are separating this out you know in all cases. Let me just ask you flat out -- you know is there a set percentage of the market that you -- that's new construction in your papers that I have been talking about all day -- you -- say you assumed 25% you know, is that similar here?

MR. FRANCO: That's correct, so just to reiterate this is the household by household. The building sample 25% is assigned to new construction. That's then you can disaggregate those results and sorry about that that's a good clarification. These results are only for replacements. There's a similar table in the TSC and I'll point to the page that has the new construction results and all the analysis, new construction is obviously very different, very different considerations.

The page for this is page 22 and 23. On page 22 this table is 8J43, which is the residential results and 8J.4 is the new construction results, sorry about the clarification.

MR. BROOKMAN: Harvey Sachs?

MR. SACHS: First I want to thank Mark Krebs. I am agreeing with essentially everything he said that new construction is battleground and that leads me to the question for Victor. In your consideration heat pump case were you considering the sort of classic all American air source heat pump or were you considering some of the newer BRF equipment?

MR. FRANCO: This is just the regular source of heat pumps.

MR. SACHS: So we are certainly seeing the beginnings of substantial market transformation in a couple of northern areas where they are finding capacity maintenance with variable speed compressors down to speeds below zero and seeing relatively high HSPF values or better yet COP values under these conditions.

This may emerge as something that matters competitively far more than the question of condensing versus non-condensing.

MR. BROOKMAN: Dave Schroeder then to Steve.

MR. SCHROEDER: I think you may have tried to answer this question before but I am not sure that I fully understood your answer so I am going to try again.

MR. FRANCO: Thank you.

MR. SCHROEDER: In cases where there is a first cost advantage of the switching option relative to the 92% case the model chooses that option where you have essentially a negative payback as you have defined it.

MR. FRANCO: Let me try to rephrase that. So we compare the non-weatherized gas furnace you mentioned 92% versus the electric option. If the payback is below 3.5 then that -- there's no switching. If it goes negative that, so below zero -- then there is switching because that's the case when you actually have operating cost savings on the electrical side.

MR. SCHROEDER: Okay so if you have operational cost savings and you have first class savings, even relative to an 80% furnace it would select that case as well and it would consider it to be a fuel switching case. You would also have probably a good life-cycle cost savings but I don't understand how that it related to the rule?

Do you understand my question?

MR. FRANCO: Yeah, this is what I mentioned earlier -- we didn't consider the case where you are going from a non-condensing to these other options. If you think that we should consider that's please submit a comment on that -- yeah.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Steve Rosenstock, Edison Electric Institute. Again another option which is not considered is the ground source heat pumps which Harvey was very involved with for many, many years. Geo-thermal heat pumps is another design option for new construction. Anyhow I am looking at all of these numbers and I am just -- it's basically from what I am seeing in terms of when you switch over the water heaters is that it seems that it is 20% or switching to electric heating source that another that 2 up to 4% of that, 20% or up to 35%, basically about 20% of those are also -- they are also going to switch their water heaters as well.

And again I guess you took a lot of things into account, I just you know especially for over 55 gallons we are going to have to go to a heat pump water heater, I definitely have to agree with Don Brundage of the Southern Company. I think especially for replacements in my mind I think with all the other technology options out there these numbers just seem way, way high and also there is no context of the fact that the heat pumps have increased twice in efficiency and their costs have increased twice over the last 9 years and this doesn't talk about the other side of the equation where people can put in gas equipment rather than heat pumps because of the higher cost of the heat pumps, thank you.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: I think there is one area in this analysis that you need to factor in so you -- in the chart on slide 74 on a national basis roughly 20% of replacement installations are installations where there is no air conditioning.

MR. FRANCO: Thank you, that's correct.

MR. STANONIK: So when this consumer is faced with the choice of replacing their gas furnace and they are presented with the choice that it is only going to be a condensing gas furnace okay. Given that significant purchase and significant change out of the system okay, I think you need to consider that if you know, if they aren't into this situation well what am I going to do and the choice is well we can give you this very expensive high cost installation condensing gas furnace or we can give you a heat pump, which oh by the way will give you air conditioning that you didn't have in the past and as Andrew and I discussed, consumers value comfort and in fact there is a dollar value to that comfort, okay.

If you think about that, that significantly changes at what point the consumer would say from an economic standpoint, oh sure, give me, let's forget that old gas product just give me that wonderful heat pump I will have heated and I will have cool and that will be great because they didn't have cool and there's no question that a standard home in the United States today has heating and cooling and those people who don't have it either can't afford it for whatever reason or they just haven't got around to it but they sure would like to have it and so I think you have to factor that in.

That the choice might be okay you are either going to have to pay this cost for your new gas furnace or whatever or I could give you this heat pump and yeah it might cost more okay, it might cost more but now your house is going to be warm in the winter and cool in the summer and as we talked there's a value, I think you have to work it in there because it will drive that decision.

MR. FRANCO: Thank you so much. Just to clarify how we did it and what -- we did not consider in that situation the heat pump to be an option if they didn't have a central air conditioner so for example the case would be say, for example, number 4. The options are listed here, they would either have an electric furnace --

MR. STANONIK: And I think that there's a slight error in the analysis.

MR. FRANCO: I thank you for that comment, we appreciate it.

MR. BROOKMAN: Please say your name.

MR. DRUMHELLER: Craig Drumheller representing the National Association of Home Builders. One of the components here that I think is missing with fuel switching -- I represent the National Association of Home Builders, we build roughly a million homes a year and all of them have to make decisions whether you are going to use gas or electric but I think one of the components that is missing here is deciding okay I am going to go to a direct vent furnace so now what am I going to do with my water heater?

Am I going to go with a direct vent gas water heater, am I going to go to a B vent on my water heater, or am I going to go to an electric water heater -- so I think that's a major component that's missing on this -- so you are talking about heating and cooling comfort but you are not talking about water heating and I think that's where a lot of my builders said well that's what I'm probably going to do I am not going to run a dedicated B vent for a water heater -- so I think you should include that in your analysis.

MR. FRANCO: Thank you, we appreciate that comment.

MR. SACHS: Craig this is Harvey Sachs. I think that is an important question and we certainly have some empirical experience which was related to me by a Massachusetts utility that the builders in their area were responding in a very constructive and cumulative even way. What they did is install the condensing furnace and then they installed a power vented gas water heater, low efficiency and then they offered the chimney as an expensive adder so that people could have a fireplace.

Once they had gone to the condensing furnace and the power vent they kept all of the amenity of gas and built themselves in a very nice option that most people chose to go upscale with.

MR. BROOKMAN: I think now we are moving on to slide 78, Dave Schroeder?

MR. SCHROEDER: In the fuel switching logic the model chooses whatever option has the longest payback period and assuming that there is one over 3 years. If there are two over 3 years what's the rationale for choosing the one with the longest rather than the lowest first costs -- because presumably people are considering switching because of first cost issues.

MR. FRANCO: Again to thank you we did not trust that that was one of the questions that you had asked -- that was just a simplification -- we assumed that was the greatest one, please submit comments that you think how that can be improved, thank you.

So these are the results -- these results presented here are with fuel switching so when you see for example 90% a fraction of these results are actually switching to either a heat pump or electric furnace or going from a gas water heater to an electric water heater. This presents a simple payback and the overall system. The next slide presents the impacted consumers and the average LCC savings.

The next slide actually compares the results between without switching and with switching. In the appendix we also provide different scenarios for the switching so you can look at what would happen if there was a difference in switching a fraction in terms of changing the payback criteria.

So you can take a look at that analysis in the appendix 8J.

MR. BROOKMAN: Neil?

MR. LESLIE: Could you maybe explain why the payback period drops when you start to put fuel switching in there compared to without fuel switching?

MR. FRANCO: Thank you for that question and that's a question you have provided. The -- you can think of it as the LCC results that is a distribution. Most of the people that would be more negatively impacted would be in this negatively impacted distribution. If they find this equivalent to be benefitting because they have a lower cost and maybe their operation costs are not that different they would be more positively impacted than if they were with going with the standard.

Because of that the overall payback decreases and the LCC savings decrease. Now if you notice from this slide note that for example the switching -- without switching and with switching fractions are very, very similar so they are still pretty much being negatively impacted but they are less negatively impacted on average.

This does not mean that all households are not more negatively impacted -- say for example they decide to install electric furnace, maybe over the lifetime they will have significant operating costs but on average the payback does decrease and the LCC savings on average increase.

But this analysis is done household by household, so household to household they will be both negatively and positively impacted, does that answer?

MR. LESLIE: Mostly I guess -- my other part

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of this is when you run it, with and without switching them, is it expected that a different house will be impacted with in the without switching version compared to with switching? In other words, how do I get from the 9 to the 7.7 using the same house or is it a different house that wound up winding up having a net cost or is it the same house with a net cost but that when you switch then you accrue a benefit by switching?

MR. FRANCO: So one feature of Crystal

Ball and again it's a little bit technical, but one feature of Crystal Ball is they can actually sample -- if you do different scenarios -- you sample the same household, so what we do with and without switching, you are sampling the same household so essentially what you are doing is in this area with product switching the household that switched for example will choose a heat pump and that's the -- the benefits in terms of the heat pump going from 80% that they wish to install and not having to install a heat pump and the results without switching that same household economics are going from because there was no switching it would need to go to the condensing, that's 90% or 92% whatever the standard, wherever the level we are looking at.

Hopefully that answers.

MR. BROOKMAN: Mark Nayes, I almost dropped you out, you are next, please go ahead.

MR. NAYES: Yes, I want to go back to the inability to install certain condensing furnaces and certain condominiums. I can get about 99.9% of homes install a condensing furnace just by being able to be creative but there are certain instances where like in a condominium if you are on the lower level and you have a vaulted ceiling, there is no wall you can go through to vent out you are going to have the vent going through your kitchen table, it is going to go through your dining room window.

If you want to go through a different wall you are going to someone else's living space and we are not allowed to do that so what am I supposed to do in that instance?

MR. BROOKMAN: Did you say 99.9, it works?

MR. NAYES: I can get it in just about every instance. I can put a condensing furnace in just about any home out there but there are some that it doesn't matter what kind of money you put at it, what kind of costs I put on it I cannot install it according to code.

MR. BROOKMAN: Okay thank you. Bud Miller?

MR. MILLER: Thank you, Bud Miller, APGA. A number of times today the speakers indicated that he would in the next generation revise certain things to account for things that have been said in questions and answers today. So my question, whether it is of the speaker or you, John, is when will we see this new iteration? Will it come with full explanation and we will then have a revised comment period to respond to that revised iteration?

MR. COHEN: Yes, I mean we are going to have to look into this and talk it through really, it depends on what the changes would be right. If they are just sort of clarifications or corrections or whatever we could just put another new version of the spreadsheet in it doesn't really change the basic thrust of what is up there now.

MR. BROOKMAN: So that was Dan Cohen.

MR. MILLER: And this is Bud Miller. Hopefully if you do put up a new spreadsheet A -- you will tell us about it, and B -- you will explain it because we have had that problem in the past and then we will have to decide if you don't provide a new comment period whether to ask for one depending upon what we see in terms of what you post, but notice is very important in terms of when you post it and what it reflects, what changes it reflects, thank you.

MR. CYMBALSKY: So before we move on so I just wanted to recap for the benefit of the questions for docket. We think we have got questions 1A and 4 in the section noted as previously asked and not answered. We also think we have got question 1 related to installation costs and question 5 in the previously asked and not answered, okay just to keep that.

MR. BROOKMAN: Okay we are going to press on here.

MR. FRANCO: This next slide and John will present it.

MR. CYMBALSKY: So I will take this one. We want to throw a few slides in here just to compare the AGA analysis that has been out there, it is actually in our docket as well compared to what we have here in the NOPR so we just threw a couple of slides up here to show that. I am not going to read through here but you could see what we believe to be the AGA assumptions in their modeling and so you can see them there. If we advance the slide we could see what the key differences here are so really when you look at the analyses we have several levels of fuel switching in both.

What really matters is when you do switch my recollection is where it switches like in what region of the country what the heating load is in that switching situation and then all of the economics that play out in terms of what we used in our analysis which is what we presented here, the prices that the AGA analysis has, how carbon factors and things such as that change over time to get the environmental benefits.

But you know we think that you know everything that we have done in our fuel switching analysis clearly has taken some good comment here today but again we think the level of switching is similar it is just you know what house switches and where the house is and what the heating load is gets you to a different answer in both of our studies which is kind of a high levels.

MR. FRANCO: This answers a couple of questions from AGA I think.

MR. CYMBALSKY: Yes, that is question 1C on the previously asked and not answered.

MR. BROOKMAN: Steve Rosenstock?

MR. ROSENSTOCK: Just a very quick -- I have not had a chance to see the AGA study. I know you said it is on the docket. On slide 81 these conclusions, which I would love to look into deeply, are these annual figures or over 30 years? And there are conclusions are those 30 year numbers? Annual? Well I would have issues with a couple especially the emissions thank you.

MR. BROOKMAN: Okay.

MR. FRANCO: So the next final piece of the LCC is we do a subgroup analysis we take a look from our sample of people that would be in the low income or senior only. The results presented here are the comparisons between the senior or low income of all consumers.

The next slide just to finalize if there are any additional comments for the LCC then we will move on to the next.

MR. BROOKMAN: Yes, Mark Krebs?

MR. KREBS: Just one real short -- just to reiterate what the comments in the furnace fan rule from Sophie Miller that states that for those low income groups you are vastly understating the discount rate.

MR. BROOKMAN: Okay thank you, Mark Nayes has a comment -- it's a question in fact. If this is designed to save energy why is the entire building mechanical not being considered as a whole?

MR. FRANCO: The standard is only for furnaces we only considered the furnaces on this analysis, thank you for the comment.

MR. BROOKMAN: Frank Stanonik?

MR. STANONIK: This last slide -- hopefully in one or two sentences you can explain how does the average life-cycle cost for a senior only become higher than for the nation? Wouldn't they have the same installed price, cost of the furnace?

MR. FRANCO: This relates to the distribution of these furnaces throughout the country and the appropriate discount rate and so there's a lot of economic factors you would have to look into exactly the distribution of these and economics but they are all -- everything is similar in terms of the assumptions and this is the results of that.

MR. STANONIK: Follow up, Frank Stanonik, AHRI. If that is true then why would you look at senior only as a separate sub-group? They have to have some significant changes and I guess I'll go look at the TSD.

MR. FRANCO: Thank you for that comment.

MR. BROOKMAN: Neil?

MR. LESLIE: So I know we are all getting very close to the end of the day here. First of all I want to express my appreciation for the efforts you all put into doing your best to answer questions that are very thorny and maybe somewhat very challenging. I appreciate the efforts and it doesn't matter whether we agree or disagree with the answer what I appreciate is the fact that you worked hard to figure out an answer to them.

I have one last one sitting in here -- I think aside from the West Virginia thing, you already did it, thank you I was somewhere else at the time even if I was here.

But I have a challenging question in here in that I'm not sure what's equitable and how we get at equity so it has to do with question number 4 on the overall sheet and I am going to just ask it again and if you feel you have answered it in the best way you can, okay, but I am struggling still just a little bit.

So the question is and they are both important. How are negatively and positively impacted homes segmented? North, South, new construction replacement, different options in different home locations and sizes and configurations as well as other factors that would impact consumer classes differently -- our concern is that the averages continue not to show the impact on marginal effected consumers both positively and negatively.

I am not sure how to address that right now but as you had offered to do your best to answer all the questions that were on here I believe that is the very last one I see that is in play in my mind right now.

MR. FRANCO: Thank you for that question.

Kind of -- it was answered throughout the presentation. Basically what we do is we segment the market in terms of new construction, replacement in the building sample, in terms of the building sample. Once we produce the aggregate results the average of all the 10,000, so for example, if you want to only look at the results for the South out of the 10,000 that represents 4,701 households.

The disaggregation between of that -- between new construction and replacements would be 1,161 and 3,500 so you can actually if you had all the 10,000 they will all be there in terms of they are all disaggregated and all the inputs are representative of what they should be for new construction versus replacement. Hopefully that answers.

MR. LESLIE: It's almost unanswerable I know but the hope is that if we can identify and this may be for some of the other folks that may be having some discussions, different sub-categories that matter. And that is what I was trying to get at, both positive and negative not just negatively so that people can appreciate and understand the impact on different classes of consumers.

Locationally and size of home, income classes, whatever type of granularity as you said there is a lot of information in the 10,000 data points and of that large set of information there was a certain subset that deemed to be appropriate for the rulemaking.

The concern that we have is that there may need to be some additional granularity in this for a good equitable rule.

MR. FRANCO: Thank you so much for those comments, I appreciate it.

MR. BROOKMAN: Questions? Go ahead please.

MR. DRUMHELLER: Craig Drumheller representing the National Association of Home Builders. These are just kind of my final statements so that some of them are similar to what Neil has just indicated.

They are very concerned that a large section of the population will be negatively impacted by this rule. Warmer climates, less expensive gas areas, replacements especially those that exist in finished areas. The analysis, just like any analysis has a series of assumptions what I call knobs and it appears that all of these knobs seem to be turned in one direction.

The low discount rate -- we believe this is unrealistically low. Consumers based on their willingness to pay and alternative debt that they have the discount rate should be closer to the 10, 12, 14% range. Energy cost escalation rate you know historically they have been -- it has been much flatter than is typically predicted by the Department of Energy and projected material prices -- again all of these knobs turn in the direction that overestimate the payback.

While the consumers are typically willing and these are surveys that NHB has done over and over again about a 7 year payback, NHB adjusted their policy a few years ago to say you know what we will go to a 10 year payback but it is not really what the people that buy the homes want. They want 7 but we went to 10 just so we could be involved in some of the conversations.

And DOE's numbers in a lot of cases go above 12, 13, 14 years which is unrealistic especially for a piece of equipment that your estimates says 21 years and some of ours are even closer to the 18, 16 year range. That's cutting it rather close. Everybody needs to keep in mind this is a minimum standard, everybody has to do this we are not talking about Energy Star we are talking about everybody must comply with this and we think that this is overstepping.

Corrections to this problematic requirements may be bifurcated standards maybe for condensing and non-condensing and have separate categories and separate requirements for each category, potentially having regional North/South requirements and in addition having exemptions for replacements.

So hopefully you will consider that and we will include that in our comments, thank you.

MR. BROOKMAN: Okay thank you.

MR. CYMBALSKY: So at this point I am just going to announce that clearly we didn't reach the finish line so we will see you all again on April 13th to finish the meeting so we will put out an announcement and a blast and do a webinar 9 A.M.

So let's try 10 A.M. because I think we will have some west coasters that may not want to travel all the way back for the rest -- so it is a Monday, April 13th -- yes. We will be here as well so please mark your calendars, we are going to pick off at the shipments and finish the rest of the slides.

And then at that point everyone can do their closing remarks. I really appreciate everyone for sticking around and really this was a great dialogue a lot of good information. I know the material was dense but we got through I think the hardest part so I appreciate it. Thank you.

(Whereupon the meeting adjourned at 4:51 p.m.)

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