Courtney Kendall: Good afternoon. My name is Courtney Kendall from the National Renewable Energy Laboratory. And I'd like to welcome you to today's webinar on the Solar Aspirations and Disinclinations: Learning from 3,600 Households. We're excited to have you with us today. We're going to go ahead and give folks a few more minutes to call in and log on. While we wait I will go over some logistics and then we'll go ahead and get started with today's webinar.

I want to mention that this webinar will be recorded and everyone today is in listen only mode. You have two options for how you can hear today's webinar. Select either use telephone or use mic and speakers. If you select use telephone use the telephone number listed when you log in. It is in the box with a specific audio pin you should use to dial in. We will have a question and answer session at the end of the presentation.

You can participate by submitting your questions electronically during the webinar. Please do this by going to the questions pane in the box showing on your screen and type in any questions that you may have. And our speakers will address as many questions as time allows after the presentation. So before we get started I would like to introduce the speakers for today.

Our first speaker is Ben Sigrin. Ben is an energy analyst at the National Renewal Energy's Strategic Energy Analysis Center. He is the principal investigator of a multiyear grant from the Department of Energy, studying residential adoption of distributed solar. His research focuses on policy, modeling, and market analysis of distributed energy resources.

Our second speaker today is Mithra Moezzi. Mithra is trained as a statistician and anthropology-based folklorist with her graduate degrees from University of California-Berkeley. Most of her work has been at the intersection of people, technology, and energy. Also with us today is Kim Wolske. Kim is an environment psychologist and researcher with the Erb Institute for Global Sustainable Enterprise at the University of Michigan. Her research explores the psychological and social dimensions of energy-related consumer behavior.

Now let's go ahead and get started with today's presentation. Ben?

Ben Sigrin: Thank you Courtney. Good morning. As she mentioned my name is Ben Sigrin and I'm the principal investigator for the NREL-led

SEEDS project. Today we'll present some of the data and analysis completed over this three-year project. The talk today: solar aspirations and disinclinations: learning from 3,600 households is the third and final part of our three-part webinar series. You can find recorded audio slides from our prior presentations and much more content on our website which is: https://www.nrel.gov/seeds.

As the project wraps up we'll be posting additional content to that website as it becomes available, including a condensed version of the survey data presented today which should be released later this summer. Next slide please.

So the talk today will center around two ways that we analyze our survey data. First Kim Wolske will preset what predicts levels of interest in going solar among the general population and how we can use established theorems of psychology and behavioral science to better understand these processes. Second Mithra Moezzi will dissect the various segments of population and what matters to them as they go from interest in solar to consideration to committing to adoption.

And on a personal note I have to say that I'm quite excited for this talk. The content you'll hear today is not only novel, but the research design is very well thought out. This gives us a deep and verifiable understanding of who is considering solar and why, and also what predicts their movement along that decision pathway. Next slide please.

Before we get into the results let me give you a brief overview of our projects. So the SEEDS project was a comprehensive three-year project funded by the Department of Energy SunShot program to understand the drivers and barriers to customer adoption of rooftop solar. Our research team included NREL, Portland State University, The University of Michigan, and several other academic and industry experts in diffusion science.

Though the residential solar market is vibrant and growing quickly and installed costs have decreased over time the costs of acquiring customers remains a stubborn and large component of overall system price. So that was really one of our central research questions: how to improve regeneration and conversation, and particularly when thinking about how the market could transition from a niche to a mainstream product.

Also I wanted to let you know that today's webinar focuses on findings that represent a fraction of our overall work which were documented in prior webinars as I mentioned, and also in other research papers, some to be published later. For now I'd like to hand over the microphone to my friend and colleague, Mithra Moezzi from Portland State University. Mithra please proceed.

Mithra Moezzi: Hello everybody. I can't advance. Oh there it is. I want to give you a little background on the survey data collection. And first I want to say it's really a great dataset I think. It allows a lot of comparisons. That's for several reasons. First we have four different states: two that are relatively new in terms of their solar market – New Jersey, and New York, and two that have much more established markets.

Amongst these we collected over 450 variables. And there were three surveys. One is a General Population Survey where it basically surveyed any single family owner occupied household that didn't have solar. The second – and this is maybe the most difficult to get – is the Considerer Survey. This is people who have actually talked to installers. And we asked them about why they did so and why they haven't adopted solar yet, and then finally the adopters.

And the types of data we collected are listed on the left. There's a big variety here. We did demographics and house types. We asked questions about solar familiarity and attitudes, especially among people who hadn't adopted solar. Values, Beliefs, and Norms. We asked about energy bills and about special uses in the house, what got people to think about solar and what they thought about it.

And then details of the installation, installer interaction, social interactions, and otherwise the decision experiences. And backing all this up we also had a non-survey component which was talking to installers which really helped us understand things as well. So the survey data is very complex and this has implications for how we analyzed the data. These are the three surveys listed along the rows. The General Population Survey has fairly easy statistical properties 'cause it was panelists.

We have fairly even numbers of observations – that's households. For each state. The Considerer Survey was much more difficult and we used both panelists and leads from lead generators and installers. These were uneven across states. And then finally the adopter survey where we used both installers to get their customer

lists and panelists. And you'll see that this is heavily stacked for California because one of our installers did a lot of work there.

So this is great but it also makes the comparisons fairly difficult and the statistical properties are complex. And so we've taken that to account in the way we've done our analyses. Now I'm going to hand it over to Kim.

Kim Wolske: Great. Thanks Mithra and good morning or good afternoon depending on which time zone you're in. So one of the primary objectives of surveying the general population in these four study states was to understand what motivates initial interest in solar. Throughout this project – hang on just a second – next slide. There we go. Throughout this project we've conceptualized the adoption process as occurring through four stages where a household starts not really considering solar at all.

Then something happens where they learn more about solar. They become interested and become a lead at which point of course they can either adopt or not adopt. And the General Population Survey was really focused on this first transition. How do we get people interested enough in solar that they feel compelled to talk to an installer? Are there particular segments of the market that we should really be targeting?

Are there motivations that we can be tapping in our marketing and outreach so that we can more efficiently generate leads and reduce soft costs? So to explore this issue we included a number of questions which Mithra gave an overview of on the General Population Survey that we thought would capture a range of reasons that people become initially interested. And many of these were informed from conversations with installers.

Certainly some people are going solar for environmental reasons and that may especially be true of some of the earliest adopters. In the last decade with third-party ownership and ITC obviously we're seeing much more interest now to get solar because it can save consumers money. And there also seems to be a segment who is pursuing it because it's this new and novel technology. So to explore which of these motivations are really correlated with initial interest in contacting an installer we looked to three well-tested theories of behavior change in the academic literature.

To explore whether people are really pursuing solar out of environmental concerns we're looking at the Value-Belief-Norm

Theory of pro-environmental behavior. And this is a theory that colleagues on our team – Paul Stern and Todd Dietz came up with to understand whether people are pursuing this more out of self-interest, to save money, we're turning to the Theory of Planned Behavior. And then finally we're looking at Diffusion of Innovations to understand whether it's really the novel _____ of technology and the fact that it's becoming increasingly popular if that's what's sparking interest.

So as Mithra showed earlier the General Population Survey was filled with about 1,300 respondents. And the analysis I'm presenting here is a slightly smaller subset. We excluded people who indicated that they had already talked to an installer because we felt that they might actually be at a different point in the decision making process. And on the survey we include two main types of dependent variables.

The first is one that we're calling social curiosity. And this is a scale that was comprised of two items that basically said if your neighbor installed solar how interested would you be in talking to them. Likewise if a friend installed solar would you be interested in talking? This isn't a stringent measure of intention to talk to an installer but it does at least give us an understanding of whether people are curious to find out more.

And then our next dependent variable is much more about interest in talking to an installer. And this was comprised of three items that measured their intention to talk to an installer in the next six months. And it also gauged whether they would want to talk to an installer if one were in their neighborhood or if they would be interested in getting a no cost estimate. So our hypothesis is that these two dependent variables are probably related to each other and that social curiosity may be a bit of precursor to talking to an installer. And the more one is socially curious the more likely they are to talk to an installer.

So our approach for analyzing variables on the survey was to first answer a very basic question of how much can we explain interest in talking to an installed from socio-demographics alone? There is certainly a strong interest in the industry of trying to target customers based on readily-available data that we have in terms of household size and household income. So we wanted to understand what alone can we understand from that. And then we did three path analyses – one for each theory.

And a path analysis is basically a set of nested progressions. Our goal here was to understand how much do environmental motivations on their own predict interest in talking to an installer? And likewise how much does interest in the technology drive interest? I should be clear here. We did not measure every single variable in each of these series. And our intent was not to make these theories compete with each other. We just wanted to understand well if you're only looking at one set of motivations how correlated is that with interest?

We looked at those separately and cleanly. And then in a final stage we did an integrated model to understand how these variables interact so that we can understand their relative importance. With our first model based only on socio-demographics we found it explained 11 percent of variance in interest in talking to an installer. We found that younger individuals in males tended to be more interested than their older and Mithra Moezzi counterparts.

And also households that had higher summer electricity bills, people who are at the lower end of the income spectrum, as well as people who'd experienced more power outages in the last 12 months. What's interesting is as we started to add other psychological variables only age and gender tended to remain significant. These other financial factors fell out.

So our first theory: are people pursuing solar because it's an environmentally friendly behavior? We based this on the Value-Belief-Norm model. For those of you who aren't familiar this model basically says that people will engage in environmental behaviors like getting solar if they have strong altruistic and environmental values. The theory says basically people who hold strong environmental values are more likely to be aware of environmental problems, feel a sense of responsibility to address them, and in turn form what we call a personal norm, or a sense of moral obligation to do something about the problem.

So by this theory we would expect that people who feel a stronger moral obligation to the environment would be more socially curious and more interested in talking to an installer. Like I said before we weren't able to measure all variables so we only have the bolded ones here. And when we did the path analysis we found that it did have explanatory power.

As provided, this diagram for those of you who like to get into the weeds of regression, these are standardized coefficients. For those

of you who haven't seen a diagram like this before this is basically showing the strengths of relationships between variables. So I've drawn lines only where there is a statistically significant relationship and a bigger *[inaudible comment]* stronger relationship.

I've also highlighted in blue the variables that remain significant in the final model predicting interest in talking to an installer. So we see here that sure enough people who have stronger pro-environmental norms are basically more socially curious and more interested in talking to an installer. So this entire model explained about 35 percent of variance in interest with the VBN variable explaining an additional 11 percent above the household constraint.

Our next model is based on the Theory of Planned Behavior. And this is really a rational actor type decision making model that basically says people are weighing out the pros and cons of something before they decide to engage in a behavior. And there are three types of considerations that go into that process. One is their beliefs and attitudes about the behavior – so what type – What do they think solar will do both good and bad. And what attitudes do they form about it?

There's also a social element here of taking into consideration what you think your peers, friends, and family might think about you getting solar. Would they be supportive or opposed? And how much do you care about complying with what they want? So as a shorthand it's sort of a feeling of social pressure. And then there's this final element of people's perceived ability to act, or in the theory we call it: perceived behavioral control.

So we measured a number of different attitudes. Personal benefits included items that measured whether people thought solar would benefit them financially or whether they thought it would prevent rising electricity costs. And in general if they thought that solar was something that would help meet their family's needs. We also had items about the perceived environmental benefits of PV, perceived risks in terms of damaging home. Or is it just generally a risky thing to do?

We had a few items that measured whether people thought it would be better to wait because they thought PV – the technology might improve. And then of course we had some items that captures whether people thought it was too expensive or outside of

their budget. To measure sort of this social pressure idea we had several items measuring whether they thought their family members would be in favor of or opposed to solar and whether they thought their friends and neighbors would be supportive.

And then finally to measure their perceived ability to adopt we had items assessing whether they thought their homes were suitable. And this isn't just about roof quality, but do they think they live in a place that gets enough sunshine? And then finally we asked an item to measure whether they thought they might not reap the benefits of solar because they could be moving in the near future.

So when we tested this model we found that the strongest predictor in talking to an installer was whether they thought it would benefit them personally. There were then three other variables that were about equal weight in terms of their predictive power. One of those being concerns about costs which as you might expect was negatively related to interest. The more people thought others would support them, the more they were interested in solar.

And then somewhat unexpectedly we found that people who thought their homes were unsuitable were actually more interested. And this seems counterintuitive. My explanation for this is that because we were surveying people in four states that have some of the largest solar markets it could be that as people are starting to see that as people are starting to see solar crop up in their neighborhood or community they're kind of curious. They think their home may be unsuitable but they actually want to get confirmation that it is.

So overall this model explains slightly more variance than the Value-Belief-Norm model which is something we would expect. These items were much more specific to solar than the items that are used in the Value-Belief-Norm model. So our final model then looks at Diffusion of Innovations. Just to be up front I've really only captured a slice of this whole theory. But Diffusion of Innovations basically describe the process by which new innovations are adopted and makes the claim that in part the first people to adopt an innovation like solar are going to be people who are less _____ and who tend to seek out novel and new products.

And then it also argues that adoption of an innovation and the diffusion process are sped up the more people have favorable perceptions of the technology. So do they think it will be advantageous compared to the status quo? Are those perceived

risks? Is it something that they can try out before adopting which is obviously a bit of a hurdle with solar panels? And there's also a characteristic of observability which is: can you see that others have successfully adopted this technology?

We tested a model – and this is much a spider web of relationships. But again we're seeing the same theme that the more advantageous or beneficial that people perceive solar panels the more likely they are to be interested in talking to an installer. And we also see a strong relationship for consumer novelty seeking. So even after controlling for how beneficial you think solar is those individuals who are just naturally drawn to new and novel products are more likely to be interested.

We also see smaller positive effects for observability and this other measure of consumer innovativeness. What's sort of interesting to point out here is look at the predictors that are for social curiosity and you start to understand how those two measures are different. It's really the innovative consumers who are most likely to talk to an installer but for people who are socially curious that's really predicted more by PV seems a bit risky. And there are people who have a strong need to want to try something out.

So they may have more reservations and want to learn from others who've adopted solar first. This model is similar to Theory of Planned Behavior, explaining about 45 percent of variance. Overall, looking across these three models, we see empirical evidence that yes people considering solar because of its environmental benefits. They're evaluating it as a consumer good and determining whether it will meet their needs.

And they're also pursuing it because it's an innovative and increasingly popular technology. But there's this question then of how do these different motives relate to each other? Certainly someone can be interested in solar both because it saves them money and it's good for the environment. But what type of marketing message is going to be more effective? To help answer this question we proposed an integrated framework for understanding why people become interested.

And I find it easiest to explain this by working from right to left. We have our dependent variables, interest in talking to an installer, which we assume is influenced in part by they're curious to learn about other systems. Two dependent variables are most directly influenced by very specific beliefs and attitudes that people have

about solar. Do they think it will benefit them personally? Is it risky? Do they think they can afford it? Would others support them?

These beliefs and attitudes in turn are influenced by two different factors. One is sort of external influences. And I should note here that we added three additional variables to our model based on what we were hearing from the industry. So we would imagine that people's beliefs and attitudes about solar are going to be influenced by how much they're seeing it pop up in their neighborhood, by the marketing and advertising they're exposed to as well as how much they trust the information they're getting from the industry, and how much they trust information in their social network about solar.

The other factor that can influence these specific beliefs is something we're calling person disposition. We can imagine that people who have stronger pro-environmental norms are more likely to see solar in a positive light. And the same could be said of people who are naturally more innovative. They're likely to see the risks of solar as being lower than people who are less innovative. And then finally we have values as a set of variables that feed into one's personal disposition.

So we tested this integrated framework again through a path analysis and it increased the R^2 – so slightly more explanatory power. Drawing a web with all the significant coefficients would've been impossible to interpret. So I've just highlighted in blue the variables that remained significant in the final model. Once again we see that personal benefits are the strongest predictor of interest in talking to solar other than social curiosity.

This is followed by that measure of innovativeness, how novel – how much do people seek novelty? And we also see that trust in the PV industry is important. I've highlighted some other variables in green italics. These are variables which while they were not significant in the final model; they have strong total effects – meaning that they're indirectly influencing interest by affecting other in-between variables.

So for example we found somewhat unexpectedly that people who have strong environmental norms were actually more likely to think that solar could benefit them financially. It still suggests that this is something to consider even though it's not significant in the final model. What does this all mean in terms of how we reduce

soft costs for lead generation? I think there are some messages here about who, what, and how to target consumers.

So certainly we seem to have evidence that we're still in that early stage of adoption where solar is more appealing to people who are innovative in their consumer purchasing. So this might suggest targeting customers who are early adopters of other technology, perhaps people interested in smart home technology for example. There is also evidence that we might expect environmentally conscious households are more predisposed to be interested as well.

And I would caution here that this doesn't necessarily mean we need to target these consumers with environmental messaging. In one of the models we had a variable for environmental benefits of solar. And we found that it actually was not correlated with interest. So it's not the case that we need to demonstrate to people that solar is good for the environment.

Rather we need to help people see how PV aligns with their values, but perhaps then demonstrate how it can also work with their personal finances and other household needs. And that's really the second point here about what type of messaging we need to show people how PV meets their needs and addresses their concerns. And the how then really gets at the importance of having trusted information sources.

And our final model: trust in the PV industry was one of the most significant predictors. And we also see the strong role of social networks. Social curiosity was a strong predictor of interest in talking to an installer. So it suggests that we need to better leverage referral programs, those Tupperware style parties. This also though has implications for how we structure incentive programs and policies. It needs to be very obvious to people how solar can benefit them.

And right now we have a situation where there are many different wonderful incentives that someone could tap into. And while perhaps going to a leasing model helps alleviate some of the confusion of sorting that out. Most consumers really don't know how to make sense of the information that's out there. So the more we can simplify this to make clear that solar is beneficial the better.

With that I will hand this back to Mithra who will talk more about learnings across the three surveys.

Mithra Moezzi: Thank you Kim. I first want to acknowledge my close collaborators at Portland State University: Aaron Ingle and Loren Lutzenhiser, as well as the Survey Research Lab. And of course everybody on the team helped with this analysis. So compared to what Kim did I'm adding two more surveys: the Considerer Survey and the Adopter Survey.

So I have a nice big dataset. And one of the first things that people usually do with a nice big dataset with many rows and columns is they model it, build regression models and other sorts of models. And this can be very useful. But in this case we chose not to analyze the data this way. And there are a few reasons for that. One practical one is that the data are very complex statistically and it would be hard to actually meet many of the requirements for statistical significance and statistic qualities. I'm talking about all three of them together, not the GPS which is something different.

But maybe the more interesting reasons that we chose not to do it this way is that models can tell a nice, compact story. But they also hide a lot of things. They tend to see things as averages and they can't see niches and segments as much. And they also would not use so much of the data. As I said we have over 450 variables. And these are things that can't be seen usually in a model.

And so especially to help direct other stories here – tease out other stories – I want to do sort of a descriptive and interpretive analysis of some of these variables. And part of the reason I want to do it this way too is I think it also helps actually talk about things. Maybe there are little bits or little clues or sorts of small data that can help us all communicate a little better. *[inaudible comment]* to industry, the installers, the policy makers, and the researchers aren't seeing things the same way at all. So with this kind of perspective I hope that we can continue to talk in a way that makes sense. And you can all share.

This graph – this figure – shows again the three surveys. The GPS that Kim just talked about is on the left – General Population Survey, then the Considerer Survey and the Adopter Survey. And as Kim did we've divided up the General Population Survey into a few different segments. And I'll talk a bit more about that. But there are the people who have thought about installing solar and

haven't thought about installing solar, and even people who have talked to installers – which are similar to the considerer group.

And we use this distinction between people who haven't – aren't interested in solar at all – to the people who have adopted solar to help tease out some of the contrasts. So the question is what can we learn from early adopters and what caution should we bear in mind? On the left I have a Diffusion of Innovation illustration – which there are hundreds of these. And usually the innovators are called the first 2.5 percent. And we're below that at this point nationally – so not even in the early adopter stage.

So it was 40 years ago in 1977 that science said if there's a dream solar technology it's probably photovoltaics. So photovoltaics have been around for a long time and we know that their interest and installation is growing a lot. But it's still very early. And a lot of the early adopters have been supported by subsidies which makes it a little bit hard to interpret what we can learn from these early adopters to the rest of the population. And also I want to say that photovoltaics are a pretty weird product because everybody has electricity in the United States.

And for the most part it works pretty well. There are very few blackouts for most people. And it's not that expensive for most people too. So it's something that we already have that works. And secondly there is lots of future uncertainty. It's a big investment and lots of things to worry about as you'll see later. So I want to spend the first part of this talk looking at this 99 percent – the people who haven't adopted.

This slide I've segmented these people who haven't adopted into a few different segments. The people who haven't thought is 38 percent. These numbers might be a little bit different than Kim's. And among those some of them – 25 percent of the total population – seems not to be aware of solar much at all. And then there is also a small segment who seem to be very disinterested in solar, even antagonistic, by some of the things that they've said – not interested at all.

Then about six out of ten have thought about solar they've said. So many people have thought about solar and say that they're interested. But not many have done something about it. And by this estimate we only have 11 percent who said they've actually already talked to an installer. And then in comparison I have on the

bottom one percent or less than one percent of single family houses nationwide who have installed solar – much more in some places.

So on the top we have people who are quite resistant to solar. They don't want to hear anything about it, and then others who seem enthusiastic but really haven't done anything about it. Comparing the people who have not thought about it – that first column – to the people who have thought about it but not bought it we segmented why people aren't interested in or might not be interested in solar using a combination of variables throughout the dataset.

The biggest one is it's not compelling financially. So people think 66 percent of the people who haven't thought about it just think it's not going to work for them. And the second is very low trust in information sources especially around the people who have not thought about solar. So 49 percent of people haven't thought about solar don't trust information. They might trust their neighbors and friends. But universities, government installers, trade organizations, utilities; often the trust is very low.

There are many other reasons that people list. They think that it's better to wait is a big one. And a surprising number of people think their family or friends would not support them. Many people mistrust the technology. So there are just many reasons why people don't do things. And the differences here – I want to point out – are between the people who have not thought about solar and the people who have thought about it and not bought it.

One of them is in the money category. The people who have not thought about solar are much more likely to be not at all interested in savings from it. The people who have thought about it are interested in savings and we see this all the time. It's very much about money – at least on the surface.

So then we moved on to seeing what considers say. And I just want to give you a little texture here. These are some quotes from what some of the people who have considered solar have not bought it yet said. "The market is very confusing," they say. It's, "difficult to determine the best route." And then the second is that people don't think that the financial qualities that they hoped they would get would really work very well for them. They didn't want to wait for the incentives to come.

Or they didn't get the incentives because they didn't have the income that was required for that. And sometimes I think people were a little bit annoyed. They thought the incentives were unfair. And some people are just annoyed by being called by solar companies all the time.

So then we asked these people who had considered solar what their initial concerns were and how much difficulty they had. There are two columns here. One is the people who said they didn't have hardly any difficulty with this aspect. And the other is the people who said it stopped them. So money stops more than half – affordability in particular, but also whether they think the investment is good enough. There are all sorts of other reasons.

And what's interesting here too that I'm talking about – the top part of the table here for now – is that some of the concerns that didn't show up very much for the General Population Survey seemed to reassert here for people who have actually talked to installers. They have new concerns sometimes. Most people have problems with many things. So if you see on the left very few people in most cases have said that they didn't have at least some trouble with something.

We first looked at the demographic and energy use characteristics of adopters and compared these to the General Population Survey. This is a way of comparing to the population in general as if it was the census. And although most of these are quite obvious I think it's also useful to bear in mind 31 to 43 percent had bills that were either summer or winter bills that were over $275.00 a month – far less – less than half of that – of the general population had such high bills. And these ranges are the state ranges across the four states.

Arizona has been an exception in many ways. The income is much lower. And they tend to be older and more retired. So Arizona stands out. The states were quite similar in many ways, but not Arizona. In particular you had low income there. Interesting also as Kim pointed out – this resonates with what Kim had said – the people who filled out the Adopter Survey were much less likely to be Mithra Moezzi than in the other survey. So women are not owning this in a way at least in terms of whether they want to respond to a survey, whether they're the one who thinks that they know the most about surveys.

The question is: is this actually a missing segment in terms of how things are being marketed? Or is it something else? And then also obvious there are lots of pools and lots of AC. And the pool result was particularly interesting because at least according to what people said 30 percent of the adopters had pools. We didn't ask if they were heated or not but this is really a remarkably high number. That's much less than the whole population.

So we thought about decision pathways that adopters might have. And the academic way of thinking about it is this brain on the left, this sort of deliberative way where people start to think they're interested in solar, whether it will save them money or for the environmental reasons. And they start thinking about it in this way and sort of weighing the costs and the benefits and monitoring in that way too.

And this is a hard path because it's very hard to have enough information about solar to actually know whether it's going to work for you or not, at least according to some of the people we've talked to. So these people who think a lot get stuck sometimes. Then a second type of decision pathway we think is more event driven. They might've been thinking about solar some but something happened like they just had a few high bills in a row that they couldn't explain or things to that nature.

And then they used that and solar became much more salient then. And that salience probably took over from this deliberative type way of thinking about things. And then finally – and this we thought was very interesting – was this opportunistic style of adopting solar in which 54 percent of the cases when people said, "What prompted you to consider solar," 54 percent of the case people said, "Well when the seller came knocking on the door and the seller approached me."

Many of them had other motivations but this is very interesting especially if people hadn't been thinking about it before. These are people who might be able to be convinced fairly quickly that solar is good for them without thinking about it a lot. And this I think is especially true if solar is free, if they don’t have any upfront costs.

So here are many ways we might segment adopters but we did it this way. Environment, money, or both, and very few of the adopters seemed to prioritize environment. Three to five percent is our estimate that thought environment was important and money was hardly important at all. Most thought that both were important

but money was more important than the environment. That's 39 percent there. And quite a few also thought they were equal. So here we have 72 percent who thought both environment and money.

And then some people were actually pretty antagonistic about the environment and/or the environmental politics or environmental rhetoric. And this I estimated as six percent there. This doesn't add up to 100 percent yet. And then finally the opportunistic category I'm not sure how much that is. And they might fall into the categories above there too. But it could be 10 to 30 percent. And I'd be interested in hearing what people in the audience think about that.

Here's a sort of simpler way of looking at it too. We looked at people usually had multiple reasons to adopt. The number one reason: lowering your total electricity costs: 78 percent thought that was extremely important. But also in terms of the money it was more complex than that. People wanted protection from rising electricity prices in the future rather than just saving money on their bills. That was 62 percent. And then these two environmental ones were considerably less but still substantial.

Half of the people said being able to use renewable energy was important. And whether this was for energy security or because it's cool to use something free this was quite a few people as well, environmental impact at 43 percent. So here's just a different sort of look at what people said prompted them to get into solar. Looking for ways to reduce bills; almost everybody said that – 88 percent. And here we have also just being approached by an installer – 54 percent as I mentioned.

Most had that and something else but ten percent or said just said approached by an installer. And then also figuring out that solar was more affordable than they thought it was. This is a sort of complicated table but I want to show it to you anyway. The big numbers in the table – the 46 percent and 2 percent – are the percentage of adopters who fell into that cell. The rows are low bills on average or high bills on average. And the columns are low environmental and high environmental.

And I've taken out the middle . People who are moderate aren't shown there. That's why it doesn't add up to 100 percent. So the remarkable thing here I think is that 46 percent had both environmental – high environmental values – as stated and high

bills averaging over $275.00 a month. Forty-six percent were in that category. And when we looked at the disinterested people – the people who weren't interested in solar – they were much less likely to fall into that category. They might have been as interested in the environment in many ways but they didn't have the high bills.

So here's a little more texture. I really like looking at what people said about what they thought about what had happened. And most adopters, especially buyers, are pretty happy so far. As I footnoted there 14 percent of the people who've leased and 9 percent of the buyers stated that they had regrets. And all these people are pretty happy here. One of the things that several people mentioned is that they couldn't believe that it was free. "I tell other people that my panels were free, but nobody believes it. I couldn't believe it myself. I can't understand why people do it."

And then even one person said "We've heard so much bad about solar," which is interesting, but their experience has been great. So we'd like to ask those people why did they even talk to somebody if they had heard so much bad about it. But also adopters didn't always know what they were getting into. And sometimes it was sort of surprising what they didn't know – that there was a true-up bill or that the true-up bill was going to be as big as it was. Or that their PV system wouldn't supply them with power during an outage.

And then I thought this one in the middle was interesting too because here is somebody who, "Installation was free. But with the higher cost of electricity, my costs are twice what I expected. I am not some stupid environmentalist." So this person is pretty antagonistic to the environmental thing. That's certainly not why they adopted it. And one thing we think too is those people who are paying upfront costs might've researched less. So they might be more likely to be surprised.

So various triggers and interpretations of what solar is for. For example one person said they didn't even have heating or cooling. It was a swimming pool pump. And this is interesting in terms of the very high levels of swimming pools that we saw too where people were really starting from swimming pools or something else. Or are they just starting because it's free?

I want to give a little comparison between low users and high users here. We looked at the pre- and post-bills. These are just self-

reported and we know this isn't the whole financial statement. We looked at how much people said they were saving per month. On the top those people with high bills – people who had bills over $100.00 a month and many were saving a lot. Very few – five percent – weren't saving. Five to ten percent said they weren't saving anything.

But for low bills it looks much different. Actually quite a few – over 40 percent of the people – said their bills were about the same. These are people who had bills under $100.00 in the summer and the winter. So these people aren't saving a lot. And this has implications for how we think about what happens in the future too. These people with low bills obviously can't get the savings because they don't have the initial bills there.

So one of the strong stories we have is that people think solar is very much about money. At least it's a way to report it. And this interesting too because it hasn't always been about money. Initially back in the '70s and '80s there was a lot about kind of an alternative lifestyle, living off the grid which doesn't come out anymore. And the environmentalists are often not primary. So why have things changed so much? And how much does solar being about money now have to do with that's the way that we're exactly selling it – that it should be about money?

That helps some people but also can hurt too because nobody wants to have a bad deal or think that they've made a bad decision based on the decision criteria that they've been handed. The way we sell solar is shaping what we can _____. But I think beneath the surface of looking at this money thing is there's a lot more going on that people aren't quite saying. As you can see in this sort of crazy pictures there are two ways to see these things as well. So what else could be going on?

And I want to give a few ideas of things. I would be interested to hear what you think. One of the quotes that shocked me a little bit – although it should be quite obvious, "We wanted to help the environment while maintaining our lifestyle." I think this probably describes a lot of people not only for solar but for lots of environmental things too. I think it's sort of guilt alleviation too. And the people who adopted had much stronger statements about their personal obligations. It makes them feel less guilty to use what they want.

We don't know if they're using more or less – but less guilty. And then another one that I think is very interesting is this idea of independence. So this is back to the homestead type view that people think even over 50 percent of the people in the General Population Survey thought that installing solar would protect them during a blackout. And we don't know how many of the considerers and adopters actually thought that. But it's quite high there too.

And then also there's a sense in which there is probably a lot of internal household stress about energy use whether because it's once they had a very high bill and now they don't want a $500.00 air conditioning bill in the summer so they don't use air conditioning. Or they fight about using air conditioning. And solar can kind of save them from that or other sorts of stresses trying to control other people in the house. So solar – free – gives you sort of – It de-guilts you, de-stresses you and protect you in a way or at least you can imagine its protecting you.

I'm just going to summarize some of what I've said now. I'm almost done. On the surface the top interest is in saving money. But we think much more is going on. And who buys solar depends on who it is sold to and how. So it's not just people – The market isn't just shaped by what people want. It's working both ways. For deliberators a number of people said – The people who thought about solar said it's really too hard to figure out what's going on. There's not good enough information. I can't find trustworthy information anymore.

And somebody said, "If you guys had told me how well it would work I would've done it before." But people don't know and there's not trustworthy information for them or not ways to overcome uncertainties as things are. Environment matters to most but there's a sense in which it said environmental benefits of solar are quite vague. You can't see them. It's all in the head. Environmental politics can be a negative hot button for people.

We also think many – we don't know how many – buy it more or less because they can be convinced by somebody which doesn't mean it's a bad deal for them. People's knowledge was low when they hadn't thought about solar and even when they had thought about solar. I was also struck by how little – looking in the literature how little investigation has gone on into what happens after solar has been installed. How do people experience solar? What do they change? How do they think about energy differently?

It was clear that most people were happy with what they had gotten. But it's still very early days. The market has been heavily subsidized. It has been wealthier people in general who have bought these things and incentives are changing. So what happens as we get people who may spend less or have lower income or who can't take advantage of some of the incentives especially as they go away?

So for non-adopters the modest majority say they thought about solar. But most aren't doing very much about it. Their knowledge seems to be pretty low. Environmentally they didn't seem different than adopters except for they didn't endorse that they had a personal obligation to move the country to a more renewable energy future or to combat climate change. And the detailed circumstances matter. There are lots of things that can go wrong, that cannot fit. And we can't capture all of those in a survey.

So still 40 percent said they hadn't really thought about solar. A lot of them were just unaware of it. But the people who had definitely not thought about it were quite different from the rest. They were less environmental oriented and sometimes anti-environmental, and usually with lower bills. And then finally I'm leaving with a few questions and recommendations. Should solar remain being about money? How much is that hurting and how much is that helping? And what else could it be?

How can information quality be improved? And how many people really do want to know ore but they don't know who to trust or where to get balanced info? They might only get good information from solar companies. And they might not know the kinds of things that could go wrong or even an FAQ of things that people just don't seem to know. And then there's also the question to which technical changes or marketing changes can unlock some under-attended niches.

Some people might be being missed – people who don't care about money so much might be being missed. And women might be being missed. There are other possible ones too. In one of the earlier lists of what was holding people back I think there are things to think about on each of those rows as to how marketing or technology could actually change to kind of better sync with those. And then finally the question is what happens when the current incentives go away? And how can this work better because the

people who are going to adopt it in the future are not the same as the people who have adopted in the past.

That is all I have. Ben I'll hand it over to you.

Ben Sigrin: Thanks Mithra. That was fantastic. So just a note for the audience we're currently at 12:01 PM. We respect your time. We'll take two or three questions and we've already had a few that were submitted. So Kim the first question is for you. The question is: what conclusions can we draw for income? It seems like the role of income in determining interest was different in the General Population Survey. It was a significant predictor for adoption. But then Mithra indicated that adopters typically had higher income.

You know how do we scare this difference of low and high income and how that relates to interest in solar?

Kim Wolske: Sure. I think it helps in part to realize that in a sense Mithra and I are looking at different behaviors. So much of what she's presenting is from the framework of actually adopting solar. And the General Population Survey – in our minds the behavior is interest in talking to an installer. So it could be that people at lower income in these four states where solar is rapidly growing in the market are interested in knowing whether solar could really work for them.

But then when it comes to actual adoption it may be that still people with higher incomes feel more able to take on the risk of having solar on their homes. I don't know Mithra if you have any other thoughts.

Mithra Moezzi: No I concur.

Ben Sigrin: Okay thank you. We had a note from one of the audience members that they're having difficulty hearing the audio. We apologize for that. We're trying to figure out those technical difficulties. Now they say they're back. This I think will be our second and final question because of time allowances. This is from Bill. Bill says, "Do we think that current early adopters are reflective of the beliefs or motivations of later one? Or should we consider this considerer data to really be representative on issues that installers should be rallying around trying to convert leads?"

Mithra Moezzi: I definitely think that the considerer – and looking through adopters went through – are really important because I think things

are changing especially – The data that we had I would mention that some of the people hadn't had solar for very long as well too. So their experience isn't very long. Nobody's experience is very

And monitoring what happens there and how it reflects back on the people who continue to consider as income gets lower, as experience with leasing _____ would be a very important way of looking at things. The novelty in some ways is going to wear off. It's going to be about something else.

Ben Sigrin: Yeah I agree with that. I think part of that was research design – Mithra mentioned this earlier where we specifically chose California and Arizona as states that have more advanced markets than New York and New Jersey. Or at least this was true when we started the study. New York is a pretty active market these days. So I would just say we are in the early days as you mentioned and I personally think there is continuing questions to be answered about how do we move from a niche product to a mainstream one?

How do the types and motivations from middle adopters compared to earlier ones – a lot of really interesting questions that we can use data as it comes in over time to answer. With that I want to thank everyone on the call. We appreciate you taking an hour out of your day to hear what we have to say. Again all of this content will be on our website. We should have that up there in around five business days. I know a lot of you are scrambling to type out notes quickly.

Anyway thank you for attending and have a great day. Good-bye.

[End of Audio]