Male: *[Automated voice]*

[Silence from 0:00:05 to 0:01:07]

Hi, everyone; thanks for joining. We're gonna wait for another minute or two, to all folks to join, and then get started.

[Silence from 0:01:12 to 0:01:54]

Cindy Zhu: Hi, everyone; this is Cindy Zhu, from the Department of Energy. Thank you for joining us, this afternoon, to participate in our webinar focused on commercial mortgages – how energy can be factored in to mortgage loan default risk. We have some great speakers with us, today, that are working with us on this project from UC Berkeley, and also the Lawrence Berkeley National Lab. I will let them introduce themselves, in a moment, but first I'd like to remind everyone to please use the chat box to ask questions throughout the talks. We will be looking for questions throughout the speakers' presentations, and we can pause them and have them answer the appropriate questions while they are speaking.

We will save time at the end of the presentation, to open the floor up for comments and more questions, so you can either choose to continue using the chat box, or use the raise-hand function. If we see that your hand is virtually raised, we can open up your audio controls, and then you can speak your question. If there are any glitches at all, just please remember that the chat box is open, and we'll be constantly looking for your questions to field to our speakers.

All right, next slide, please?

First up, we have Paul Matthew. Paul, do you wanna do a little introduction about yourself, and then go ahead and get started.

Paul Matthew: Sure, thank you, Cindy. Hi, everyone, this is Paul Matthew; I'm staff scientist here at Lawrence Berkeley National Laboratory. I'm just gonna kick things off, to provide some premise and context, and then I will be ably supported, here, by two co-presenters from the Fisher Center for Real Estate, at the Haas School of Business at UC Berkeley – that's Professor Nancy Wallace, and Paulo Issler, as well. So, just as a quick outline, a few slides on the premise and context, why look at commercial mortgages, and a quick note about a scoping study we did.

And then we'll go straight to our feature presentation, which is new and exciting results on looking at the impact of energy factors on mortgages. We're quite excited by these – or as the Millennials here in California say, we are stoked about these results.

So, next slide, please. Okay, you can go ahead – one more.

Okay, so, commercial mortgages currently do not really fully account for energy factors in underwriting evaluation, and particularly as it relates to the forward projections of energy consumption and price volatility. And as a result, energy performance – and, therefore, energy efficiency – is really not properly valued, and energy risks are not properly assessed and mitigated. But we think that commercial mortgages and – no, not we think; I should say we know that – commercial mortgages a very large lever – they're a $2.5 trillion market – and could actually be a significant channel for scaling efficiency, as well.

So that's kind of what prompted us to look into this, and with that, given that prompting, the Department of Energy commissioned us to do this scoping study.

So if we could go to the next slide.

And I just wanna present a quick couple of findings from that scoping study. So what we did was that we conducted, first, a pretty exhaustive literature review, and surprisingly, they actually won the literature on impact of energy factors in commercial mortgages. And then we also held over 40 stakeholder discussions, mostly with lenders and owners, but also some service providers, and various industry organizations, and their representatives – a primary sort of state of the market, what current practice looks like, and what the potential interventions might be.

So, on today's presentation, we don't have the time to get into the details of the findings of the scoping report, but it is available as a public domain document, and the link is here. And everyone, I think, will be getting the slide, so you'll be able to review this at your leisure, later.

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Okay, so the way we're thinking about these interventions,   here are the schematics that kind of illustrate that. So on the left, in the green box, you have what might be sort of drivers of mortgage value that are energy- or green-related. And there are quite a few studies, actually, out there, now – some of them are anecdotal, of course, but – that relate green features or energy features, to increase rental income, to reduce vacancy rates. And, of course, we know for a fact that more efficient buildings have lower utility costs, as well as potential utility cost volatility.

Also, on the right are the potential outcomes that could come from that, if they're properly incorporated into the mortgage process. So the outcomes are really that it should be reflected in greater property value, potentially lower interest rates because of less risk in terms of energy cost risk. Also, potentially, better terms in terms of loan-to-value limits, or debt coverage limits. So right in the middle, there, are what we kind of highlighted as our key intervention points. The first is appraisals; the second is on underwriting methods and requirements; and the third is on property condition settlements.

So if you could go to the next slide?

So with that, we have three efforts underway, right now. The first is what we call a "move the needle analysis," which is simply to demonstrate to lenders why, where, and how much these energy factors actually move the needle on key underwriting *[audio cuts out]*. Because what we heard from the scoping report was that, "This sounds interesting, and, yes, it makes sense logically, but we'd like to see some actual analysis of how much it moves the needle." And that *[audio cuts out]* today's presentation.

But I just wanna quickly mention that we do have efforts underway in these other two areas, so we are looking to incorporate energy efficiency into the property condition assessments. And also looking at incorporating efficiency routinely into appraisals. And we'll have more information about both of those, actually, at the end of the presentation, because we'd definitely be interested in continued engagement from the stakeholder community, here.

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All right, so let's go straight to the feature presentation, here. So, let's look at just, again, energy cost factors, and how it affects valuation in terms of net operating income. So net operating income is, essentially, your gross income, that you get from your rents, minus operating costs, of which there are many. And the particular one we're interested in is energy cost.

Energy cost can be part of consisting of two key components. There's a volume component, which is, "How much electricity and fuel am I actually using?" That is driven by building features, operations, and weather, as I think most of us understand, here. But then there's also a volatility to that use, which is driven by operations. And I think many of us know anecdotally that sometimes you get a really good facility manager, and suddenly the building gets much more efficient, without any changes in the actual assets. Or, of course, you may have a very hot year or a very cold year, and that can change your volume, as well.

And then the second key component is price, and here, again, it's the fixed value of the price itself, and then how that price may vary over the course of the mortgage term. So, our question that we'd hoped to address in this analysis was, how do these factors in fact affect NOI and mortgage default risk.

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So, ideally, from what we know about lenders, and the kinds of things they're interested in, they wanna see empirical data. And we'd have, ideally, an analysis on an empirical dataset that has time variant data on energy factors for a specific building, matched with low performance data for those same buildings, and that's a fairly representative sample across different market segments. Well, *[laughs]* that's a nice wish, but, you know, Santa Claus isn't around for this sort of dataset. I mean, the challenge really is that there's a lack of consumption data that can be matched with loan data. There's a lot of anonymized data that's around, but very hard to get very specific building data. And also a lack of data building to get it at the scale that we're interested in.

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So what we did is, we looked at a bunch of data sources, and in the interest of time, I'm not gonna go into the details of each of these data sources, here. But suffice to say that for loan data, we used a dataset called Trepp – and Nancy and Paulo may say a little bit more about that as they talk about the analysis – combined with energy price data from the ISO and the RTO. And for energy use data, again, because we wanted the empirical data for known buildings – not just anonymous buildings, but known buildings that we match – we decided to use the benchmarking disclosure data that comes out of several cities, now.

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So with that, I'm gonna hand it over to Paulo Issler, our team member, here, who's now actually gonna talk about the model that was constructed. And then Nancy will follow with the results of the analysis.

Paulo Issler: Hello, everyone; thank you for attending. My name is Paulo Issler; I am the Labs Director for the Real Estate and Financial Markets, at the Fisher Center. I would like to highlight, in this picture, basically, our key approach for modeling – how key components would affect mortgage default. So, on top of the page, we have that expression that shows that mortgage default is basically a function of several factors. And going from right to left, first, the region where the property is located, that would be an indicator of economic conditions that may drive mortgage default on a different fashion across different .

Another key component – and these are pretty much traditional of the financial markets, to analyze mortgage default – is the loan-to-value ratio. At the time the commercial operator entered into the mortgage, there is a property value, and the loan-to-value ratio is a key indicator, or is a key element, that translates into the risk of the mortgage. So the higher the loan-to-value ratio, the higher the risk of the mortgage getting into trouble in the future. Another element has to do with the interest rate market that is another key traditional driver of markets default, which is what we call the gap. Which is the difference in the mortgage rate at the time of mortgage origination, versus the market rate that the building operator, or the property owner, can refinance the mortgage in the future.

So, of course, the higher that gap, meaning the higher the interest rate has moved relative to the interest rate at , the higher the risk default. Now comes two elements, which is the novelty that we are bringing into our analysis, here, which is the EUI, or the energy capacity of the building, energy of the building, and the energy price gap. I think the energy price gap deserves a little bit more description, here, and I would like to go to the next slide, so we can explain that a little bit better.

Next slide, please?

So, the energy price gap is basically what we're using, as Paul mentioned before, as a proxy for –

Cindy Zhu: Hey, Paulo, I'm gonna pause you for one second – we do have a question that I think is important, before we move on. Somebody asked, "What is the ISO RTO dataset that is being used for this model?"

Paulo Issler: The ISO is called the independent system operators – these are institutions, or these are organizations, that basically coordinate the dispatch of the grid on a large scale. So they basically cover the electricity grid going over multiple states, covering an area that goes over multiple states, as they basically optimize the dispatch of the grid. Meaning, they tell which plants need to be run, and at what time, and in which fashion, so that the grid preserves its reliability. And at the same time provides the electricity demanded by what we call the load entities of that component of the grid – mainly, the utility companies, which ultimately distribute the energy to the buildings. So, that's the role of the ISO.

So the key data that we got from the ISOs are the wholesale electricity prices. Meaning, these are prices that the utility company will have to procure in the market and purchase from these power producers, to provide the necessary load to fulfill the demand of the system. So, basically, that's what the ISO is, and that's the kind of data that we collected.

Going back to the energy price gap, now, what we are doing, then, is using that ISO data – that wholesale electricity data – to construct a proxy, basically, for what we call the unexpected energy expenditures. Think of the energy price gap as analogous to the gap – it tracks, along the life of the mortgage, how much pressure the energy cost is putting over the net operating income, which is gonna be, ultimately, a driver of mortgage default. So think of this: if a building operator is facing, month after month, a much higher cost or energy prices than what was originally forecast at the time of the mortgage origination, that may prompt the NOI, or that may push NOI, to lower and lower levels, which will ultimately be driving the mortgage default.

So, the way we built this variable, here, as an exploratory for mortgage default, is defined by the expression on the slide. I'm not gonna go over all the math, there, but basically we're accumulating these price differentials along the life of the mortgage. And keeping track of that up to the time of mortgage termination – either it's through mortgage default or if the mortgage terminated as contracted.

So, LMP is basically what we call the locational marginal price, which is the data that we've collected from the ISO. And the historical LMP is, the forecast is, the prices that has been faced by the building operator at time of origination. And that's what they would use to forecast what the energy cost would be in the future. So by keeping track of these differences, we expect to explain mortgage default.

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This is a very quick example – I'm not gonna go over all details – but it shows how equal , over there – that's the time of mortgage organization – you can see there are 12 historical prices, marked in yellow, over the past 12 months. And as the mortgage goes along over the timeline, we keep tracking these differences in the realized price versus the historical price. And we keep accumulating that, and that's how the energy price gap is constructed.

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Nancy Wallace: *[Crosstalk]* next slide?

So, good afternoon, everyone; I'm Nancy Wallace. I'm a professor at UC Berkeley, in the Haas School of Business, and I'm chair of the Fisher Center and the Lab. As Paul introduced, he's our empirical director, and I'm co-chair of the Fisher Center. And we are very focused on mortgage default analytics, at Haas, and so this project was right up our alley, but really with a twist that we'd never explored seriously. So this has been quite exciting for us in terms of looking at different data and trying to connect the dots, to see whether or not, as Paul set out, our task to see whether or not accounting for energy carefully really does move the needle. And understanding the incidence of default amongst specific buildings.

So as Paulo said for the model that he was going through, the schematic, we're looking to model the probability of default for a dataset of specific mortgages that we track over time. So the data that we have are mortgage data that have been merged with the benchmarking data that come from the cities. And then we track those data, on a monthly basis, to see what their performance is. And we are treating default in our dataset as either a 90-day foreclosure or REO. So typically if people go into 90-day delinquency, they don't emerge from it successfully, so that's our measure of default.

And we are looking at an array of variables, as Paulo summarized them, some of which are *[audio cuts out]* things like the difference between our contract rate on the mortgage, and the current interest rate on that origination timing. And then, things like the original loan-to-value ratio, information about the structure of the mortgage, how long to a final maturity date, when the final balance is due on the loan. And then information about the year it was originated and other features of the mortgage that we know at origination.

And then we're tracking these loans, over time, and that's where the information on a source EUI – we're gonna look at three different measures: source EUI, site EUI, and Energy Star – those are the information we have from the benchmarking data. And then we also have the electricity price gap, which we're tracking over time. So for each month, on these mortgage originations, we track these over time. So, this was a big effort in terms of merging datasets that had never been merged together, before, of the ESO data that was relevant for that building, all the mortgage data over time, specifically. And then all the information about the buildings themselves, which we also have in this dataset, merged to their energy characteristics.

So, what we're looking at, here, is just a table of a regression, where we're trying to fit, statistically, what the effects of these characteristics of the loan and the property and its energy exposure are, relevant to its observed levels of default. So, each building we're tracking, it either is current until the end of the period, and we're tracking these data over a period of time between 2000 and 2016. So that we're looking, month-by-month, for all the mortgages that were originated over this time period, from the first day of their origination – because we have the date of the origination – until the end of the period. And so the way you are observed in this sample, you either survive until the current period, 2016, or you die because you have defaulted.

And so, what we do is run these regressions, and as you can see, many of these explanatory variables are highly statistically significant, which is quite interesting, in that this is quite a small sample. It was a laborious effort to merge to these various datasets that were never intended to be merged, but we are finding very strong results, and –

If you could turn to the next slide, please?

– which we've summarized, on the next slide. So, rather than look at the numbers in this slide, what we thought we'd do is summarize what the bottom line is, what the key results are.

And, basically, the first , our two energy factors are the usage variable – which is the source EUI, which we take logs of, because it's a very skewed variable – and then the energy price gap, or the electricity price gap. So those are our key variables, and what we find is that both the electricity price gap and the source EUI are highly statistically significant at normal cut-off levels. So, even with this small sample, we're finding that there's a very important correlation between the source EUI for these specific buildings, and what's a treatment effect – if you wanna think of that – of being exposed to variable electricity prices over the experience of the mortgage.

So, not only are these statistically significant, but obviously what all of us are really interested in is, are these economically significant? Do they really affect default levels in a meaningful way? And the answer to this, also, is really quite interesting and positive. So, what we find is that the higher the source EUI, the more energy usage per square foot, the higher the likelihood of default. And Paul is gonna spend more time, right after I finish this section of the webinar, talking about exactly what that means quantitatively, and relative to overall default levels. So, it's relatively meaningful – it's about a ten percent increase in default level.

So we also find that the higher the electricity price gap – in other words, the larger the difference between the realized and the expected electricity prices since the loan origination – the higher the likelihood of default. And, again, we're modeling all of this loan by loan – these are not aggregates; these are specific loans that are tracked, and then we're fitting models to their behavior.

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So as part of the benchmarking data, we also have information on the site EUI, so we fit basically exactly the same expression that I showed you before. And, again, the sample sizes are small – we have a little bit more data on the site EUI, but we don't find that it has quite the explanatory power that the source EUI has, that the measurement of the site EUI is less precise. Now, it appears in terms of forecasting default, and so it seems to perform less well. But the energy price, electricity price gap, performs extremely well, as it did in the prior slide.

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Cindy Zhu: Nancy, we have a question. So related to the timeframe that these loans were looked at, somebody asked about the benchmarking data that you guys looked at, going back to 2000. Obviously, we don't have benchmarking laws in place *[audio cuts out]* that far.

Nancy Wallace: That's correct. So, we are looking at the benchmarking data for the end of the sample. So we're looking at the benchmarking data that we observed in the last round of benchmarking, which was 2015?

Paul Matthew: 2014.

Nancy Wallace: 2014.

Paul Matthew: Yeah, and we to say a little bit more about that, I think, right at the end – that is one of the study limitations, in terms of a single annual snapshot of the for overall efficiency.

Nancy Wallace: What we would've loved is to have a snapshot year by year, and we tried that, because we do have a short panel. And even on our short panel, we're getting very similar results, it's just that we have fewer observations, which is more difficult to make inference or make positive statements about what we expected to happen in the population. So the results, here, are that the site EUI does not have a statistically significant effect, but it has the right sign. The electricity price gap remains highly statistically significant, but both of them have highly meaningful signs, in the sense that they have the right positive or negative. They're positively correlated with defaults, and the magnitudes of those are reasonable, at least for the electricity price gap, which is statistically significant.

May I have the next slide, please?

So the third analysis was to use the Energy Star scores that we have from these data. Again, for these buildings, not all of them have an Energy Star score, so we're losing a little bit of the data, just in the availability of this particular explanatory factor. And we find, again, that it has the correct effect on default, in that the higher the Energy Star scores, the less likely you are to default. But the statistical significance is somewhat weaker, but that also is associated with a slightly smaller sample size, having to do with things and statistics that are relevant and important, but are not super important for us, right now.

May I have the next slide, please, which is a summary?

So this the summary from the Energy Star regression. And, again, we find that it's not statistically significant at .05, but it is at .10, which is a perfectly acceptable cut-off limit. And it has the right sign, and the right interpretation economically. Again, the electricity price gap – which is, again, just to remind you, this treatment effect of what the building actually experienced in terms of this energy realizations and prices over time – is highly statistically significant, and both of them have the correct signs.

So, this is really the first study that we have found, on the planet Earth, that shows in a highly rigorous fashion that there is definitely a channel, here, between both the relative efficiency measures, having to do with source and site EUI, and Energy Star, and the actual treatment effect, which were the prices experienced through the ISO region of the buildings.

So I'm gonna pass it, now, to Paul.

Cindy Zhu: Quick question – Nancy, can you speak a little bit about, for the source and site EUI studies, were building occupancy or any normalization measures factored into the variables?

Nancy Wallace: So, the source EUI is, neither of them – the answer is no to both of them, specifically. We do have occupancy data on the buildings – in fact, we have quite detailed lease information on the top tenant exposure on the buildings. The problem with the data are that we have lease date on, so it affects our sample sizes, so we didn't use it. We have looked at the age of the building, and we find that it's not a highly statistically significant explanatory of default, and so we didn't incorporate in that. But as we carry this study on, we're planning to use – we have a lot of covariates; we're only using a subset here, and we hope to get more deeply into the leasing data, because we do have that data.

Paul Matthew: Okay, Cindy, anything else you wanna catch now, before we continue?

Cindy Zhu: Yeah, does anyone have any questions for the analysis, right now? Please go ahead and raise your hand, or talk into the chat box. *[Brief silence]* All right, Paul, why don't you go ahead, and I'll stop *[crosstalk]*.

Paul Matthew: Thanks, Cindy, again. So this is Paul Matthew, back, and I'm sort of the energy efficiency guy, here, so my question is – as I can imagine many of you folks who are energy efficiency folks are wondering – okay, so what does that mean in terms of classic efficiency characteristics, and their correlation to default risk? So that's the question we're posing: what are the actual cases? So, what we did was to develop a range of scenarios that have potentially different energy factor risks. So this would be different building types, in different locations, with different features, with different operations, et cetera.

And for each of those, we'd like to determine what the consumption in price volatility is, using some combination of empirical and simulation approaches. And then actually use the hazard model coefficients – those coefficients in the table that Nancy presented – to determine the actual impact on default risk.

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So, again, these are initial insights, so just as an illustrative case, we selected office buildings, and we looked at large office buildings, because those are the buildings that are in the dataset that we actually analyzed. So these are , as you can see. We looked at two climate zones – for the perfect nature of the climate zones, you have a – it essentially refers to the New York climate zone, and Washington D.C. , and two areas close to, say, Houston.

And then we looked at three levels of asset efficacy – that's the fixed asset efficiency, you know, the windows, and the walls, and the , and the HVAC systems, and so on. A high-efficient building was one that approximately meets 90.1-2013; a medium was one that meets 2004; and a low would be one that has, essentially, a pre-1980s .

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So we ran – actually, for each of these – so those are the asset types. Now, for any given asset type, whether it's high, or medium, or low, you can then have a range of factors that affect year-to-year use variations. And if any of you have been involved with building commissioning, you recognize all these parameters that can affect building energy use, operational energy use. I'm not gonna go into them, but it gives you a flavor – there are things that are managed by facilities, factors that are affected by facilities, factors that are affected by occupants, or just maintenance procedures.

Of course, year-on-year weather variations, as well as vacancy rates within the buildings. And how do you manage vacant spaces? Do you actually turn things off? Do you leave some lights on in vacant spaces? And so on.

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So what we sought to then do was, we took a subset of these factors, and we said, okay, so let's say you have a building, again, no changes in the assets. I'm gonna take each of these operational factors, and kind of define three levels of practice, that we're just roughly calling average practice, good practice, and poor practice. And we can debate whether these truly do represent good or average or poor, but the point is that there are three different levels of practice. We then went ahead and modeled those, we simulated those.

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Here is sort of a very quick high-level summary of what they look like. The column on the left, the three charts on the left, show the data for the 4A climate zones – that's the New York climate zone – and the columns on the right is the 2A climate zones – that's Houston. The top row is a medium asset efficiency; the middle row is a low asset efficiency; and the lowest row is a high asset efficacy.

I just wanna point out a couple of key things, here, because the details of the data and the numbers are not actually that important. But the key thing is that, even what may seem to be pretty small operational factors can have a pretty big impact on what we're looking at as total source energy use variation compared to average. So the red bars represent how much use increases for a given variable, relative to average practice. And the green bars represent how much it would reduce it with good practice. Again, for a given asset type and climate location.

And you can see, lighting controls, settings, and minimum flow settings can have up to eight to ten percent impact on total source energy use intensity, as a variation. And some of those may be smaller. And, again, any given building, you know, your mileage may vary, of course, but the point is these are notional in terms they give you a sense of the differences. And those who have done commissioning will kind of recognize some of these numbers, which is that, yes, from commissioning, you can get these kinds of variations, basically.

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So then what we did is that we sort of just kind of combined those together and created, if you will, more outlier scenarios, or bounding scenarios, if you will. So imagine a building that has poor practice across the board for those factors, or a building that has good practice across the board for those factors. Here is what the range looks like, so it varies anywhere up from 20, 30, to 40 percent increase in source EUI, just for those operational factors. Remember, this has nothing to do with asset changes; this is strictly operational factors, at an improvement of between 10 and 15, 20 percent, if you actually use good practice. So, given that, that those are kind of notionally what can happen just from operations, how did that translate ?

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Oh, sorry, before I go on, weather as well. We looked at year-on-year weather changes, and, actually – and we've known this, also, from some previous studies – the impact of year-to-year weather variations, on total annual source EUIs, is actually pretty small. As you can see, these numbers are – we looked at running these buildings for actual year weather data for 2000 to 2015, and the max and the min for +/- one to two percent, max. And , zero variations may be much more, so just your variation cooling over the summer can be much higher. But if you look at total annual energy use, it's actually pretty small.

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So this is our one takeaway slide, if you will, which is – okay, so what's the net impact on default risk? So, again, I'll just provide a very simple scenario, here. Imagine we have a baseline with a source EUI of 200K BTUs per year, poor operational practice – as we showed, based on some of those previous simulations, of, say, +30 percent – could be 40, could be 20 – and good could be, say, -10 percent. Based on the coefficient in the model, the absolute change in default risk would be those numbers that you see, there – .0084 for the poor, and -.0034 for the good.

And the average default risk in the tracked data, Nancy tells me, is essentially about eight percent. So if you look at .008 relative to 8 percent, that's essentially a 10 percent increase in default risk, just due to poor operational practice. And I would say this is actually a conservative estimate, because we didn't even look at a whole range of operational practices; we looked at, really, a subset of operations factors. So those are significant – we think that these are real numbers that are worthy of the attention of underwriters and lenders.

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Okay, important to note limitations. This is currently limited to the CMBS market – commercial mortgage-backed securities, that is. We do use proxies for energy cost – remember, what actually drives NOI is, of course, cost, but what we're using is source EUI – costs – and wholesale energy price gap. The source EUI data, as the question came up earlier, is an annual snapshot, so if somebody, you know, what they're saying is that essentially that is a proxy for how that building may have been operated over the previous three-four years. Which is, it's a reasonable proxy, I would say, but it is a proxy. We didn't use the actual source EUI month-to-month, with for the loan data.

And, of course, our dataset is limited – by scope, by location, by buildings types and sizes, and so on – so we hope to expand it with additional data.

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So looking ahead, on the analysis side, we'd like to do default risk analysis using RCA bank loan data. We can say more about that during the discussion period, maybe, if the question comes up. And then in terms of the actual impact, we envision a year or two years from now, we almost have almost like an actuarial-style look-up of energy risk *[audio cuts out]* key asset operational characteristics. Sort of just like you do car insurance, right now, and they ask you ten questions – the color of your car, and your age, and your gender, and things like that – and then they have a look-up based on risk characteristics for that, imagine we could do that with key asset and operational characteristics. That's, I think, where we'd like to get to, to truly operationalize it.

So that's on the analysis side. We, of course, want to disseminate it – this is the first time we're actually sharing these results, so we're pretty excited about that. But we'll also wanna do many more webinars, and conferences, and produce – we have been producing a pretty hefty technical report, as well, on this. And the primary audience, really, are obviously lenders and owners, but other stakeholders matter, as well.

And then, here's the ask to everyone *[laughs]*: We would like to engage lenders and owners to do two things. First is develop methods and procedures to fully incorporate these energy factors into mortgage valuation. We've now made the case that they're worthy of appropriate inclusions, and we'll of course do more analysis to kind of strengthen that case, but we'd like to start working on actually incorporating it properly, both the volatility and the use levels. And then actually trying to apply them on a couple of mortgages, and document them in case studies. So, if you think there's an acquisition coming up that would be a good target case for this, we'd love that.

And there are a couple of other areas, as well, that we're working on mortgages, so we would request that you contact Cindy, if you'd like to participate in any of the activities related to our commercial mortgage work. And Cindy's e-mail is here on the slide, and, again, we'll be sending these slides out, after the webinar.

Next, please.

I think that might be end, actually. Oh, yes, some acknowledgements. We'd, again, very much like acknowledge Holly Carr and Cindy at the BSDOE, for tolerating us and supporting this effort. *[Laughs]* And then, also, the other team members of the overall mortgage effort. This was just one piece of it, the underwriting analysis piece, but we have work going around . That includes colleagues of LBNL, as well as the Institute for Market Transformations, so, thanks to them. And I believe that is definitely the last slide.

So, we can just go the next slide.

Thank you for listening. We appreciate your attention, and, again, welcome your questions, of course, now with the analysis, but also we very much welcome your engagement with us, going forward. Okay, I guess we can go to questions.

Cindy Zhu: All right, great. Thank you Paul, Paulo, and Nancy. I actually have a question for the audience members that are still online, if you wouldn't mind just typing into your chat box. Now that you've seen this presentation, who do you think are good audiences for us to reach out to with our analysis and our ask for participants? And could you mention if there are specific roles in your organizations, who might be really good points of contact for us to reach out to? If you all don't mind just typing that into the chat box, that would be really informative for us.

Now I have another general question Wallace: How do you plan to incorporate energy factors into mortgage valuations? Will this be voluntary, or will it have to be approved by relegations? So if you wouldn't mind talking about that a little bit?

Nancy Wallace: So, that's a very good question. We have, as a team, been thinking about this problem for quite a number of years. We had an earlier grant from the Department of Energy, that was completely focused on valuation. The valuation – mortgages are priced, how we say, actuarially, as Paul said, with a lot of empirical data. And basically, it will be the bond market that dictates what's incorporated. And the way the bond market works – so the market that buys the mortgages from the bank, so the way the banks are regulated to risk manage their mortgages – is, as this information becomes more available, given that we've shown it moves the needle, once you know it moves the needle, and you're a risk manager, the banks are the residual claimants on the risk.

And so, their incentive should be to mitigate the risk. And what does that mean? Well, it means that, for a building, if we can get a modification in, say, the PCA – so, there's a simple ratio that shows a building relative others, or, say, use the source EUI – a lender could modify the contract rate that's offered to a borrower. Or a lender might, if you have an especially attractive source EUI, or, say, Energy Star score, given this actuarial table that Paul was talking about – a look-up table, basically, of risk – a lender might be willing to offer a higher loan-to-value ratio. So these tradeoffs, lending is done off menus. These menus are set up based on statistical analyses of what the relationships are between, say, loan-to-value ratio, or contract rate, or debt service coverage ratio, and performance.

So with studies such as these, and others that will be done as more benchmarking data are available, lenders will have a rationale, a logic, for how they do their pricing. And it will incorporate this information, which will be very valuable to them, because they literally are blind to energy use in buildings, right now, if they don't have a way to see it. So defaults happen, and the causality through this channel is simply not acknowledged or represented in the risk analytics that either the banks do or the regulators look at, in terms of understanding the balance sheet.

Paul Matthew: So, Nancy, but you envision that *[audio cuts out]* again, it'll happen kind of the wouldn't be necessarily from a regulator telling *[crosstalk]*.

Nancy Wallace: Oh, absolutely – I mean, regulators don't do this. I mean, what regulators do is say, "You have to hold x amount of capital, given the risk of your balance sheet." And so, the bank's job is to establish the relative riskiness of their balance sheet. All of that reporting comes from the bank to the regulator. And so, as this information is incorporated, and banks have a way of sorting borrowers in a fair way, given inefficient buildings seem to be more prone to default – and it could be an array of behaviors having to do with the way that they operate the building, that are measured, on our scale, by things related to energy – but it gives the banks a way to sort good borrowers from bad borrowers, and that's always good for the banks.

Cindy Zhu: All right, great. Next question – which might also be a suggestion – have you done any back-of-the-envelope estimate of the value to the commercial mortgage-backed securities market, in avoided losses if they were better able to understand how energy costs and features of buildings could factor in to default *[crosstalk]*?

Nancy Wallace: So that's a great question – I love this question. The answer is, from our last DOE grant, we absolutely have that apparatus to do that. And that's the big benefit of these data, in that every loan that we're looking at is a member of a pool, and we have all the bond data and all the pricing data for each of these bonds. So we can absolutely connect the dots in this study, between the loan market and the bond market. And because the bond market is so important for the commercial loan market, because it gives the banks the liquidity they need when they decide to offload loans, this is a very, very big question.

I think you're picking up on some of our optimism about these results, that these are strong results, and so these results can definitely be taken to the actuarial question having to do with the pricing of the bond. And we have the apparatus to do that. Now that we've connected the dots on the energy side to the loans, we have all the data from the loans right directly to the bonds, so we could definitely answer that question.

Cindy Zhu: Do you have any plans to expand this analysis to multi-family properties? And then to take this information to Fannie, Freddie, and HUD?

Nancy Wallace: Another *[audio cuts out]* we love these questions. *[Laughs]* The answer is, definitely. So as you can see from the analysis we're doing, here, I'm not showing you the multi-family results, but we have multi-family results, and they're essentially the same. We're a little more worried about the multi-family results, because the human factor is such a big effect in multi-family. We've talked to Fannie and Freddie, and definitely once we've established this move-the-needle component of this analysis, as Fannie does more with their multi-family programs and collects data, again, along the lines of having the source EUI for the buildings, this absolutely could be replicated on Fannie's portfolio.

Cindy Zhu: If tenants are paying the utility bills and energy bills, wouldn't the impact of higher energy usage and prices on an owner's default be at best indirect, and likely minimal?

Nancy Wallace: So this is a good question, and the jury is kind of out on this question. But in an earlier study, I had a very large financial institution give me all the leases from a commercial real estate mortgage-backed *[audio cuts out]*. So these were thousands of leases, and we actually analyzed the leases for the bank. And leases are just another form of fixed income security, and the mortgages are basically a delivery mechanism for the risk and the leases. And so, if the tenants cannot pay the energy costs – I mean, they're the ones that are being treated with these higher costs, and they're the weakest link in this chain.

So you do get these groupings of – I mean, it depends, obviously, on the diversification of the leasing portfolio and given buildings, but we have information on the leases. So, that's another set of dots that we haven't done it yet. But from earlier work, I know absolutely that the leases can be priced in exactly the same way, we aggregate it up for that deal, for this institution. And now that we're dealing with the SMBS loans, the Trepp data has a lot of information about the leases. So for these same buildings where we have source EUI, we've tried with the leasing data – we have good leasing data for about 300 buildings, approximately.

The results are the same, that's the good news, but we haven't dug into who those tenants are, and what their situation is. But the Trepp data gives us good information about the performance of the tenants, and what those lease performance data are. We just haven't done it, yet, with these new merge data. But a lot of really interesting questions that we can tackle very directly, here, and then have a better answer for how indirect this is. My hunch is, from working on the leasing data, that it's much less direct than you might suppose.

Cindy Zhu: Here's a comment that I think you might wanna respond or reply to – it's related to commercial PACE. Most states that have approved commercial PACE require mortgage consent. Commercial PACE is specifically to finance energy efficiency and renewable energy projects for commercial and industrial properties. This will be a useful analysis to justify what, in reality, is additional debt on the building, albeit deemed off-balance sheet debt.

Nancy Wallace: So, you're talking to people in Berkeley, California, the birthplace of PACE, and we have thought about this problem a lot. But getting the data for PACE programs is in its infancy, and we just need more experience data before at least the type of work we do is gonna have more of a say on that. I think both the GSEs and also the commercial lenders have realistic concern about getting some kind of an actuarial fix on what that means, in terms of their first position. I think they're willing to give leeway, right now, but actually quantifying that, I don't think we're there, yet. I don't think the datasets , at least to my knowledge.

Cindy Zhu: Do we have any other questions or comments from the audience? If not, this session has been recorded, and we will post it online, on the Better Buildings website. I think all attendees will get an e-mail once that is done, too, if you guys wanna review or forward this session on to any colleagues that weren't able to make it today. All three speakers have their e-mail contacts up on the screen, right now, if you have any individual questions and want to follow-up. Any last comments from the speakers?

Paulo Issler: No.

Paul Matthew: *[Crosstalk]*

Nancy Wallace: No – thank you for attending.

Paulo Issler: Thank you for attending.

Paul Matthew: Thank you very much.

Cindy Zhu: All right, we'll give you guys five minutes back. Thank you.

[End of Audio]