*Timothy Unruh:* Hello, I'm Timothy Unruh, program manager for the Department of Energy's Federal Energy Management Program. Welcome to the 2012 series of First Thursday Seminars. This year FEMP is expanding its training course offerings to help you gain the core competencies necessary to fulfill the Federal Building Personnel Training Act. Furthermore we recognize the ever-increasing challenge to making our buildings the best performing they can be. We believe that expanding our training and building performance improvement especially in energy efficiency can make our workforce best in class.

This training will focus on core competencies to meet key job performance goals. We want to provide you with real, on-the-job skills that make a difference. First Thursday seminars will help you obtain project funding through a streamlined ESPC process tailored to meet the need of small sites; place UESC task orders under a GSA area-wide contract; identify, select and deploy new and underused technologies to drive markets and accelerate change; achieve the greatest possible energy and cost savings through deep retrofits and identify critical opportunities and implement action plans to achieve energy security in federal facilities.

The new knowledge and skills in these seminars will help you do your job better, help your agency reach its energy, water and other building performance and sustainability goals and help our government save taxpayer dollars. Through our efforts we want to make the federal building stock a place of innovation and high performance and efficiency basing our success on the measured results that we achieve.

Visit the FEMP website for the most up-to-date information, view archived seminars online 24/7 and register for upcoming seminars. We also hope you will take a few moments to provide us with important feedback through the evaluation at the end of this program. Together we can continue to learn, improve our core competencies, and meet new energy challenges with confidence. Enjoy the seminar and thanks for joining us.

*Kathy Hyland:* Hello. Welcome to the Federal Energy Management Program's First Thursday Seminars. I'm Kathy Highland and I will be your moderator today. This is the sixth course in the 2012 series focusing on implementing deep retrofits. If you'd like to call in a question do so immediately after the presentation. From time to time on your screen you will see an email address, a fax number and a phone number to ask your questions.

We have two instructors today: Jesse Dean is an engineer in the National Renewable Energy Laboratory's integrated applications office where his primary areas of expertise include commercial building retrofit analysis, solar energy system analysis and building energy modeling. Elaine Gallagher Adams is a licensed architect and senior consultant with the buildings program at Rocky Mountain Institute. She has a wide range of experience in historic preservation, energy conservation and green operations with expertise in passive solar design and rehabilitating existing building, campuses, cities and regions.

We also have with us live from the Department of Energy's Federal Energy Management Program Ab Ream. Ab is an energy technology program specialist with the U.S. Department of Energy's Federal Energy Management Program. His program specialties include operations and maintenance, energy assessments, metering, commissioning and measurement and verification.

Listed on your screen are the core competencies this is designed to address. I'll let you take a look at those.

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As a result of completing this training we hope that you will be able to select appropriate facilities for deep retrofits and set performance objectives, employ an integrated design process and end use technology applications for deep retrofits, determine how you will insure optimal performance, identify DOE and industry resources to support your decision-making processes. And let me briefly look at our agenda for today.

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We're going to start by an overview of deep retrofits and understanding deep retrofits in general. We're going to talk about the process for deep retrofits. We're going to talk about integrative design, financing and utility markets, end use technologies, insuring optimum performance and we'll end with some case studies. So let's get started.

Elaine I am turning it over to you.

*Elaine Gallagher Adams:* Thank you Kathy and thank you for having me here. We want to look at what we feel is the most critical aspects of deep energy retrofits. And to start that we want to talk about what a deep energy retrofit is.

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Within the Advanced Energy Retrofit Guides we had a long discussion about this, and I'm going to share with you what we came up with. We ended up with three different types of energy projects that we all often hear about.

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And just to help you categorize them let's talk about them.

The first one is an energy audit, and we see these all the time. They're fairly cursory; they're often also a retro commissioning effort. They often involve about 15 percent energy savings and that's quite common. When we re-commission a building or do measurement tracking or install measurement tracking tools we find between 10 and 17 percent energy savings, so 15 is right in there. We get a quick payback usually; these are no-brainers. We often start with these projects just to get into the energy efficiency track for the longer term. We often know the con -- the problem with some of this -- is that occasionally we'll exhaust low-hanging fruit because sometimes they'll throw energy or lighting retrofits into this and that can hurt us later on. It's okay to take advantage of low-hanging fruit if you can recover those savings and invest them in the future for a longer-term project.

Now the second level of an energy project is what we call an energy retrofit. And we see this a lot with ESCO projects, energy savings performance contracts that we use quite often. With this we'll get deeper energy savings, maybe 30 percent. We're talking a lot about equipment, very commonly lighting, HVAC equipment, controls, what-have-you, most often done through an ESCO. There is really -- with these projects there is a mechanical focus; it's not what we would call a holistic integrative solution but it's kind of very financeable; quite often you get your big paybacks with this. And we're used to doing them; we're very comfortable with them.

So what we want to talk today really about is deep energy retrofits. And these are a little different because what you might even call this too is a comprehensive building retrofit. It's very often combined with a larger project, which is what makes the business case so strong. If you're already going to invest a lot of money in a building for other reasons please consider adding energy aspects to it to realize even deeper savings. And when I say deep savings I mean at least 50 percent savings from your existing energy use.

Now the critical thing about this is that it be right-timed. Now with all these they're not -- they're all viable at different times. There's a right time and a right place for any of them. And a lot of times if we are working with an agency with goals to create net zero paths for certain buildings deep energy retrofit may be the perfect solution there.

Deep energy retrofit doesn't have to take place all at once either; it can be over a period of time depending on how that project can unfold financially as well as operationally. We include passive and mechanical solutions; this is not just about equipment, it's not just about what I call the shiny stuff, the renewables. This really is a comprehensive view of a building and how all the energy efficiency measures can also enhance the building and the building users and the value of the property as well. It's a much bigger picture. This also provides obviously a much more compelling business case.

The challenge with this is that it does require coordinated planning and advanced financial planning too. Obviously it's most often done through a capital expenditure plan, also sometimes in conjunction with an ESPC.

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So these advanced energy retrofit guides have been long in the making, and recently released, in fact so recently that we have them coming out just about every few weeks. The health care one was just released that I just saw the other day. Rocky Mountain Institute where I am, we helped with three of these guides and it's been a fascinating process to go through this and I hope you'll use these guides; they're available for download from FEMP itself and they are geared towards specific building types. We have five of them I guess right now; I thought there were four. But they're just moving that fast so keep your eyes open; I believe there are going to be six total at the end of this time.

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So what is a deep energy retrofit really? How is it different from any other retrofit project? And we're working very closely with ESCOs to help them redefine it too. They're redefining their own service provisions, their own services that they're providing. And really the big differentiators appear on this slide you'll see, and the first one and the biggest one is that it's a broader conversation with the owners. You're getting much more involved with the owner's motivation, the owner's real goals, not energy targets as much but their owner's real goals. It's also very integrative; it's an integrative design process from start to finish. It has to include everybody involved in the project. In fact integrative design leads to innovation -- more often than not you're going to get a much more successful level of innovation when you include everybody.

It always includes advanced energy modeling and LCCA, life cycle cost assessments. Now advanced energy modeling or energy modeling in general is not a deliverable. Don't think about it as a deliverable. It is a process. Use the energy model to help make decisions, to help form the building itself, use it from the beginning. Start with a conceptual model and go from there. You may have to build it a couple different times but use it; it's incredibly powerful. And find people who know how to do that well.

Then we have ongoing energy tracking: proof of success. We're not talking about just a checklist once a year to see if all the set points are still where they're supposed to be. We're talking about measurement and tracking, real-time energy tracking to know what these buildings are doing. Again, it's a holistic approach to energy efficiency through a comprehensive retrofit process. And it is long-term. And the ESCOs we're talking to are talking also about creating long-term relationships with agencies, with their clients in order to carry this out. It's a different model.

We have tenant-related strategies. The tenants are essential in these projects. We have plug load issues and the tenants are all about plug loads. If they're going to bring in all their gizmos and plug-ins that's a big issue; we have to get them interested and excited about trying to help all of us reduce energy and use it more wisely.

And then finally consider the timing of other planned renovations. If you are replacing major equipment or what-have-you timing -- it's a good time to do it. And we'll talk more about that in another slide. Essentially from these differentiators you get larger savings, every time, you will always get deeper savings if you follow these concepts.

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Now deep energy savings retrofit targets are outlines in ASHREA Standard 100 essentially by building type and by climate. So your targets -- if you're one of those people that really love the absolute EUI target to shoot for use this as your maximum number. These are fairly high for some of these building types so use that as your absolute maximum target shoot for even better than that because in this case lower is better, obviously. So we want to shoot for a low target to really start the conversation rolling. What is they say? If you shoot for a moderate target you might just get it; shoot for a tough target. You'll get there.

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So the process for a deep energy retrofit is also a little different,

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and it's also more in line with a standard design project. We have launch: at the launch of the project you want to set goals. And again, I'm not talking about energy targets; I'm talking about real project goals, transformational goals, and not incremental goals. What does the owner really want to get out of this project? What is the agency trying to accomplish through this project? Are they going to -- is market -- are market factors at work here? Are they worried about losing their tenants? Is there something going on here where the building is going to change functions somehow? These goals are important for the design team to understand. Maybe the goals are to accommodate a growing workforce. Well, does that necessarily mean we need more offices or is it that the building needs to be an innovative solution to accommodate a growing and more transitional and more 21$^{st}$ century workforce? We all know offices are becoming different things these days in light of technology; how can we design 21$^{st}$ century workplaces and make them very energy efficient? So those goals are important and the owner sets those goals with our help.

Then you want to select a good team and align incentives. Why do we incentivize a design team by paying them a percentage of the cost of the project? And then you wonder why the budget goes over, right?

Incentivize your team for achieving high performance; it's a different mindset. It's a little bit like energy savings performance contracting but including the architects and the engineers as well as the ESCO. It's very different and we're all working on new contract Word templates for that.

Now we go into the design aspect of a deep energy retrofit. And you identify opportunities, right from the start. And what we do is we always have a charrette or a workshop or whatever you want to call it and those design opportunities come out through a collaborative meeting. And if you don't invite every bit of the table you're not going to get all of the innovative ideas. Just bring up everything; we always say no idea is dumb. Bring it all up; you never know what's going to float to the top, and I'll tell you some great stories on some of those opportunities later.

Analyze the options. There's a lot of analysis in a deep energy retrofit. And you're working often side-by-side with the architect and engineer or you are the architect or engineer, and the analysis -- you have to understand that analysis is iterative and recursive. Design is not a linear process; it never has been. Don't treat it that way. And contracting officers, you know, it's tough. They want to write a contract that's a linear process, you get paid after certain phases but we all know it's not linear. It is you have be available, you have to be allowed to go back and revisit concepts and make sure that what you're doing is really meshing with the project, and those project goals: always checking back with those project goals.

Then we implement it, we construct it, commission it -- we're used to that. And then verify, obviously: verifying is very important. We talk a lot about measurement and verification; what I'm seeing now is a trend toward measurement and tracking because verification again is often just a once a year thing, we're checking off a list. Measurement and tracking is ongoing; you're on top of it. If something goes wrong in a system, you've caught it within 12 hours, you take care of it. There's a lot of savings there; we have a lot of anecdotal stories about the savings involved in that. We need more information and studies but goodness, the stories floating out there right now about how valuable that is are just terrific and very useful.

And then obviously share successes. When you do this well talk about it.

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So within the realm of deep energy retrofits we talk about ripeness. At Rocky Mountain Institute we think ripeness timing is essential. And when I say timing I'm talking about planning capital improvements. If this building is due for an upgrade and hasn't been touched in 20 years or 30 years boy is that the right time to do it. And we have to make mechanisms within our acquisitions process, our capital planning process to account for energy efficiency improvements in the form of a deep retrofit in these capital improvement projects.

Then we have major system replacements. If you're going to replace major equipment for all practical purposes it doesn't make sense not to reduce the loads that those systems need to meet. So if you can invest more money into the shell, the envelope and the passive measures of the building in order to reduce the load itself, obviously lighting projects are included in that, then those major system replacements change their scope quite often. I love to say if I do my job well I don't need that whole system back, and maybe sometimes I can get rid of large parts of that system. So again, integrative design: you look at the whole building before you look at that system because that system is part of a much larger whole.

Major envelope projects. We're looking now at a lot of mid-century modern buildings; the envelopes have been tough. Even those of us -- I come from the historic preservation background; those envelope projects, the early curtain wall projects are very, very challenging. Sometimes we can rebuild them; sometimes they just have to be replaced. It depends on how they were constructed. That's a major project and a major opportunity for improving the envelope of a building, and boy does that cut down on your energy loads. So take advantage of that. If energy's not part of those large envelope projects you're missing something.

Then we have code upgrades. It's tough to keep up with the codes right now; they're moving so fast but obviously take advantage of whatever you can do as part of code upgrades. New owners, refinancing, new use quite often with that -- occupancy types. If a building is really changing its character again jump in. How can you -- maybe it's going to an open office plan now. Take advantage of daylighting; that's a huge opportunity. And other aspects of the building itself.

Then there might be large utility incentives, high-energy costs -- that's a great motivator as well. Just mitigating an "energy hog" often goes hand in hand with those too. Some of these buildings have really been allowed to deteriorate to a point where they're just using an enormous amount of energy. Often it's old solutions that have caused the problem, so it gives us a chance to go back, undue some of what we did and recover some of that. Often with historic buildings we can recover the sustainable aspects, the energy efficient aspects of those buildings. And I get really excited about that.

And ultimately portfolio management. If you're talking to an agency or a client that has a large group of buildings they are managing this portfolio like a juggler would manage balls, right? There's a lot up in the air, they're looking at many aspects of portfolio management, what to keep, what to dispense of, how to upgrade their buildings so that the energy doesn't get away. We're looking at enormous costs of energy in some of these portfolios and they know that that's a real opportunity. So again, how do you time these deep retrofits?

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There are a lot of barriers to deep retrofits but don't let that stop you. Policy is an obvious one; there's a lack of policy that creates no motivation to invest in capital sometimes. Obviously we've gotten very good at creative financing and figuring this out. The policies to allow deep retrofits and to encourage deep retrofits can sometimes get in the way but at the same time they can be very helpful.

Watch the trending of energy codes; they are moving at a very rapid pace and they are going to be our friends. Policy in that respect are going to push for better and better buildings. And I personally get very excited about that. Because the policy, because the energy codes themselves are moving so rapidly we cannot rely on just mechanical systems upgrades; it has to be a holistic, deep energy retrofit solution to meet those codes.

Then we have project analysis tools. The tools are still babies; they're still being developed. We have a workforce out that there of service providers who may or may not know those systems. When we go looking for energy modelers I like to say I'm looking for a black belt energy modeler. How do you know? It's tough. It's tough to know who's really got that level of expertise. You have to just ask the right questions, really. At some point we may have some certification process and that would be great; it would help us a lot but at this point if you are an energy modeler, of you are a service provider just training, training, training. It is moving very rapidly.

Then there's uncertainty of technical and economic performance. A lot of these new conservation measures or energy efficiency measures we don't really know what the outcomes could be, what the savings could be. Again, it's based on sometimes limited, if no, energy modeling. So what can we do to tighten up the information we have, the data we have? If you really want to be innovative sometimes you don't know what the savings are going to be. There are workarounds, you have to get creative and you have to reduce risk.

Financing. Financing is a big problem and it has been for the last five years. Again, there are lots of windows opening now; we have PACE programs, we have unbilled financing, we have UESCs, we have ESPCs, we have lots of different options. And don't forget the opportunities to use the energy tax credits, the historic preservation tax credits, whatever aspect of this building works for you layer it on like lasagna. Just look for these funding opportunities.

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Optimize. Optimize the building; optimize the process.

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Now what we have on your screen right now is what Rocky Mountain Institute calls the right steps in the right order. And essentially you need to define your needs and set your goals, right? We talked about defining goals, setting goals, transformational goals right from the start. Do that from the start.

Then you want to understand the existing building. What's there? What is the capacity on that site? How much renewable energy could you possible generate on that site? How much water falls on that site? What's going to become a big issue soon and I do include it with energy when I talk about it. Even waste -- what is the capacity for waste on that site?

Now understand the existing building operations. It's very important; you want to know what the baseline is. You want to know what the cost of doing nothing is. And that, to me, is incredibly powerful. What is the cost of doing nothing? That's your budget right there. And if you can reduce that budget that's good, right?

Then you want to understand the scope of the planned renovations. Again, what is the plan? What is the purpose of the renovation? What is the purpose, the motivation behind this project? And that way you can dovetail in more closely with some of the larger ideas and get even more synergies between what you're trying to do as an energy service provider or an architect with what the real motivation of the project is.

And then we want to reduce loads, obviously. That's foremost when you start talking about technologies. What loads can we reduce in this building to eliminate entire systems, or partial systems? We just want to reduce, reduce, and reduce. But not at the cost of comfort; in fact often at a benefit of comfort.

Simplifying systems. That's a huge opportunity to de-clutter-fy these buildings. Sometimes they just have so many iterations of equipment in there. Simplify it, reduce loads. There's a real opportunity there.

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Now some people start here, and you know who you are. Stop it! You want to select appropriate and efficient technologies. But you want to do that *after* you've reduced the loads, after you've understood the scope of the project, after you've set the cost of doing nothing. Do your homework first, and then look at the technology. There are a lot of exciting things going on out there; we don't want you to not go there, but it's in the middle of the process; it's not the beginning of the process.

Then you want to seek synergies. A lot of systems, a lot of energy conservation measures or energy efficiency measures have terrific synergy. Sometimes 2 + 2 = 5, and you can get real benefits from that if you're looking at even simple envelope improvements, maybe even landscaping improvements that keep the building cooler. There's a lot of things that can be done around that building that add up to more energy cost savings than just the aesthetic improvements. So keep in mind all these things; don't discount anything; even the little ones add up. Keep in mind bundling these measures so that you get a larger impact.

Then we want to optimize controls. Controls are huge, and you can say as much as you want to that we have great occupants in this building, they're going to do everything right, but in the end you really have to have a lot of control over the building. Your building needs to be automated; it needs to be recommissioned, obviously, constantly. And then, only then, do you integrate renewables. In fact renewables should be the very last step. And again, I call it the shiny stuff but it's good; when you're done with a good project put the cherry on top -- that's your renewables. That's a good project.

And then ultimately realize the intended design. Make sure the project is going to perform the way it's supposed to perform as designed. And commission that building. Commission and recommission at regular intervals, ongoing commissioning. I recently told some people that not commissioning your building is like driving down the highway with the gas cap and the blinker on; you just look like an idiot. You don't know that all this stuff is happening to your building and its just going forward and it's not operating the way it's supposed to.

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I want to introduce a concept to you that we at Rocky Mountain Institute are starting to work with quite a bit. And it applies to almost anything, to designing any system, even your life if you really want to go that far. Calculate the minimum technical potential: how low can you go? Is it building -- it's building energy limbo, right? Start with -- say we have a building that operates at, you know, 100 percent of what it's operating at, obviously. And you remove all the constraints that are making that building not perform well. And when I say remove those constraints I say remove physical constraints, fiscal constraints, and expectations.

In your energy model just take away everything that is making that building not perform. In a perfect world what would you do to it to get lowest energy use? We call that technical potential. Now that I would posit to you is a long-term goal to achieve technical potential. However, given life and codes and all kinds of other things we have to sometimes add back some of those constraints, especially if we're looking at a current project that we want to happen soon. And so by adding back some of those constraints you end up with an achievable potential, right? And an achievable potential is your short-term goal. You end up at a very, very different place by following this path than you would by starting with existing energy use, deciding by consensus some arbitrary energy savings and just shooting for that.

Whenever we go through this exercise on a project we end up at a much better performance than had we started at the top and gone down. This way you're starting at the bottom and you're justifying every kilowatt hour, every Btu that's expended. And you know where it's going.

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Optimize the whole, not the parts. There's no point in going into a building and just getting this -- doing one aspect of the building as if it were the greatest project you could design and not addressing everything else. A building, lost any other system, is a sum of parts as a whole. And when we say holistic solutions we mean holistic solutions. That's early intervention, goal setting, technical potential, and all the things we're talking about now. You look at the building as a holistic problem and a holistic solution.

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Factors for economic success in a deep energy retrofit vary.

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Obviously we've talked about facility selection; not every building is ripe for a deep energy retrofit right now, but there will come a time when it might be. Plan for it; don't do anything to counteract that, meanwhile. But just understand when the buildings in your portfolio, if you're looking at a bunch of them, which ones are ripe for energy audits right now, recommissioning, which ones just need an energy project, just an energy ESCO intervention somehow; which ones are ripe for deep retrofits?

The more we can then reinvest the savings from the first two levels into a future deep retrofit the more valuable that will be. There's a lot of savings to harvest but you can't do it all at once; you have to be able to bank it for a while until you can get the full implementation of the savings.

Then there's energy costs. There are parts of the country where energy just doesn't cost that much. There are some parts of the country where it's ridiculously expensive. And the energy costs themselves can be a huge motivation for the project. Then there's motivation itself: why is the owner motivated to do this? Are they getting ready to sell the building? That's a tougher sell. So we don't know what can impact that.

Then ultimately financing strategy. Financing strategies -- again, think about that lasagna of financing that is available to most clients, whether they're private or federal. We just have to be creative there too. Again, combining sometimes an energy savings performance contract with a capital improvement project.

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Elements of a techno economic analysis, also known as life cycle cost analysis, really should include a lot of different elements. It's not just a spreadsheet with line items. It should include the energy efficient elements itself, the economic elements, some of the motivators especially if there are human resources issues in play. What is the confidence level of these outcomes? The life cycle cost assessment process is a lot more than just a spreadsheet.

You can find actually a great tool on our website Retrofitdepot.org for life cycle cost assessments; we're working currently with NREL to develop it into a better tool. We don't know how long that will take so just for now use the tool that's on our website. But keep your eyes on that one.

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Tunnel through the cost barrier. And I'm just going to say this as simply as I can, right? Quite often in a traditional project we will invest in energy efficiency until we meet what is perceived as a cost-effectiveness limit. And then they'll stop. And we stop because we're spending as much as we're going to save; we're done, right?

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But what happens if you spend more? What if you keep going, and then you can ultimately, again, eliminate entire systems? Then your costs drop tremendously, and I'll show you can example of that later.

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Deep retrofits and net zero energy life cycle cost play hand in hand, especially when you're looking at ultimately power purchase agreements in whatever form you're going to do that. With a typical ESCO you might reduce your EUI by a certain amount and then your power purchase agreement has to be quite considerable. When you go into a deep energy retrofit project then our power purchase agreement can be quite a bit less because we've reduced our energy use that much less. Think in terms of that technical potential exercise.

Now what happens -- I always think it's an interesting exercise in my head to say if I can get down to within 10 percent of a technical potential isn't that the better time to buy renewable energy? And at that point my PPA is quite low.

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GSA has launched a very interesting project called the GSA ESCO Retrofit Challenge, or Renovation Challenge, or Net Zero Challenge -- it's got a couple different names right now. The goal really is to see if we can use the ESCO model to achieve net zero on these buildings. And the buildings that are included in this project -- I think there are 30 or 33 buildings all over the United States, some of them are already operating quite well. They're really quite advanced already; they've done a lot. And that's a tough place to be in because all the low-hanging fruit is gone. What a great way to challenge the ESCO community to really push and see if they can use integrative design, iterative modeling and really get down to the lowest, lowest possible energy use.

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We started the ESCO challenge with GSA back in the fall with a workshop where we included all the super ESCOs and a number of people from GSA and others working I think with FEMP. It was a terrific workshop. It was honest workshop. We fleshed out a lot of the problems with the ESCO process that are right now this year being fixed. And as you heard Tim Unruh earlier a lot of the processes are being streamlined to fix some of these problems.

Obviously the analysis and integrative design is an issue because analysis is commonly not included in an ESCO contract. So GSA is rethinking what these contracts need to look at too. Project economics: what does it mean if every project has to be net positive every year? That can be very limiting and that's one of the big problems, the big barriers with shooting for a net zero building through an ESCO contract.

Then we have the ESPC delivery process itself, which has been excruciatingly long, very risky for the ESCOs and that's one of the biggest and first things that have been addressed at GSA and through FEMP in general.

Occupant behavior: we know there are savings there; how do you account for them? Is it an actual ECM or is it a risk mitigator? So we have to think about that differently as well. Ultimately M&V or M&T, measurement and tracking, the interactive benefits need to be accounted for -- how do we do that? How do we keep tracking for these results, and to assure that we are getting the results we thought we were getting?

Kathy?

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*Kathy Hyland:* Now let's turn it over to Ab at FEMP and hear what Ab has to say.

*Ab Ream:* Hello, I'm Ab Ream, an energy technology program specialist for the Federal Energy Management Program, and thank you for joining us for this First Thursday Seminar. FEMP is committed to unlocking the significant energy, water and dollar savings associated with deep retrofits. Federal agencies are subject to numerous mandates for reduction of energy use and greenhouse gas emissions and the majority of these reductions must come from federal buildings. Since these buildings already exist and many of them are aging the reductions must be found from cost-effective deep retrofits. The deep retrofit strategy begins with an integrated whole systems approach to achieve a comprehensive and cost-effective whole building solution. The key to a successful deep retrofit is to look for multiple benefits from ECMs and expenditures that are linked together.

This integrated approach begins with efficiency. It is critical to explore all cost-effective efficiency measures up front and then balance energy efficiency with renewable energy opportunities. We have found that many of the proven technologies that can achieve efficient retrofits are often underutilized.

To help you evaluate and assess the available technologies FEMP has developed the technology deployment matrix. This tool currently evaluates and ranks 49 technologies by impact. FEMP also support the GSA and Green Proving Ground Project that evaluates 16 new technologies from ground source heat pumps to smart windows.

Renewable energy systems can also benefit from integrated approaches that optimize power generation. These include storage devices, advanced metering or micro grids, for example. FEMP offers many resources to help you maximize efficiency with blended technologies to optimize building performance. Deep energy savings through the installation of new technologies can require a substantial financial commitment not always available through appropriations. That's why FEMP offers assistance in developing energy savings performance contracts, utility energy service contracts, power purchase agreements and other project funding opportunities.

In particular take advantage of ENABLE, the streamlined ESPC process for small sites. Of course measurement and verification is critical to round out success. FEMP offers information on current M&V methods to support deep retrofits, enhance ongoing performance optimization and educates staff and building occupants. And finally, FEMP is pleased to support the GSA Deep Retrofit Challenge involving the whole building retrofits of 30 federal facilities totaling nearly 17 million square feet using ESPC project funding. Look for the results of the deep retrofit challenge on the GSA website soon.

Thank you for your efforts to implement deep retrofits to realize deep savings. I look forward to answering your questions later in this seminar.

*Kathy Hyland:* Ab will be available to answer questions at the end of this session. I'm going to turn it over to Jesse Dean at this time.

*Jesse Dean:* Hello everyone. So I'm going to get started by talking a little bit about the role of energy modeling and integrated design.

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We Elaine said energy modeling is really fundamental to a deep retrofit process. About 90 percent of the retrofit projects typically use spreadsheet-based models and getting them to move to more of an integrated process where we are using energy modeling as kind of a fundamental step in the right direction.

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There are a number of software tools that are available. There are a number of free software tools. We're going to quickly walk you through a few of those; two of these are developed out of NREL and all of these are free software tools.

The first one we're going to talk about is BEopt. It's actually an energy-modeling tool that's built for residential projects so it can be used for both new construction and for retrofit projects. But one of the neat aspects of this is it has an optimization engine that really allows you to truly optimize the building performance and come up with an optimal solution. The program is available for -- on top of Go-to or EnergyPlus and I'm going to walk you through this process of optimizing building performance.

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If you take a look at the graph here over on the left hand side of the graph, when we're starting out with our baseline facility we essentially have a certain utility bills we're paying per year. And as we implement measures we reduce the life cycle cost and we're moving down this cost curve that moves in this direction here. So each one of these dots that's represented here is a different combination of building designs I can implement within my facility. So if I move over to this case, for example, as I move across this screen I'm getting to in this case 40 to 50 percent energy savings through the integration of these design elements.

Really the cool innovative part of this is the ability to truly find kind of an optimal design point within an energy-modeling program. So each one of these represents a different set of energy efficiency measures that are implemented and then as I'm moving through here I'm layering on more and more of these ECMs and really capturing the interactive effects of each one of those.

What it also allows you to do is not invest money in projects that aren't going to get you a return. So this is another crucial piece that an optimization tool does a great job of. It allows me to hit a cost threshold without implementing additional items that don't give me additional savings. So in the future as we're moving forward with these deep retrofit projects we're going through this process of truly optimizing building performance and these energy-modeling tools are crucial to doing that.

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So eQUEST is another commercially available software tool that you can use. All of these modeling tools have a detailed description of the thermal properties, so the building envelope, the internal loads, the lighting and HVAC systems. Again, really taking into account these integrative effects of layering on these different opportunities that we're talking about.

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And then the final energy-modeling tool we wanted to let you know about is a tool called Open Studio. This tool is built with funding through Department of Energy's building technologies program and is the first kind of open source tool for modeling in EnergyPlus. It has a Google SketchUp front end to it; it allows you to go all the way through building an energy model. And then one of the neat features that's going to be released in the next version of this is it will have what's called a building component library within it which is going to allow you to essentially have the energy modeling community build components and keep them in an open source environment where other energy modelers can use these.

So if I create a chiller, for example, I can take that chiller that I've created and other people can use that later on. So really a neat way for people to build systems that can easily be used and shared with other energy modelers. So we're really excited about this software suite. But as we said, there are a number of software tools you can use out there and the main takeaway is that you need to be performing energy modeling as a part of this process.

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So ensuring persistent savings. Elaine covered most of these topics; we want to use energy modeling programs to identify effective ECMs. We want to make sure we're commissioning the measures that we're implementing. And commissioning is really just making sure that the measures are performing to a design intent. There are numerous measures that are going to be found within a commissioning effort that aren't working correctly, so a third party commissioning agent is crucial to making sure that those are caught and captured.

We also want to make sure that we're following up with correct operation and maintenance protocols and as Elaine had mentioned it's really important to implement measurement and tracking. I think one of the really neat things that energy modeling can provide for you is also an indication of where you should be for your subloads. So if I'm measuring my lighting system, for example, I know how much energy my lighting system should use and I can compare that to my model loads and see how well that model is comparing to my energy use over time. So measurement and tracking is a really critical part of this.

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So end use technologies.

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With the end use technologies discussion there are literally hundreds of technologies we could talk about. There's a limited time we have today so we're really going to focus on how do you integrate these strategies into a deep retrofit. So there's definitely a number of technologies that might not be mentioned today that are going to be implemented in deep retrofit projects but really what we're focused on is just kind of giving you an idea of how this process is different than a standard retrofit and then how these items get integrated into a deep retrofit.

So starting off with building envelope, building envelope is sometimes one of the most expensive systems to retrofit, and the energy savings associated with this is really a function of the building size. So your smaller facilities are going to have greater energy savings from building envelope retrofits than your larger facilities are. And there are also a number of other drivers that are going to be driving this. So for example if I have kind of thermal comfort complaints because of single-pane windows and leaky walls there's other reasons that I need to upgrade my building envelope that gives me kind of a segue to use that as an opportunity to build that into a deep retrofit.

So for building envelope opportunities here's standard retrofit items that are going to include things like adding roof insulation, doing a cool roof, air ceiling, blown in wall insulation, and then as you move into a deep retrofit really what you're doing is kind of optimizing these systems to include these passive opportunities as well as upgrading the thermal performance of the building envelope.

For example I'm going to be taking into consideration how daylighting is going to play within the building. Most times when building envelope is retrofitted daylighting has given little to no consideration. And so making sure that you're thinking through that is crucial. You also want to make sure that you're thinking through the process of selecting an appropriate glazing type, depending on which building envelope system you're retrofitting. And then other standard items like again, roof insulation, wall insulation and then upgrading the windows.

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So starting with building envelope roof retrofits -- roof retrofits are the most common retrofit because we regularly have to replace our roofs. It's a great time to add insulation and retrofit that in an energy efficient way.

So when we're doing a roof retrofit there's a few starting points you can take. One of those starting points is going to be to set a minimum R-value based on ASHRAE Standard 90.1 or one of the advanced energy design guides. As you can see here these are really aggressive insulation requirements so R30 to R60 is a lot of insulation in the roof either as kind of an exterior for foam board or an interior insulation. So one of the things you want to do is use this as a starting point but really fine-tune this number based on any limitations you have with your existing building construction, or the building location. So here's where an energy-modeling program comes into play to make sure you're really hitting that appropriate R value target.

Some other things to consider would be a cool roof, which is listed as a white roof here, and then also a green roof has a number of benefits relating to reducing heat island effect and reducing runoff. So again roof insulation is an important piece of this and the R-value should be determined through an iterative building modeling process.

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Wall retrofits. Wall retrofits are some of the trickiest measures to implement. They are definitely one of the more expensive ones to retrofit in a number of commercial buildings. As you can see from this picture here this is a facility modernization of a GSA facility where they're going through and refinishing all of the interior surfaces. So in this particular case they are adding wall insulation to the wall here and doing this is a part of the facility modernization.

Elaine mentioned some challenges associated with this: in historic structures you need to look at kind of the new dew point of the wall and how the airflow is going to move through that wall. So wall retrofits are some of the trickier ones but a crucial piece to ensuring thermal comfort within the assembly.

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Finally window retrofits. Everybody is familiar with window retrofits but I think one of the things we want to talk about is there's definitely three options you should consider when moving forward with a window retrofit. In all cases you don't have to come in and just replace the window. So one of the things you can do is put in an interior blast window. You're seeing this happening in a number of the GSA buildings in Washington, DC where it's adding blast protection and then at the same time adding essentially acting as a double-paned window where it's improving that performance of the window.

You can also refurbish the window. A really neat case study of that is the Empire State Building case study that RMI has worked on. And this bottom photograph here on the right is showing them refurbishing the windows from the Empire State Building. They actually added a Mylar film into the window and were able to achieve an R8 for that window. So really good R-values from refurbishing it and doing it at a cost threshold that is less than for a new window.

So two options to consider would be refurbishing the window, installing kind of a blast or storm window, and then finally installing a new window. And then as you're installing that new window you want to set pretty aggressive performance targets; you can see here that we're listing the DOE R5 bulk window purchase program which is essentially trying to promote R5 or triple pane windows and getting these manufacturers to manufacturer those.

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So to recap with building envelope, it's important to address the walls, the windows and the roof, and as you're doing all of those you're also addressing air ceiling within the facility. So as you're addressing those window retrofits you're sealing up that facility, making sure that you're putting in the appropriate windows for daylighting and then also making sure that it's sealed appropriately so that you can implement other types of HVAC projects that we'll talk about here in a minute.

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So for lighting -- lighting is one of the most common retrofit items within facilities. Standard retrofits are going to do things like retrofit existing fixtures, so I can take lamps and ballasts and change those out. I can put in occupancy sensors, replace exit signs. So these are all really common items that you will see implemented within a standard retrofit.

And then as we move to a deep retrofit we're really taking a fundamentally different approach to this. As a first step you want to make sure that you're determining the visual needs of the occupants, so I really want to make sure that I'm hitting appropriate illuminance levels within the space. And then after I've done that I'm determining and optimal lighting solution for that space. So for example I'm going to move towards using a lighting power density metric to determine the appropriate fixture type to actually meet a specific watts per square foot threshold that I want to hit with that. Then after I've done that I'm going to layer on daylighting controls and other advanced controls such as vacancy sensors and occupancy sensors.

But all of these bundled together fundamentally change the energy lighting use within a facility and lighting itself is experiencing technological advances faster than any other industry.

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So we're going to present you with numbers here today that are within current standards but have already been surpassed by some of the new solid state lighting standards. Again, you're seeing drastic improvements in lighting technologies.

So starting with daylighting. Daylighting is a very important piece of optimizing your lighting systems. And it's really challenging to do this correctly. You see facilities mess this up regularly. One of the biggest things is people will put in daylighting controls and they have no way of controlling direct sun in the windows; all of the occupants close the blinds and the daylighting controls don't do anything. So the first step is making sure that you have redirection devices that are controlling glare in the space and allowing direct sunlight in at some level.

So here we're showing some redirection blinds. The way that these work is the upper portion of the blinds would allow for natural daylighting to bounce into this space and the lower portion of the blinds -- the occupant can essentially close those blinds so that this is blocked. So this is a solution where you're always allowing daylighting into this space even if the occupant closes the blinds.

Another option is a light shelf that allows you to redirect the light into the space, and then again you want to make sure that you're maintaining a visual connection to the outside.

Daylighting in existing buildings is definitely harder to put in appropriate glare control than new facilities, so when you're doing this one you've got to kind of look at the facility itself and determine an appropriate solution.

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Lighting re-design considerations. We talked about this a second ago but really what we're doing is trying to find the appropriate illuminance levels for a space and then setting lighting power density. So that's a watts per square foot metric that we want to hit for a space. And both of these in some cases should be considered upper limits. So for example with an open office 30 to 50 foot candles; I'm really trying to hit an illuminance target closer to 30-foot candles, and doing that with a combination of overhead and task lighting.

And then with the lighting power density the same thing: we're listing lighting power densities here of 0.9 watts per square foot; there's no reason that you can't hit a target of 0.6 to 0.7 watts per square foot within these facilities. And with some of the new solid state lighting technologies you're seeing designs even below 0.5 watts per square foot. So there are opportunities to drastically reduce your energy usage.

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So here we'll show you kind of a neat case study that will illustrate this point. So if I look at this slide here over on the left hand side I've got an image of kind of a traditional layout of an older facility. Before we had computers so essentially any facility pre-1970 was really designing for drastically different illuminance levels. We're talking about 90-foot candle illuminance levels, and if I'm trying to lay out a space to meet a 90-foot candle illuminance level you can see that in this particular design I'm using 20 light fixtures to do that. So I'm using a lot of light fixtures to meet an illuminance target.

If I'm trying to retrofit that facility really I'm stuck with all of these light fixtures and all I can do is come in and change out the lamps and ballasts whereas if I have an opportunity to redesign that space I'm going to get rid of a bunch of those light fixtures. I'm going to put in a more efficient lighting fixture and I'm going to drastically reduce my energy usage. So here for example we're showing -- we've gone from 20 fixtures on the left to nine fixtures on the right. Just by setting an appropriate illuminance target, putting in a more efficient lighting fixture and then we're allowing ourselves to hit a really low watts per square foot threshold.

So that's what you want to do: you want to redesign the space, get in the appropriate light fixtures and then layer those with appropriate daylighting controls, occupancy sensor controls and vacancy sensor controls.

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So plug loads. Plug loads is one of the more challenging retrofit items to implement. Once I've implemented a building envelope measure it's typically in there for 30 to 50 years. Lighting measures is another fairly static measure. Plug loads, on the other hand, the occupants have a ton of control over their plug loads and it makes it really challenging to regulate these loads. So standard retrofit items are listed on the left; I'll just talk through a couple of those here but they're things like changing from desktop computers to laptops, computer power management and LED monitors.

Really what you're doing in a deep retrofit is similar to what we just talked through with lighting. We're taking a totally different approach to doing this; we're setting either a power density requirement or a workstation allowance. So for each workstation within the building you're only allowed to have so many watts per person and drastically different approach to the current approach that allows kind of this unregulated amount of watts per square foot or watts per person. And then we're laying on advanced controls. There are some really interesting plug load controls available today. You can do scheduled timers, there's load sensing plug strips which essentially would sense the loads on that plug strip and turn things into -- turn them off or into a low power state. And then occupancy sensor controls.

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Again with plug loads the industry is changing quickly and there's a lot of innovation happening that's allowing us to hit much lower plug load targets than we did just a couple of years ago.

If I'm hitting a power density or a workstation allowance we've provided two examples that you can use as starting points here. 0.55 watts per square foot is 50 percent above ASHRAE Standard 90.1. Another thing that you can do is hit a watts per workstation. So for example we're listing 60 watts per workstation, and really that is a huge difference between how we operated our plug loads a long time ago, even just as little as 10 to 15 years ago.

So if I walk through this, for example, we now have kind of combination LED LCD monitors, we now have LED task lighting instead of linear fluorescent task lighting. We have lower energy use computers, and even are being cognizant of the residual loads such as a phone load here. So really significant decreases in energy use. If I compare this to a workstation from the mid-Nineties my monitor alone would use over 100 watts, my computer is over 100 watts and my task lighting can be in the 30 to 60-watt range. So we're taking a workstation down from as high as 300 watts per workstation down to 60 watts or less.

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So for plug loads we're seeing some really interesting advancements in computing energy usage. A lot of the big computer manufacturers are really paying attention to energy usage and really offering some kind of green solutions here that allow you to provide computers for your employees that use considerably less energy. So for example a standard desktop computer is right around 80 to 100 watts; we're talking about computers that have the same processing power that use considerably less energy. So really exciting to kind of see this in the plug loads industry much lower energy usage with even better processing and memory power.

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So behavioral change. Behavioral change is a big part of plug loads. There's a few ways you can promote behavioral change. One of the first ones here is if I'm sub-metering my plug loads I can provide real-time feedback on how much plug load energy I'm using. I can do weekly prompting or an occupant competition. But again, really what you're wanting to do is layer these all with controls. I want to make sure that I have plug load controls in place that are regulating this and are not just leaving it up to the tenant to regulate themselves.

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So we've talked through the first three items there: building envelope, plug loads and lighting systems. Really those are all fundamentally implemented before you get into HVAC considerations. I want to reduce my loads as much as possible; it's not uncharacteristic to reduce your loads by as much as 50 percent before I go into designing my HVAC system and then given HVAC systems are so oversized it's not uncharacteristic to put in HVAC equipment that's less than half the capacity of what's currently in there. So as a first step I want to reduce my loads; second step is I want to implement efficient HVAC systems to serve those loads.

So standard retrofit items is stuff like converting constant volume, pumping to variable speed pumping, putting in variable frequency drives and HVAC controls, and then deep retrofits are really taking an innovative approach to either setting up performance reduction target or fundamentally changing the HVAC system that was in there.

So a couple examples we provided are constant to variable air volume HVAC systems, downsizing the equipment I'm putting in, and then these last four are really innovative ways HVAC systems are being applied in ways that really in the last 30 years they haven't been applied. So dedicated outside air with energy recovery -- so if I put energy recovery on my outside air ventilation I can reduce my ventilation loads by 50 percent.

Installing heat pumps is a huge way to reduce energy usage. We'll show you some really innovative ways where one building, one GSA building is going to reduce their heating energy use to $1/8^{th}$ of what it currently is with innovative heat pumps. So huge energy savings from heat pumps and then radiant heating and cooling allows me to provide heating and cooling to the facility at a much lower energy use than standard forced air systems. So really innovative ways to apply a combination of these strategies into a deep retrofit.

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The first building we're going to talk about -- this is a GSA building in Region 8. This is the Byron Rogers facility. This facility is in Denver, Colorado. This is a project from RMI. RMH is actually the mechanical design firm that we're going to talk through their design here. But they did an excellent job of really bringing innovative concepts into this deep retrofit process that RMI has helped to spearhead. This is an excellent way to illustrate a number of concepts here.

One of the things they've done is starting with the building envelope they've put in new windows and new insulation to seal the envelope up. They've come in and put in a radiant heating and cooling system, so this is actually chilled beams you're seeing throughout the facility here. Those chilled beams -- we'll show you how those are being served but those serve the building loads and the ventilation loads within the space are handled through dedicated outside air with energy recovery. Then this system also includes thermal energy storage. They can actually store thermal energy and use it later in the day.

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Really one of the neat things they've done with this facility is figured out how to use heat pumps to move energy around. So one of the things they're doing for this particular design is this is showing you a case study where I have early morning sun coming and hitting the side of the building. This would be kind of a fall day where it's going to be kind of cold outside. So I've got early morning sun heating up one side of the facility. And then the other side of the facility is cold. So this side needs cooling; this side needs heating.

What they've done is they've taken the chiller for the facility, they're running cold water through these chilled beams on this side of the facility and then -- so they're pulling the heat from one side of the facility and using it to heat the other side of the facility. They're able to run such a low delta T through those chilled beams that they're hitting really low energy usage levels. Where this chiller, again, can operate at below 0.3 kilowatts per ton, which correlates to 1/8$^{th}$ of the energy use of the original energy heating system. And this particular facility hit a reduction target of 60 to 70 percent. So huge energy savings, and the baseline for the building was similar to kind of the GSA national energy for energy use intensity. So really cool project, really neat to see what they're doing there.

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Another way to use heat pumps is what's called a water loop heat pump system. This particular building, it had air-handling units that served the interior and exterior of the building. When you get into these larger commercial buildings sometimes if I'm taking a look at this zone here I'm always in cooling mode. So it can be the middle of the winter and I need air conditioning to cool the middle of the building. So what you can do is take that heat that typically gets exhausted from the building and use that heat to heat the perimeter of the building. So I'm taking that heat from the middle and using it to heat the perimeter in the wintertime. And by putting in heat pumps in the perimeter of the space I'm also reducing the energy use to provide that heating and cooling.

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So this particular design -- I'm going to skip through the majority of this but in heating mode essentially what's happening here is I have an air-handling unit that's cooling the space. I'm taking that heat to heat the perimeter of the building all through the mechanical chiller within the space and a supplementary boiler. So really neat way to approach HVAC and huge energy savings here, modeled savings at over 60 percent relative to the baseline HVAC system.

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And then finally controls. I think we've talked about this a lot but the main thing we're doing with controls is integrating all of our energy systems. We're integrating with HVAC, with lighting and with plug loads and making sure that those are all working to control the building properly.

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Last thing I'm going to go through here is renewable energy. Once you've optimized your energy usage of your facility your last step is to install renewable energy to meet your reduced loads.

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And significantly reduced loads as we've talked about here. There are some nice guides that are listed here for helping you integrate renewables into building construction. FEMP is developing a new guide that's going to be released soon that will walk you through the process of integrating renewables into major renovations. So definitely keep your eye out for those resources.

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And I'm going to quickly go through this but as you're retrofitting a system you want to look at these renewable energy options. So there are a number of renewable energy options that should be considered and implemented into your facility as you're retrofitting those.

All right so I'm going to turn it back over to Kathy.

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*Kathy Hyland:* Okay. Back to Elaine; she's going to talk about some case studies and then our time is limited so if you'll start phone in your questions.

*Elaine Gallagher Adams:* Thank you. I'm going to be -- try to be very respectful of your time and go through two quick case studies that we think are very interesting.

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The first one was a project that RMI got involved with a few years ago; it's the Indianapolis City County Building. Problematic when it comes to energy efficiency; it was constructed in 1959, modeled after the U.N. Secretariat building. All glass, obviously. Fairly high-energy use already. But the real key to this was the integrative design process and we got everybody together at the beginning of the project, got a very diverse group of people together in one room for three days, and ultimately learned that since 1959 groundwater had been pumped out of the lower level of this building for by now close to 40 years.

It was determined very quickly, because we had a lot of engineers in the room, that that building could be heated and cooled through that groundwater. So immediately the entire conservation shifted and we went toward trying to use that wonderful resource we had onsite to change the course of our energy project.

They recently signed an ESPC with a local ESCO to create regional jobs that was very important and estimated cost savings is 59 percent. That's huge. And that's not even as deep as they could go. The building I believe is scheduled for even further retrofits to address daylighting and better office layouts. So they're going to go even farther. It was a tremendous success, and now I look for groundwater wherever I go; it's a real asset.

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It did include some interior work, including some pilot projects for the retrofit since some lighting upgrades. The building itself has lots of envelope issues that have yet to be addressed too. But just in that one big project we were able to get quite a lot of savings. So keep your eye on that; the case study is available on our website: retrofitdepot.org.

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Then there's the Wayne Aspinall Building which is a GSA building in western Colorado. It is an historic building, and this project is very exciting to me just coming from historic preservation in that their goal is to be the first net zero energy building on the National Register of Historic Places. It also was -- and one of the inspirations for the new guidelines for sustainable historic preservation under the Secretary of the Interior Standards for Rehabilitation: if you're working with an historic building don't discount the option to go net zero. A lot of times you can optimize the existing the original sustainable aspects, the original energy efficiency and daylighting aspects to create a really wonderful contemporary space in these historic buildings and save a lot of energy. So keep your eye on this one too; I believe it's under construction and it's very exciting for Colorado Region 8 to be able to do this.

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I'm not going to go through all the details but understand that it did include the right steps in the right order that we talked about, ultimately including renewables: 123 kW roof and canopy system. Again, you can put renewables on an historic building; it's not impossible, and the new guidelines do outline ways to do that and ways to approach that.

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There are tools and resources online; please use them. The EERE website is there, the Advanced Energy Design Guides are there for major retrofits as well as the Advanced Energy Retrofit Guides. And again there are six of them coming; I believe there's four of them right now so it's very exciting to see these coming out; they're long overdue.

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At Rocky Mountain Institute we just released our retrofit guides; we have three of them in total. We have Managing Deep Retrofits, Identifying Opportunities, and coming within a few weeks is Building the Case. So those of you who are working in financing look for that one. These are getting great reviews so far.

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Contacts and questions: here we are, don't hesitate to contact us with any questions.

*Kathy Hyland:* Okay now it's time for your questions. I have a few already and if you will call in your questions. Ab I'm going to direct this first one to you; it is from an energy manager. He was very interested in the plug load discussion and "I was really interested in implementing some of that however," he said, "many of the items are agency items and in a GSA building, for example GSA doesn't control items like desktop printers, monitors, etc. How can we address these issues?

*Ab Ream:* Well that's a very good question. You know, there's ways of setting policies as to what the use of those plug loads are. NREL, for example, out at their new facility out in Colorado basically set a policy against desktop computers, for example. You don't see any space heaters in there; everybody's gone to laptops. So there are ways of controlling that plug load even if you don't own the building but you have a say in how people use the building. So don't let that stop you; there are ways of getting around that.

*Kathy Hyland:* Thank you Ab. Jesse the next question I'll direct towards you. The questions from Keith Dugas in the USC Army and he was really interested in those energy modeling tools and was wondering if you could give that website again or where you might find those.

*Ab Ream:* Sure. So the eQUEST software tool is available -- if you just do a Google search for eQUEST, eQUEST Energy Modeling that will come up. I think it's Do-to.eQUEST but anyway that one will come up there. The BEopt software tool is available through the NREL website. So if you go to NREL's website and look for BEopt you'll find a link to that and then they'll also give you the names of someone to contact to get that program. Not sure if that one is available as a direct download, as an executable from the website.

And then the Open Studio tools are available through EERE's building technologies program so you'll need to install Energy Plus and then as a next step you'll need to download the Open Studio tools which you'll have a link for there.

*Kathy Hyland:* Thank you. Elaine let me direct this question to you. It says "I have a building with some relatively serious building envelope issues resulting in moisture problems. Right now that building is being considered for closure and new space being developed. What would make use consider a deep retrofit as opposed to new construction?

*Elaine Gallagher Adams:* Well I would say to that -- again, go back to the motivators. If the agency is closely calculating their carbon footprint and carbon more and more is coming into the equation then it is always better to reuse an existing building when you're counting carbon than to build a new one, especially even if you have to just gut it and take it down to its core. It's still better environmentally to reuse a building.

Now coming from historic preservation I never met a building I couldn't reuse so I'm not necessarily one who believes that the only option is ever to build a new building.

*Kathy Hyland:* Okay we have Liz from New York on the phone. Liz can you hear us?

*Liz:* Yes. I was just wondering if there'll be a guide for residential buildings, particularly multi-family coming out anytime soon?

*Kathy Hyland:* Elaine, a guide for residential buildings?

*Elaine Gallagher Adams:* You know, I'm not in that loop, not that I know of.

*Jesse Dean:* Yeah, I'm not sure either.

*Elaine Gallagher Adams:* I haven't heard of one yet.

*Kathy Hyland:* We'll put that on the request list.

*Liz:* Okay that sounds great.

*Kathy Hyland:* Okay Ab, I have a question for you. It says are ESPCs and UESCs the primary ways to finance these projects? Are there other creative ways given capital budgets these days?

*Ab Ream:* That's a good question. Of course if you have wads of appropriated funds I would advise to use them on your projects but that not always is the case as we all know. And so the best way to go about it is to look at alternative financing and that of course is ESPCs using private sector or third party financing. There are plenty of utilities out there that are more than happy to work with you to do something similar to ESPC.

Recently we've seen an uptick in the use of power purchase agreements particularly for renewable energy projects after you've taken care of your energy efficiency measures and you start moving into that arena. There's utilities that still offer incentives and rebates and you should take advantage of those and in the case of the federal government rebates can be handled by going to the contractor and taking down the initial cost of the project since it's hard for the federal government to take those rebates and go cash the check. So there are lots of opportunities out there.

The ENABLE program is going into pilot phase right now and we're hoping that that sets the stage for being able to do lots of smaller projects at smaller facilities out there in a very streamlined fashion so look for that to come in the near future. So that would be my advice there.

So appropriated funds, if you have them, if you have operations and maintenance kinds of fixes at your facilities it's conceivable that you could use your O&M budget to do a lot of that so there's a combination of things. So I think Elaine called it lasagna layering of opportunities and I think that's how you have to approach it.

*Kathy Hyland:* Okay fantastic. Elaine I have another question for you: "In a federal building how do I make sure I'm getting a deep retrofit instead of isolated ECMs and how can I write specific language that addresses that?"

*Elaine Gallagher Adams:* Well I would start right in the contracting process. You know, to initiate an integrative approach and to get a deep energy retrofit it's got to start right from the beginning and that includes choosing a really integrative design team and making sure that that's what you're getting, allowing for some performance bonuses. Again we talked about the contracting mechanisms that can allow for deep energy retrofits to really push the envelope and that's a great way to do it. And really that's where I would start is going first for an integrative team.

*Kathy Hyland:* Thank you, Elaine. Jesse I have a question for you: says, "I'm in a hot, humid environment. What are some of the technical considerations for deep retrofits based on my climate zone?"

*Jesse Dean:* That's a good question. So some of the things that you're going to consider there is I'm going to take a different approach to installing windows. I want to install windows with a really low solar heat gain coefficient. I also want to try to shade the windows as much as possible and then really reducing internal loads and then addressing the humidity loads is important. So things like energy recovery ventilators that will remove the moisture from the outside air is crucial to that.

NREL is working on a new technology, liquid desiccant-based technology that is also going to be a lower energy use solution to removing humidity from the air, but really my focus is reducing internal loads and then reducing the humidity loads as well.

*Kathy Hyland:* Ab this one's for you: "How can I make sure that the architectural engineering firm who performs the work on my building has sufficient expertise to perform a deep retrofit?"

*Ab Ream:* Well that's a good question and I think Elaine alluded to this earlier. It's a little bit difficult to tell but we're certainly looking for people who understand the deep retrofit concept. It's good to have people who have experience, people who have references, people who have projects completed that you can look at and you can gain some knowledge of how well they've done. Deep retrofits are definitely not your father's retrofits. In the past we've taken ECMs one at a time, we've replaced a piece of equipment with a like piece of equipment with a slightly better efficiency. And what we're getting at here is that's really not an acceptable way to go about it. So you need a company who's really got a handle on that: holistic, systematic approach as opposed to someone who is old school looking at replacing one for one pieces of equipment and calling it a day. So I think you can build into your qualifications criteria when you're going out with your RFP, here's the type of firm I'm looking for, here's the type of experience I need, here's the type of projects, here's what I'm looking for and make sure you write that criteria so that you are better insured of getting the right company to help you.

*Kathy Hyland:* Thanks Ab. Last question I'm going to direct towards Elaine. Elaine: "Integrative design sounds great on paper but it seems like it would be complicated to implement. I believe I have the ideal facility; how would I get started?"

*Elaine Gallagher Adams:* I would start with some of the online resources for implementing integrative design. As an architect I am a member of AIA; AIA has a lot of really good resources on integrative project delivery, which we call IPD and they have a terrific guideline as to a couple of other professional organizations. I would start there; get a really good handle on what that's about and how that can work for you to really transform how you contract these projects.

*Kathy Hyland:* Great. Thank you, Elaine.

Before I return to close let's look at some of the upcoming First Thursday Seminars and the First Thursday Seminars that are available 24/7 to meet your training needs.

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We'd like to thank our instructors Jesse Dean, Elaine Gallagher Adams and Ab Ream. We'd also like to thank FEMP for sponsoring the First Thursday Seminars and thank you for joining us today. We'll see you on Thursday August 2nd for "Placing UESC Task Orders Under a GSA Area-wide Contract".

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