

**Question and Answer Session from the
Implementing Recommendations from the Advanced Energy Design Guide (AEDG) for K-12 School Buildings Webcast**

This document captures the questions that were submitted during the *Implementing Recommendations from the Advanced Energy Design Guide for K-12 School Buildings* webcast on April 16, 2009. The webcast was presented by the U.S. Department of Energy's EnergySmart Schools program. A recorded version of the webcast is available at http://www1.eere.energy.gov/buildings/energysmartschools/aedg_webinar.html.

Question	Category	Answer
How does the Advanced Energy Design Guide (AEDG) compare to 90.1-2007?	AEDG Development	At the time the guide was written, 90.1-2007 was not out yet, and to be consistent with the previous guides, our primary baseline was 90.1-1999. However, we did the analysis to show 30 percent savings over 90.1-2004 as well. So in general, 90.1-2007 is slightly better than 2004, but we have not done the analysis to show how much better.
How does one adjust for schools that are much smaller than the schools in the guide?	AEDG Development	The best way to do that is to look at the recommendations by space type. For example, what the recommendations would be for a classroom, and apply that to smaller schools. If there are only a few classrooms, the classroom recommendations still apply, as well as the envelope recommendations and mechanical systems recommendations. However, our modeling is not for small schools and included typical space types for larger schools, so we have to be careful there.
Why does the AEDG use ASHRAE 90.1-1999 as the code comparison rather than 90.1-2007?	AEDG Development	At the time that the Guide series was developed, 1999 was the most common and widely available guide that was out there and that information has carried through the standard. We have provided information on the current K-12 Guide according to 2004 in our technical support document (http://www.nrel.gov/docs/fy07osti/42114.pdf). Also, according to the AEDG FAQ (see http://www.ashrae.org/technology/page/1040) buildings built to Standard 90.1 are being used as a benchmark or a base for comparative purposes - analogous to the base year being used as 100 for the consumer price index. The particular version of the standard used is not as critical as having a well-defined starting point and maintaining continuity between the various Guides in the AEDG series. The 2004 version was not approved before the initial Guide was completed, so it was therefore not suitable to be used as the base. Subsequent Guides are using the same base in order to maintain continuity within the series.
How does AEDG compare to ENERGY STAR [®] rated buildings (score of 75)?	AEDG Development	So part of the issue with comparing to ENERGY STAR rating versus a percent savings over code is that ENERGY STAR compares your energy use to an existing stock of schools whereas energy code analysis where you calculate percent savings compares to a theoretical code minimum building. It's not necessarily a one-to-one mapping if you get 30% savings in your school to an ENERGY STAR score of 75, for example. We have seen some schools that have 30%-40% savings which have very good ENERGY STAR scores, but it's not a direct one-to-one mapping. So we encourage you to do both analyses to determine what those are.

Question	Category	Answer
<p>Are there plans to update the information in the Guide based on a comparison to ASHRAE 90.1- 2004? If not, what factor can we use to extrapolate/interpret the relative performances in the guide to translate (roughly) performance from ASHRAE 90.1-1999 as compared to ASHRAE 90.1-2004?</p>	<p>AEDG Development</p>	<p>In general you can meet the 30% over 2004 if you pick the daylighting option in the Guide.</p>
<p>Are there any plans to publish AEDG guides for assembly type of uses?</p>	<p>AEDG Development</p>	<p>There are some questions on producing guides for individual types of spaces that you might find in schools. At the moment, there are no plans to do individual subsections of buildings. We have provided some specialized guidance in this Guide, as well as other guides in the series. There is a guide on warehouses, highway lodging; small healthcare is going to be coming out shortly and small office. So you might refer to some of those other guides if you think that you have a need for more specific information, especially if you were designing say the office area of a school and you want more information about making the office area more efficient, I would refer you to the small office guide.</p>
<p>From what I understand this guide is basically modeled criteria with respect to Appendix G and 30% increase is with respect to Appendix G. Was an LCCA done for all these ECMS or are they based on lessons learned?</p>	<p>AEDG Development</p>	<p>We got a couple questions about how the recommendations were developed, whether they were based on a lifecycle analysis or were they just based on best practices or lessons learned. It's a combination of both really. So there's a lot of lifecycle analysis done on the envelope recommendation, for example. The way the current codes have been developed, they've done a lot of lifecycle analysis based on the different insulation levels of the various wall types and so we did a lot of that analysis for developing the envelope recommendations, the wall insulation, the roof insulation, the windows, and such. So that analysis was carried through to develop the recommendations for envelope measures. A lot of the other recommendations, such as the HVAC systems efficiency, were generally based on the best practices available from our project committee, the industry experts that have been designing high performance schools, and so it was a combination of both some lifecycle analysis as well as best practices.</p>
<p>Will these Guides replace standard codes by school districts such as ASHRAE standard 90.1?</p>	<p>AEDG Development</p>	<p>No, the intent of these Guides is to be a guide not necessarily a guideline, a standard. They provide recommendations for going beyond current codes. They are special publications through the ASHRAE process that provide a way but not the only way for achieving a level of energy efficiency. The documents are not written in standard code language. They're written to be easy to use so you can follow recommendations and case studies. The standards will become more and more stringent going forward. ASHRAE 90.1 is intending to make their current standards 30 percent more efficient than where they currently are. They'll be using a lot of the recommendations in this Guide to develop that next generation of standards. In addition there's an ASHRAE standard 189.1 for high performance buildings, commercial buildings, green buildings and so a lot of the recommendations that are in the Guide are also finding their way into those standard development processes.</p>

Question	Category	Answer
A 30% energy savings sounds like a very significant energy savings. Do I have to use some sort of new exotic technology that might break in three years, or how do you get to this big goal?	AEDG Development	The recommendations in the Guide were developed specifically to be available for multiple manufacturers. Things that can be purchased readily have been used over time and are well proven strategies. 30% savings in a school does sound like a big chunk of energy efficiency. But from looking at the current state of the art schools recently that have been put together, 30% is not a stretch goal. And there are often times that schools are approaching 50% savings now. And so 30% is becoming kind of a starting point a lot of times for districts that are trying to go beyond energy code, and this Guide's been a great resource for those districts and designers as a minimum starting point to integrate the team to get significant energy efficiency.
So I've noticed that the Guide does not specifically address certain space types like pools and chemistry labs or machine shops. So where can I go to get recommendations on how to increase energy efficiency in those spaces as well?	AEDG Development	Yes, that's correct. The Guide focuses on space types that are typical for these K through 12 schools, and you might think that pools are fairly typical but in reality a lot of new schools don't have pools built into them. So we excluded those space types because they aren't as typical as some of the other space types that we did include for efficiency. ASHRAE has great resources available for all sorts of space types including specifically pools and how to condition those. And so you can go to ASHRAE.org and find all sorts of their Design Guides related to non-school specific spaces.
How do the climate zones in this reference guide align and/or relate to the California climate zones.	Climate Zone	The climate zones are based on the U.S. climate zones. I know California has a more detailed set of climate zones that have the same types of requirements based on temperature and humidity as the national climate zones but with more detail. You'll have to investigate how the U.S. climate zones are defined and compare those to the California climate zones. There's no direct comparison, though, that we have done.
Have you calculated the energy use graph based on a variety of climates at different times of the year? For example, in Florida in the summer the cooling use would be much higher than it would be in summer in Seattle, WA.	Climate Zone	If you take a look at the link for the technical support document (see http://www.nrel.gov/docs/fy07osti/42114.pdf), you will see how we did the modeling for every single climate zone and, you're right, in Florida, there's lots more air conditioning than in Seattle. That's apparent and the recommendations are reflective of that difference.
On your Slide #109 you state "Better if not a member of a design or construction organization." I would think you mean to "choose the best qualified with experience in design and construction as a 3rd party independent Cx agent."	Commissioning	That's correct. You would think that we would choose the best qualified with experience in design and construction as a third party.

Question	Category	Answer
How important is commissioning in this whole process? And what is commissioning?	Commissioning	Building commissioning is a systematic process of ensuring that a building performs in accordance with the design intent, contract documents, and the owner's operational needs. So commissioning is important for sure. We spent a lot of time in the Guide talking about it and trying to integrate it into the process. And it can be very important for a district. Or some districts have in-house commissioning and have lots of expertise already in house and don't necessarily need an outside commissioning authority to make sure this process goes through. And so there's various levels of commissioning that are important from the standard commissioning to more detailed commissioning process that may be needed for a district where this is all new to them. And so they're somewhat uncertain about how this is all going to work together. And so then that third party commissioning would be a critical part to make sure this is all going to work when the building gets turned over and is operated as efficiently as possible.
What is the C-factor and F-factor?	Definition	C-factor, as defined in 90.1-2004, is the thermal conductance, the time rate of steady state heat flow through the material or construction. The F-factor is the perimeter heat loss factor for slab-on grade floors, and it's based on how much insulation is around the perimeter of a slab-on grade. 90.1-2004 has those official definitions.
Why are computers not included in commercial building energy use?	Definition	On slide 6, it shows computer usage as 3%. That is predominately the data side of it, data center servers, et cetera. There's also some IT or computer infrastructure and the actual computers and the office equipment.
What are plug loads?	Definition	We basically call plug loads anything that is not heating, ventilating, air-conditioning, or lighting loads, but it ranges from all of the things that we plug in, which could be computers and coffee pots and microwaves, all the way to equipment that is hardwired into the building such as elevators, smoke alarms, security systems, et cetera, are all classified in the plug load category. It is important to remember that those things add up and are significant. I was recently in a school and they had a small auditorium with a rack of equipment that did audio and some projection, et cetera, and it was on all the time and its load was about 3,000 watts running continuously and so we need to think through the plug loads because they are a significant portion of what these buildings use.
What is mass wall?	Definition	The Guide has recommendations for insulation levels for what we call mass wall. Typically that's a tilt up or a concrete or a masonry wall construction type. The code specifies different types of insulation for those construction types versus a steel stud or a wood stud construction type. We refer to mass walls as those that typically have more mass and are built and have different construction techniques and therefore different insulation techniques in the Guide.
Please clarify U-factor.	Definition	U-factor is the reciprocal of R-factor. R-factor is the number that you quite often see on the back of insulation that's printed there. U-factor is the reciprocal of that. So if you have an R-10 piece of insulation, its U-factor is 0.1 or one-tenth. It's proportional to the amount of heat transfer that that wall can conduct. It is usually used in specifying window and window constructions and therefore the lower the U-value, the better the window is at resisting the heat flow.
Please confirm - Do you use gross area for all square feet? The same for a gym which is double height usually?	Definition	When we talk about energy use intensity or energy use per square foot we are referring to gross area for the total square footage in a school even for spaces such as a high volume gym; it's the gross square footage in all our square footage numbers.

Question	Category	Answer
You mentioned something about a design charette earlier and I'm not familiar with that term. Can you talk about what that is a little bit?	Design	So a design charette is a fairly loose term relating to a point in the design process as early as possible, typically during conceptual design. During a design charette a lot of the key stakeholders in the project, the engineers and architects and energy modelers and say daylighting experts, the facilities folks that have to actually operate these buildings, often times students and teachers are involved as well as the builder and the cost estimator and the superintendent or the school district, whoever is making those decisions related to what's actually going to be built. They come together early on to set energy goals and sustainability goals and address why you would want to do an energy efficient school and so that everyone can buy into those goals and start to think about what's needed early on to reach those goals. And so that's the intent of a charette is to have buy in into energy and sustainability goals, and to then get follow through and direction to the design team to go forth and start to develop designs to meet those goals.
What are the recommended energy model software programs?	Energy Modeling	The guide doesn't necessarily recommend what software to use. The U.S. Department of Energy provides information about energy modeling software including a software tools directory and a listing of qualified software for commercial building tax deductions. Visit http://www1.eere.energy.gov/buildings/info_software.html .
Do you have comparison data between modeled energy consumption projections and actual usage data after project completion? If so, how does it compare?	Energy Modeling	We've done a lot of that work where we've done the modeling upfront in the design and then gone back and have done detailed end-use monitoring and each project's different. Typically, plug loads are very hard to estimate in the design, and so once you're able to measure those in detail and then put those into your energy model, you can get a much better energy model that estimates the energy use much more closely. So it is definitely all over the place in terms of how accurate it is and how the energy model understands things like plug loads and operations.
None of the vertical fenestration descriptions in your table (slide 46) fulfilled all three recommendations for recommended "U factor, SHGC, and high VLT (greater than 65% vs. 30% in the examples). Can you please give examples of some that do meet low U-factor, low SHGC and high VLT?	Envelope	There are examples out there of current windows that do meet those three requirements of solar heat gain, visible transmittance and U factor. There are window types – double pane, low heat, typically – that are specified to have high visible transmittance and low solar heat gain. So yes, the table did not have examples of that specific window, but for those types of windows they're definitely available and there are various manufacturers that provide that.
R-values don't factor in the benefits of Radiant Foil Insulations?	Envelope	So I think the question is in general where the radiant barrier is. The R-factors are for the whole assembly which would include a radiant foil barrier and so that would have to be considered when calculating the whole assembly R-value.
Does the guide have recommendations for air barrier design?	Envelope	In the Guide, tip EN18 relates to air barriers and specifically about controlling infiltration, how to minimize the infiltration or exfiltration through your envelope, so there's lots of good recommendations there.
Why are the recommendations for wall insulation seemingly low? For example, climate zone 3 steel or wood framed walls call for only R13 as opposed to R-19?	Envelope	The recommendations in the Guide do not exceed code in some climate zones that are fairly temperate, the idea being that a lot of the energy savings come from things like daylighting and lighting design as well as outdoor air control because the climate is so temperate it increases infiltration in walls or in roofs. Where there's fairly little heat loss or gain because the climate is so temperate the Guide focused more on other strategies to get the 30% savings.

Question	Category	Answer
<p>I'm in a hot climate, and we want to use mass walls in our new school. Does that make sense? And is there a way to do it that would be most advantageous to the school?</p>	Envelope	<p>So on the energy side, there are lots of reasons to choose high mass construction techniques. On the durability, longevity side mass walls are always a favorite of school districts because they require minimal maintenance long term with all the banging and kicking and harassment that they get over the years. And so on the energy side the Guide provides recommendations for mass walls to help dampen out temperature fluctuations. And they also provide recommendations for how to well insulate those walls by having a mass wall with continuous insulation.</p>
<p>In some of the projects we've worked on we've seen significant problems in air infiltration and its effect for instance in hot, humid climates on mold growth inside the classroom or in general spaces throughout the school. And then also in cold, dry climates we have seen some major issues concerning localized discomfort from someone sitting next to the exterior envelope as well as significantly increased heating loads due to that. What do you recommend in terms of controlling air infiltration based on recommendations on the building envelope?</p>	Envelope	<p>The Guide provides recommendations for air barrier materials and continuous air barriers, especially addressing the joints and trying to make the holes in the walls and the roof should definitely be addressed to make sure all the joints are tight. There should be connections made between the foundation and the walls, the walls and the windows or the doors, between different wall systems. All the points in the envelope where there's different material types that have joints need to be addressed for air penetrations. A big key to get this right is to make sure this is all installed correctly. So there should be lots of attention paid to making sure that all these continuous air barrier systems are well sealed and installed to make sure that you have a good air barrier. There are ways to test that after the fact, things like blower door tests to address a building's infiltration is a potential to determine how well that was installed and designed. It's also an issue if you have significant ex-filtration. The building is pressurized is that if you have an energy recovery device and you're trying to capture all your exhaust air that is being pushed out through your envelope, you have minimal exhaust air to recover energy from. And so to make an energy recovery unit work, you really have to address these ex-filtration and infiltration issues as well.</p>
<p>You mentioned a blower door test. What exactly is that, and how can you use that to improve reducing infiltration or ex-filtration?</p>	Envelope	<p>A blower door test is a method to artificially create a pressure differential between the inside and the outside to evaluate how much air will be pushed through or sucked through your wall to replicate what a building would see for infiltration with normal wind and pressurization regimes. The intent is to be able to test how well the air barrier was constructed and designed after the fact and to find leaks, any leaks that are possible to be filled with caulking or other air barrier issues. It's becoming more and more of an issue related to how tightly sealed up these schools are. It hasn't been addressed typically in previous energy issues, and so we're starting to see it be a significant energy control issue.</p>

Question	Category	Answer
<p>I've heard from some local school districts in my area that they've actually started to switch over blow in insulation to maintain as much of a continuous insulation as possible as well as a way to seal up leaks that might happen around certain wall details such as the window wall connections or the wall roof connections. What do you feel about using rigid insulation versus a blow on insulation application?</p>	Envelope	<p>The Guide has R-value recommendations for continuous insulation as well as for insulation for standard steel stud or wood stud framing systems. And it also provides an appendix for equivalent wall assemblies for overall assembly U-values for other wall types. And so recently we've been looking at that exact issue related to a tilt-up concrete wall with steel stud furring on the inside that's held back two inches from that concrete wall and then blowing that with some sort of foam insulation. So it comes down to a cost and a performance issue. And what we're seeing now is that that wall assembly type potentially has a similar cost to a tilt up sandwiched panel wall type that may have two inches of concrete on the outside and two inches of foam continuous insulation foam which would meet the recommendations in the Guide, and then say four inches of concrete in the interior. The biggest differences between those are infiltration and an air barrier blown in foam insulation system can get those hard cracks. It really seals up the walls well and addresses these infiltration issues for sure, and it gets you a continuous layer of insulation where you don't have thermal bridging with your metal studs. It's a question of cost at that point and performance. If infiltration is seen as a serious issue and you have hard times with construction and quality assurance during the installation of say a tilt up concrete system or a sandwich panel system, that's definitely a strategy to address.</p>
<p>You were talking about pressurizing the school to prevent infiltration but it would also have somewhat of a negative effect. You'd lose some of your conditioned air through ex-filtration. The other important detail about that is how do you get access to dedicated exhaust areas such as in the kitchen or in the bathrooms? How do you recommend getting access to that exhaust air so that you can use that to regenerate your outdoor air coming in through an energy recovery ventilation system?</p>	Envelope	<p>To get access to all the places in a school that have dedicated exhaust systems, it takes some upfront thinking and planning during the early stages of design when the programming and the siting decisions are being made. If those can be made with some understanding of where all these exhausts typically are then you can minimize the exhaust duct work back to your outdoor air system. A strategic approach involves an integrated process addressing energy recovery and the potentials from different various exhaust streams. The goal is to try to minimize the amount of duct work you need to get from your exhaust sources back to your outdoor air system. This can be an effective way to maximize the potential for energy recovery from all of your exhaust streams.</p>
<p>How do you handle the extra cost associated with energy saving features?</p>	Financial	<p>What we have found is that people upfront say, "I want to build a school that has a set energy goal," and in this case today we've been talking about 30%. If it is part of the design criteria upfront the design team will work to integrate all these pieces together just like all of the other project requirements that are out there to get a project that meets a fixed budget and we've seen that quite successfully in many cases.</p>

Question	Category	Answer
<p>This is a question I had in terms of the economics of making these decisions for improving the performance of the school. Noticed throughout the Design Guide that there wasn't much focus on say economic issues such as life cycle cost or simple payback period. What was the driving force to not put these in the Design Guide? And how should a design team reconcile what's in the Design Guide with what is best for getting the most bang for your buck for the design of the school?</p>	Financial	<p>Right. So the Design Guide, the primary purpose of the Guide was to get to a 30% savings. The way that the recommendations were put together was by a team of experts in energy efficiency in school design and operation. Based on those experts' experience designing energy-efficient schools and their best practices for what has been cost effective in their past projects, that's how a lot of the recommendations were developed. There are recommendations for doing life cycle costing and for a design team to look at their specific project. Costs can vary depending on the time of the year and the location, the country and all sorts of other things that influence fluctuation in capital costs. It's part of the integrated design process to do life cycle costing in order to make the best capital cost tradeoffs and economic decisions.</p>
<p>In a heating dominated zone, efficient lighting will increase the heating load. Is there any design solution in this regard?</p>	HVAC	<p>In general, it is more efficient and better to heat your building with your heating system rather than your lights, and so the high efficiency HVAC is recommended in heating-dominated climates and daylighting is still recommended with high efficiency lighting.</p>
<p>Slide for HV 9 & HV 14 underlines either - is there never a case where both would be a benefit?</p>	HVAC	<p>I believe that would mean energy recovery in CO2 control. Demand-controlled ventilation, I think, is the question. In general, to get to a 30% savings at least, energy recovery or demand-controlled ventilation is what we're recommending. You can definitely do both. You have diminishing returns if you do one or the other. So to get to, say, maybe 50%, you may have to do both. But at 30%, the guide recommends one or the other.</p>
<p>I have a question regarding the HVAC unit. In a climate where the cooling load is predominantly driven by dehumidification, what's the best, most energy efficient way to handle that?</p>	HVAC	<p>So yes, that's a good question. And the Guide has some recommendations related to dedicated dehumidification strategies. It's key to be able to handle a dedicated dehumidification strategy rather than trying to do a control based on sensible cooling requirements and then hoping that the dehumidification is addressed. And so to address something like that with a dedicated outdoor air system that is solely doing dehumidification and cooling independent of the zone level loads is a recommendation that's in the Guide.</p>
<p>Is there any effort to get LEED® 2009 projects using Option 2 (Prescriptive Compliance Path, ASHRAE Advanced Energy Design Guide) to be recognized for more than a single point? There are now up to 19 points available for LEED for Schools 2009 projects, and earning only 1 point does not seem commensurate with the level of achievement of complying with this guide.</p>	LEED	<p>We attempted to, but the LEED EA tag felt that because it is based on 90.1-1999 and 30% savings over that and that the code is getting better and better and LEED is referencing 90.1-2007 now, so they were hesitant to give it any more than a single point.</p>

Question	Category	Answer
<p>You mentioned that the AEDG can be used as a prescriptive compliance path for LEED. Can you explain more about this? I'm looking at LEED for Schools 2007 now and it doesn't specifically list the AEDG as an acceptable prescriptive compliance path. Also, if AEDG gives me only one point in LEED 2009 that really is not that much considering how many points you can obtain in the Optimize Energy Performance category in LEED 2009?</p>	LEED	<p>See http://www.usgbc.org/ShowFile.aspx?DocumentID=3921 for a memo from the USGBC regarding the Advanced Energy Design Guide for K-12 Schools and LEED. Also see the LEED for Schools Reference Guide Errata Sheet http://www.usgbc.org/ShowFile.aspx?DocumentID=3332 .</p>
<p>How does the USGBC (U.S. Green Building Council) LEED process for schools take into account this Design Guide?</p>	LEED	<p>So the Guide has been used for previous LEED projects as an introduction to energy efficiency in the charrette process for getting to a certain level of energy efficiency. And then energy modeling is used based on the recommendations to refine those solutions for energy efficiency. There's also an alternative compliance pack in LEED for schools where you can use the recommendation in your climate zone if you meet the scope requirements that LEED has laid out. And you've been able to get four points in energy and atmosphere by meeting every single one of the applicable recommendations for your school project. LEED 2009 is offering using the Guide as a way to meet the prerequisite minimum requirements for energy efficiency for the LEED 2009 as well as one additional point for energy and atmosphere beyond the prerequisite.</p> <p>So in the LEED 2009 there's some things that have changed that have resulted in less points available by using the prescriptive recommendations that are available in the Guide. The biggest one is that LEED 2009 now references ASHRAE 90.1 2007. So as LEED has evolved and grown the baseline minimums have expanded. In addition, LEED now requires a certain level of energy efficiency for all LEED certified projects. That has been 14% savings over 90.1.2004. As LEED has evolved, the energy efficiency requirements have gotten more stringent. Therefore using the static recommendations in this Guide, there are less and less points in LEED available. The intent is at some point that code will be at where this Guide is, but we're not there yet.</p>
<p>Are you saying right now that the current LEED for schools by interpreting the Advanced Energy Design Guide K-12, you can use it as a prescriptive design measure? And how does LEED interpret that by following the Guide from a prescriptive standpoint?</p>	LEED	<p>So yes, there's an alternative compliance path in that LEED has a prescriptive way to meet the recommendations in the Guide. And that's how you get either the prerequisite in LEED 2009 or in addition the one energy and atmosphere point beyond the prerequisite. So the current LEED, version 2.2, LEED for schools is not the LEED for 2009. The code minimums are still 90.1.2004, and there are still four points available if a project was certified – registered under LEED version 2.2 for schools.</p>

Question	Category	Answer
I've heard that current schools going for LEED version 2.2 have been having some issues with meeting the acoustic prerequisite, particularly in the classrooms. Does the ASHRAE K-12 Advanced Energy Design Guide address those issues and help designers to recognize what is necessary to meet those prerequisites?	LEED	There are some how-to tips related to acoustics and good design practices to address acoustics in general. I do not believe that they provide all the good guidance needed to meet the prerequisite for LEED for schools for acoustical issues. In a new school design, the design team should investigate all the requirements needed to address acoustical issues in the prerequisite in LEED for schools independent of the Guide. The Guide provides the energy efficiency recommendations and has some good design practices to integrate acoustics with that. But an acoustical expert or a design team that understands these issues related to the LEED prerequisite for acoustics needs to be addressed early on.
Is a roof monitor another word for a skylight?	Lighting / Daylighting	A roof monitor is more like a clerestory than a skylight. A skylight has a visible or a translucent surface that is facing the sky; whereas, a roof monitor typically has windows or fenestration that do not face the sky and so it's a way to do top lighting. They're both top lighting strategies, but if you look at the different schematics in the guide related to daylighting, you'll see the difference between a skylight and a roof monitor.
Are fabric baffles practical in hurricane zones?	Lighting / Daylighting	I'm not sure how this question applies to internal fabric baffles. If there would be external, yes, that would be an issue you'd have to consider, but in general for interior fabric baffles in an interior day-lit space, I'm not sure if with the exterior hurricane or tornado zone would apply, so I don't think that question necessarily applies.
How do you know what the reflectivity of furniture items is? (slide 64)	Lighting / Daylighting	That's part of the design process in trying to make sure that the owner understands that the furniture that they choose has an impact on the daylighting performance and that high reflectivity interiors, including the paint and desktops and everything in the interior, affects the daylighting performance, and so it's part of the integrated process to make sure that the owner understands the intent and the choices the owner makes also impact the performance as well.
Thanks for the recommendation that building orientation be within 15 degrees of true north or south. Can you tell us the relative impacts once the 15 degree threshold is violated—say 30 or 45 degrees? I need real relation to costs (for sun shading, controls, etc.) and real energy use the more one deviates from this 15 degrees from true north or south. Most architects cannot be persuaded this is critical, unless one can cite "X" construction costs increase and "Y" energy uses increases, etc. Please help.	Lighting / Daylighting	I am not aware of any studies that measured the costs and energy use of one building built optimally vs. one built 45 degrees off of north or south. All analysis of this subject that I am aware of is done with energy and cost models. This is done by a parametric whole building energy model analysis of various orientations and costing the additional HVAC, glare mitigation, and window properties needed at each parametric. Not a simple analysis, but powerful if one can identify the optimal orientation.

Question	Category	Answer
The guide requires a level of lamp/ballast combination efficiencies. Why no mention of delivered lumens from a lamp/ballast and fixture efficiencies?	Lighting / Daylighting	The project committee members that were lighting designers developed the guide and the how-to tips, and they felt that the mean lumens per watt for the ballast/lamp was the important metric there. The lighting power density to maintain a certain foot-candle requirement in the classroom indirectly will require high efficiency fixtures, so the combination of mean lumens per watt from the lamp and ballast and a low lighting power density requirement will require a fixture efficiency to be considered, but it doesn't explicitly recommend fixture efficiency.
How does one prevent ice and snow build up on sun shading devices?	Lighting / Daylighting	I believe you don't. You design them to have ice and snow and water and be exposed to the elements.
Is a list of recommended reflective commercially available materials provided for paint, etc?	Lighting / Daylighting	The guide, again, doesn't provide recommendations for commercially available products. It has recommendations for the technologies and the performance needed to reach this level of savings. It's up to the design team to identify materials and manufacturers that meet those performance requirements.
Is there anywhere in the design guide to ensure it is the responsibility of the designer to inform the owner that he needs to follow on-going energy management practices once the building is built, or else it will not be as efficient as he desires?	Lighting / Daylighting	Certainly as part of the design and construction process of these buildings, the design intent should remain clear to the owner to do this. The owner needs to be engaged in that process. They need to buy into the technologies that are selected and typically we find that the more simple the solutions, the better they will work and the longer the persistence of energy savings. We've also seen systems that are very, very complex and the contractor turns the building over to the owner and they don't know how to operate it. It is important that the owner understands and is willing to maintain any technology that's put in the building.
Would you recommend a clerestory for all hallways of a school, even for multi-story buildings?	Lighting / Daylighting	So in general we provided clerestory windows where daylight would be most beneficial, including classrooms and gymnasiums where they're typically most occupied. Hallways are also a good application for daylighting if they have access to a toplit system. So a hallway on the first floor of a two-story school typically isn't a good application for daylighting, but the top floor is especially. One item of note here is that trying to share daylighting from this type of hallway daylighting into a classroom is typically not recommended. It's very difficult to get sufficient daylight into a classroom through a shared daylighting strategy from the hallway. Quite often we call that strategy the "magic areas" where you see nice cross-sections of buildings where light is penetrating through the building according to an area but in reality you need a lot more analysis to get it to work effectively and that lighting going from an area that does not require a lot of lighting such as a hallway into a classroom usually does not work very well.
Is there any issue with birds or pigeons on the daylighting light shelf areas?	Lighting / Daylighting	I think our only caution there would be that if that is an issue to design to mitigate that. The Guide doesn't have specific recommendations for that, but it should be a design consideration where that's an issue. Certainly there are lots of different variations of daylighting systems out there including external shelves versus interior shelves, actually putting light direction devices between the panes of glass is another alternative. It could be that your external shelf is designed to have some kind of bird spikes on it too if that's an issue, but you certainly need to understand the climate and the environment that you're in looking at these integrated solutions.

Question	Category	Answer
Why recessed light shelves rather than exterior linear strip - which would be considerably less expensive and more effective?	Lighting / Daylighting	There's a lot of architectural freedom in how to do these things; and in those case studies that is what the architect chose. It may not have been the least cost solution, but it was an integrated solution when the total project came in at a certain budget while meeting certain energy goals.
I don't understand why you say that a high performance lighting system is not needed. An electric lighting system is an all too important compliment and enhancement for good daylighting, it is not a substitute for or replacement for daylighting.	Lighting / Daylighting	One of the questions had to do with why we specified in the guide lower lighting power densities when daylighting is used. The Guide represents methods to get to 30%. It is not the only way to get there but suggestions on how to do that. If you've got a system that is well daylit and you don't need the lights, the efficiency of the light fixture isn't as important as it might be if you don't have daylighting and you're running those lights all the time. It is important to remember that if you have daylighting, it doesn't do you any good unless you can either get the lights dimmed or the lights off and so there is a tradeoff there that the Guide does allow an additional amount of energy from a lighting power density to go into the lights if the daylighting is there and it's functioning than if you have no lights there. That is not to say that you shouldn't design for high performance lighting systems and low power densities for daylit systems. That can then be a bonus savings and will certainly get you beyond the 30%.
You mentioned increasing the daylighting will decrease the HVAC loads. Obviously if you increase the glazing too much you will increase the HVAC loads. What have you seen as a happy medium between increasing glazing for daylighting while still not increasing your HVAC?	Lighting / Daylighting	<p>In the daylighting recommendations for each climate zone for the daylighting strategy, there's a range of glazing to floor area ratios that are provided. Our industry experts that are on the project committee have seen that as kind of an optimal level of daylight glazing to minimize those HVAC loads and so it's not over glazed but is designed to provide daylighting and sufficient daylighting without over sizing your glazing system.</p> <p>In general, if you are designing for daylighting and providing a good high quality light, it is amazing how little glass you need to accomplish that, and we do exhaustive studies on how much glass is necessary. In most cases, they will reduce the glass to the point that most people would not really be in that space and they still want additional view glass, which does come as an additional, heating and cooling load to the building. We did get a question about: At what point does the glass produce higher heating and cooling loads on the space? The thing to remember here is that the efficiency of daylight is about three times higher than it is for the best electric lighting that is out there. That is a very efficient source in terms of a light versus heat ratio. To add to that, that's if the glare and the direct gain are controlled appropriately. To caveat, that's very important to understand in comparing daylight efficacy to electrical lighting efficacy.</p> <p>And a glass box does not necessarily mean you have a good daylit environment. Usually you end up with a lot of glare, a lot of heat, and other factors which don't make it very comfortable from a lighting point of view.</p>

Question	Category	Answer
What would be an alternative to the cloth baffles?	Lighting / Daylighting	<p>We've had a lot of interest in the fabric baffles that we showed on some of the case studies and alternatives to that. The key on the baffles is to have some material that has some ability to block any direct gain that you might get, especially with lower winter sun, and then you can diffuse that light into the space. There are lots of different strategies that can be used with that. You can use a fabric material. Some jurisdictions will require that it be fire treated. But you can also use some kind of grid or mesh such that you might find as an egg crate material in a light fixture. Depending on how you design it, you may even use some smaller suspended pieces of solid material that then could reflect light and bounce light off. So there's a lot of flexibility and a lot of strategy. The key is to design it so that you don't have direct glare on the work plane or in people's eyes and that it becomes a very nice uniform light.</p>
Can you tell us more info regarding the manufacturer of the translucent fabric baffles in the gym example?	Lighting / Daylighting	<p>We don't necessarily provide recommendations for single manufacturers; rather, we're focusing on the technology. Important things to consider is it's a fireproofed fabric baffle that are optimally spaced, so there's various types. Also, see the question above about alternatives. You could use a piece of translucent plastic or Plexiglas. It's the design intent. You'll have to investigate manufacturers specifically.</p>
When using a daylighting system, how would you recommend modifying the light when the room needs to be darkened for presentations (i.e. projections onto a screen)?	Lighting / Daylighting	<p>There are some strategies where you can build in some internal overhangs in the space, a teaching wall that is slightly shaded from the daylighting and build that into the roofline of the space. Typically for the current generation of projectors, they need less light or they don't need to have as dark surfaces to function and so that definitely combines well with the daylit space. We've definitely still seen some specs out there where people are trying to use 16 millimeter projection equipment and filmstrip projectors, things that have for the most part long ago gone away and that a lot of the newer technologies, especially in terms of computer screens, other things are much more robust and much more forgiving with more glare in the space, and that definitely has helped our ability to put daylighting in.</p>
I was wondering how you handle daylighting in the spaces where the teachers need to use overhead projectors and video projectors and things like that and how you deal with that?	Lighting / Daylighting	<p>The Guide provides recommendations for daylighting in classrooms. There is often a notion that daylighting and projection cannot be done at the same time. With the current level of LCD projectors that don't need zero foot candles or two foot candles on the projection surface anymore, a higher level of foot candles can be used and still produce a good visual quality of projection equipment with today's current technology. With some general guidance on how to address a teacher wall or projection wall that can be done fairly easily in a well daylit classroom that doesn't necessarily have full darkening capability.</p> <p>The lighting controls are also an issue related to being able to have multiple scenes, an audio visual scene where not all the lights are turned off but there's multiple versions of levels of lighting that can be controlled. The Guide provides recommendations and how-to tips for how to address that. One of the key strategies I've seen in the Guide is to provide a slight interior overhang, something like a soffit that can shade the teaching wall somewhat to get to the 30 foot candles or less on the teaching wall so that an LCD projector can still work.</p>

Question	Category	Answer
My clients are pushing for a lot of view windows, and how do you manage that considering the recommended fenestration to gross wall area?	Lighting / Daylighting	Good question. So yeah, we see this happen a lot where there's a big push to have highly glazed, transparent, architecturally beautiful schools that have lots of glazing. In general, the more glazing the more it costs compared to a wall system and the more energy it uses. By focusing on energy models that can show what the energy impacts are of a fully west facing glazed atrium or entry way and the energy impacts both on the energy costs as well as the financial, the capital costs of having lots of glazing in a school can be useful in making a case that those decisions are wasting energy and money. They do look nice and there's a balance between doing a well daylight school that uses the appropriate amount of glazing as well as architecturally pleasing integration for the school.
So if we do need to put east and west facing glazing in our building, do you or does the Guide have any recommendations as to how to best shade those and reduce the solar gain that's entering the space through those?	Lighting / Daylighting	The Guide has recommendations for window tuning properties for east and west facing glazing as well as the amount of glazing that is appropriate for those. In general, we just try to minimize it for sure. And there's ways you can – instead of having a whole west facing atrium glazing you can do more of a saw tooth wall construction to have the north portion of that saw tooth wall face with glazing and have an opaque wall material on the west side. Low solar heat gain coefficient windows are critical if you have to have east and west to minimize that heat gain. There are other architectural features such as long skinny windows that have fins so that the fin can adequately shade an early morning or late afternoon sun. And that can be an effective way to introduce some vision glazing in a west or east facing wall. But in general, the Guide provides recommendations for north and south facing classrooms.
Is it important to have a daylighting designer, or can you give me some tips that I can do this myself?	Lighting / Daylighting	The Guide and the project community members that developed the Guide included daylighting designers that have lots of experience optimizing daylighting designs for schools. The intent of the Guide is to provide a starting point for those daylighting recommendations with some general high-level recommendations for doing a good job. To refine the daylighting solution and if you're deviating somewhat from what the recommendations are providing, a daylighting designer can definitely be helpful to understand how much your deviation in design is really affecting the final performance. Daylighting seems easy, but we're seeing that it's a fairly difficult thing to get right to save energy to have a quality teaching environment with minimal glare that the teachers and occupants can work well with and have persistence of energy savings so the lights are off most of the time. So it definitely is worthwhile to include someone that has experience daylighting in schools.
In your experience with schools what have you found are the biggest mistakes that schools make when they're trying to be energy efficient?	Lighting / Daylighting	This is a great question. I was part of a design charette for a school here and trying to understand some of their decisions. We spent a lot of time talking about the siting that already occurred. And the orientation was already fixed, and the footprints were already fixed. And they're trying to maximize daylighting. Once early design decisions that affect energy and daylighting potential are made, it's very difficult to maximize your energy efficiency relating to daylighting. And so it's often times a big oversight I see is that design teams and districts want to do the best daylight school, but they've already figured out where all the classrooms are located and how they're oriented. And then they want to go back and do the daylighting design. And so to really get it right it has to be thought of early and before those decisions are made.

Question	Category	Answer
I wonder how you recommend implementing daylighting in multiple story schools.	Lighting / Daylighting	The Guide provides daylighting recommendations for multiple space types, classrooms and gyms specifically, as well as the types of classrooms. If they are a top floor classroom they have access to daylighting through top lighting. Or if it's a classroom on the first floor with a classroom above it, there are recommendations in the Guide for side lighting that discuss ways to get daylighting in from either north or south facing window walls for daylighting. And on the first floor, typically it's done through side lighting. If it's on the south it has light shelves and overhangs and high daylighting glass that are separated from the vision glass. And that's put in as high in the space as possible and typically with a sloped ceiling to get as much penetration down into the space as possible. It is the most difficult part of the classroom to get daylighting into. Most classrooms on the top that have a ceiling, a roof, should all be top lit. But a second floor classroom, it's very difficult to get daylighting all the way back into the space. It can be done, and the Guide provides some recommendations on how to maximize that daylighting potential.
Why is it so important to orient schools along an east west access?	Lighting / Daylighting	So daylighting, like we spent a lot of time in the webinar talking about, is one of the most critical things to do right in a school. There are lots of non-energy benefits for doing good daylighting, the views and the connection to outside and nature for a learning and teaching environment. To introduce daylighting into a classroom that is glare free is a key part of that and so that you can have a pleasing teaching environment without the glare. To do that, a north or south facing window system as part of your daylighting system is critical to be able to control that. North is great because there's never any direct beam glare issues. And south windows can control the direct beam with overhangs fairly efficiently. East and west facing glazing is an issue related to glare as well as to heat avoidance. It's fairly hard to shade a low early morning sun angle with an overhang as well as a west low sun angle. So by being able to orient your school early on in the design process to address these issues you can cost-effectively provide daylighting to all the classrooms and a good teaching and learning environment.
Your presentation seems to recommend the use of ground source geo pumps. There has been a lot of discussion about the high cost of these systems and lower overall efficiencies of the systems. Can you recommend any studies or sources of non-biased performance data on the current systems and potential future developments in this technology?	Renewable Energy	There have been lots of ground source heat pumps installed and monitored and used, especially in schools, and in general from all the data that I've seen on whole building energy use, they're able to get under 30 kBtus and 25 kBtus per square foot per year with these systems. And so I know there's some uncertainty on how well the fans are performing and the motors because those are not part of the overall rating for a heat pump, but the practical, in-place use of ground source heat pumps in schools have been fairly successful. A lot of the newer heat pumps that are out there are made by companies that solely make heat pumps, have really refined their design, and from all the anecdotal information I've seen on them, they seem to be performing. I'm sure there's some that have had issues, but I think the technology is starting to become fairly reliable and cost-effective.

Question	Category	Answer
I have some really good incentives for using solar PV in my school district. What do you think of the strategy of just putting a bunch of solar panels on top of my school to reach my 30 percent goal?	Renewable Energy	The recommendations in the Guide don't necessarily address renewables because having good incentives is not something that all school districts can afford or have. There are some states and some utility districts that offer those. But energy efficiency is always seen as the most cost-effective way to save energy. On a national scale there are certain districts and certain states that have some financial motivation for doing additional things, and the Guide provides recommendations if that's the case for your district. PV is a great wonderful teaching tool. It's very visual for an energy efficiency strategy. And you see a lot of pictures of schools and that's what's highlighted. So it's a very visual connection for the students for energy efficiency. And it's great for that case. Unsubsidized it is very expensive still, and so the Guide focuses on strategies that are fairly cost-effective and independent of what financial motivations are available for other alternative energy efficiency strategies.
Was there any use of wind energy in any case studies?	Renewable Energy	I don't believe we've considered any case studies that have wind. I do know there's lots of schools in Iowa and Kansas and Minnesota and the Midwest that have great wind resources and have invested in wind turbines or worked with third-party owners of wind turbines to finance them and they can have significant wind turbine output in schools, but we did not consider wind turbines in this guide.
How do PVs hold up in colder climates with snow and ice accumulations?	Renewable Energy	In terms of their durability, PVs work great when they're cold. They're more efficient when they're cold; they have been tested in very cold icy climates. They're used often in the South Pole, for example, so the issue is more how much snow accumulation is on your panels reducing output rather than durability and longevity.
Can someone send the link for the zero energy building?	More information	http://www.eere.energy.gov/buildings/commercial_initiative/zero_energy_projects.html - you can see slide 23
Will the presentation be available afterwards for a learn at your own pace application?	More information	Yes – visit www.energysmartschools.gov to link to the recorded webcast
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