Building Re-Tuning Training:
Providing Energy Saving Solutions through Interactive e-Learning

U.S. DEPARTMENT OF ENERGY

Pacific Northwest NATIONAL LABORATORY

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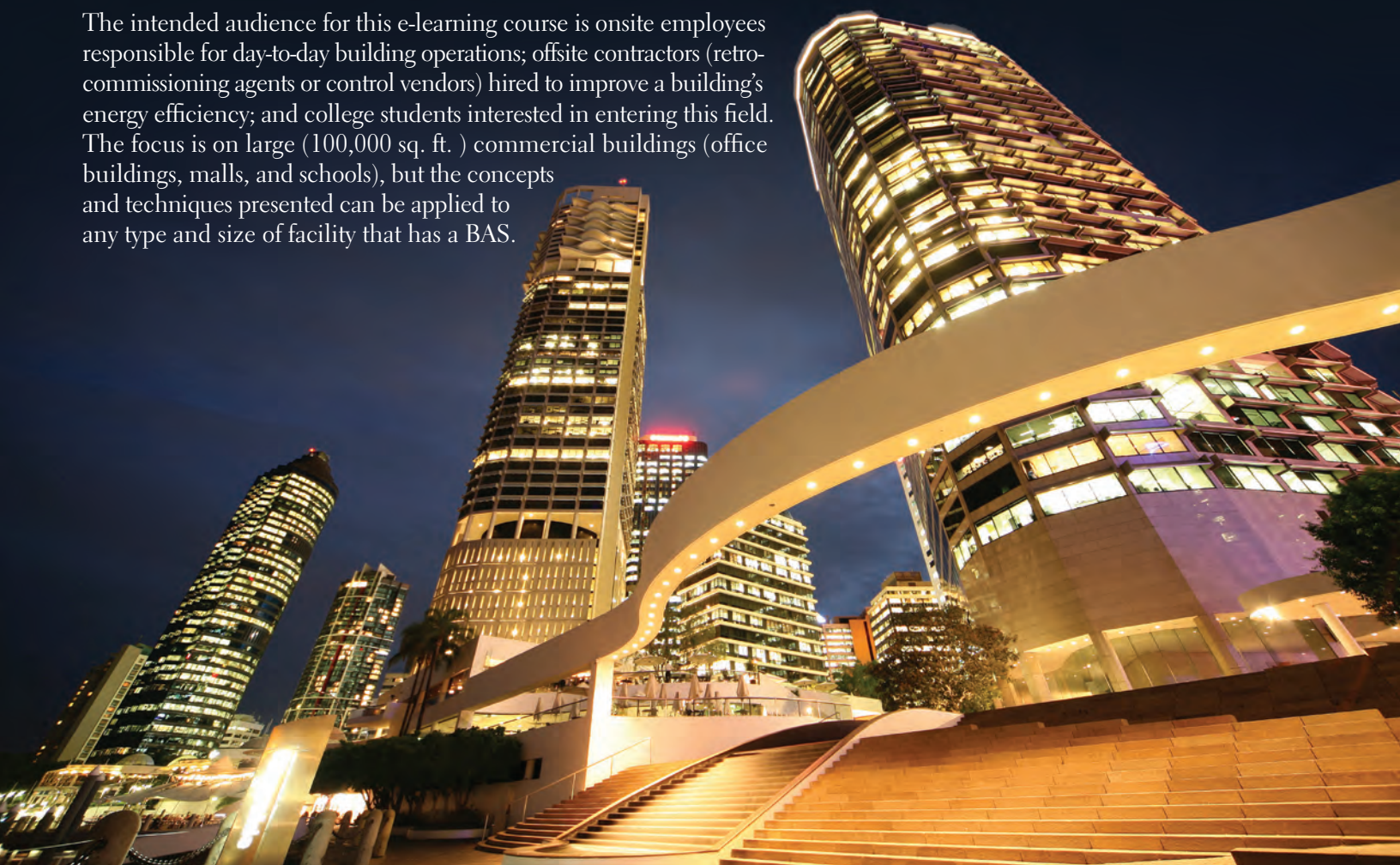
Commercial buildings account for almost 20% of the total U.S. energy consumption, and 10% to 30% of the energy used in commercial buildings is wasted because of improper and inefficient operations. While sophisticated energy management and control systems are used in large commercial buildings to manage heating, ventilating, and air conditioning systems and components, many buildings still are not properly commissioned, operated, or maintained. This lack of proper operation and maintenance leads to inefficiencies, reduced lifetime of equipment, and, ultimately, higher energy costs.

The U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL) has developed a Building Re-Tuning approach to detect energy savings opportunities and implement improvements. Re-tuning is a systematic process to identify operational problems by leveraging data collected from the building automation system (BAS) and correcting those problems at no-cost or low-cost. Over the past 5 years, PNNL has provided Building Re-tuning classroom instruction and field training to more than 300 building operators, engineers, and energy managers from more than 30 organizations. To reach a larger audience more quickly, PNNL is now offering a free interactive e-learning course to anyone interested in improving a building's energy performance and the comfort of the building's occupants.

The intended audience for this e-learning course is onsite employees responsible for day-to-day building operations; offsite contractors (retro-commissioning agents or control vendors) hired to improve a building's energy efficiency; and college students interested in entering this field. The focus is on large (100,000 sq. ft.) commercial buildings (office buildings, malls, and schools), but the concepts and techniques presented can be applied to any type and size of facility that has a BAS.



Building Re-Tuning e-Learning P

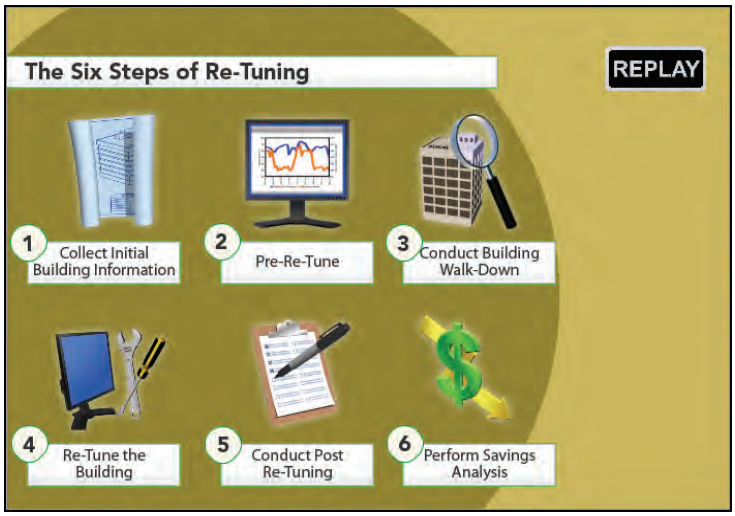
An Introduction to Building Re-Tuning

The course begins by introducing PNNL's six-step re-tuning approach through an animated case study from an actual re-tuning project. Learners are also presented with the benefits of re-tuning, symptoms that indicate a building may be a good candidate for re-tuning, and several examples of common energy wasters within buildings. Learners become familiar with the concept of personality associated with buildings and how, over time, a building's personality—along with its energy needs—may change. Once learners have a basic understanding of what building re-tuning is and why it's important, they are ready to begin participating in the re-tuning process.

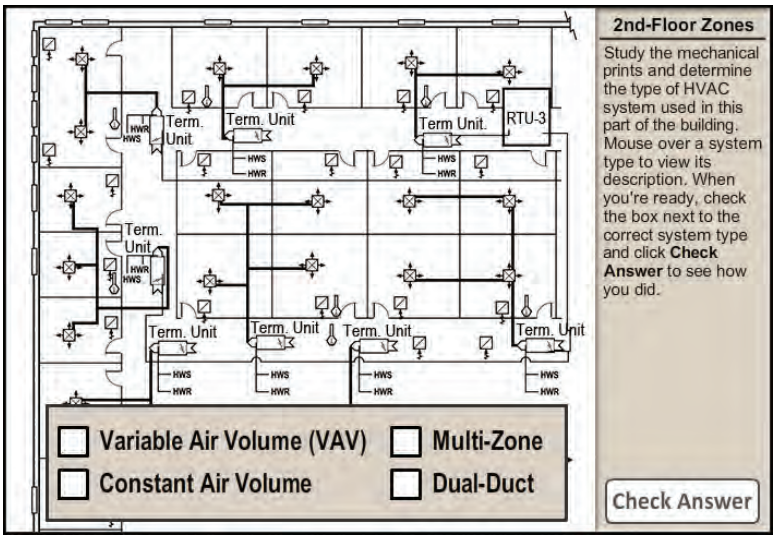
Data Collection and Analysis

A key component of the building re-tuning process is data collection. In the course, learners take an active part in the building information collection process. Through interactive exercises using our virtual commercial building, they become familiar with the building's mechanical prints, the types of equipment used throughout the building, and the trend data collected from the BAS—all tasks building operators, managers, and service providers would perform during an actual re-tuning process.

Traditional approaches to training focus on memorizing facts and procedures rather than actively solving problems. In contrast, action-based training uses real-world contexts and challenges that compel learners to apply new knowledge in meaningful situations. The PNNL e-learning team's approach to designing and developing training is built on fundamental cognitive learning concepts, sound instructional and e-learning design principles, and innovative technical solutions that use multimedia and interactive scenarios to better facilitate learning. The idea is to challenge learners in activities and environments that mimic those they will find in their workplace. By practicing relevant activities and thought processes, learners become engaged in the training, are motivated to learn, and can retain and apply their newly acquired knowledge and skills better.



An animation describes the primary steps of re-tuning. The icons representing the steps are re-used in lessons to reinforce the particular step.

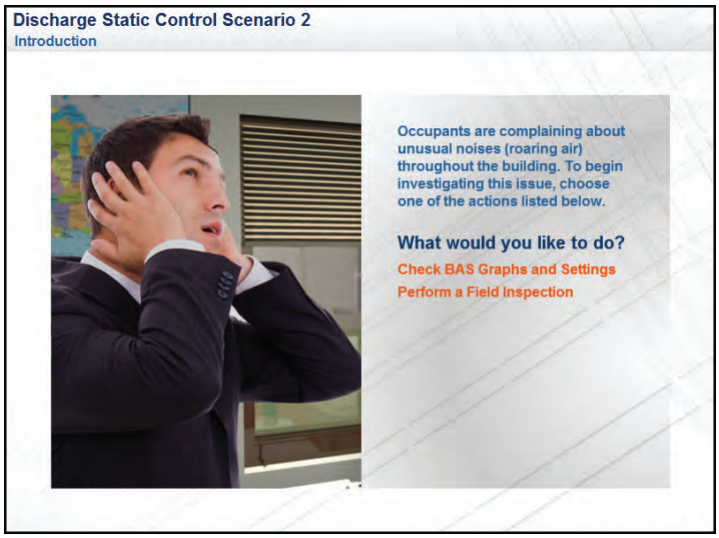


In this exercise, learners examine mechanical prints, make determinations about types of equipment used in the building, familiarize themselves with various zones throughout the building, and more.

rovides "Hands-On" Experience

The Building Re-Tuning e-learning course comprises three modules, each of which builds on the previous module and progressively introduces more advanced concepts. Throughout the course, learners become familiar with a virtual 3D, two-story commercial building. They learn to gather information about the building (such as mechanical and electrical prints, current building use, occupancy type, etc.); set up trend graphs in a BAS; examine equipment; and talk to occupants in a virtual "walkdown," or field inspection, of the building. After analyzing everything they have learned about the building, learners practice re-tuning the building through a series of interactive, scenario-based exercises.

When walking down the inside of the building, learners talk to occupants; examine equipment; check vents, doors, windows; and more. Learners can even use an infrared thermometer to help in their assessment.



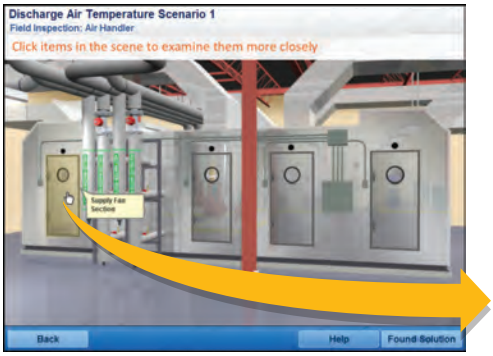
Each re-tuning scenario presents a description of the problem, along with two options: "Check BAS Graphs and Settings" and "Perform a Field Inspection." More experienced learners may develop a hypothesis based on the description and home in on a path to the solution, while learners new to the building management/operation field may need to systematically explore all the options.

Building Walkdown

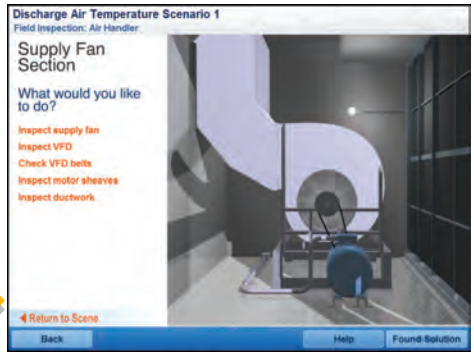
Next, learners participate in a virtual building walkdown. They navigate around and inspect the building, inside and out, looking for possible opportunities for energy improvement. If learners are uncertain about a decision point, a virtual Energy Manager is available to provide tips. Learners get to practice using common tools and performing common tests along the way, including checking temperatures with an infrared thermometer and conducting pressure checks at various points throughout the walkdown. These are the same skills they will need when they perform building walkdowns in real life.

Re-Tuning

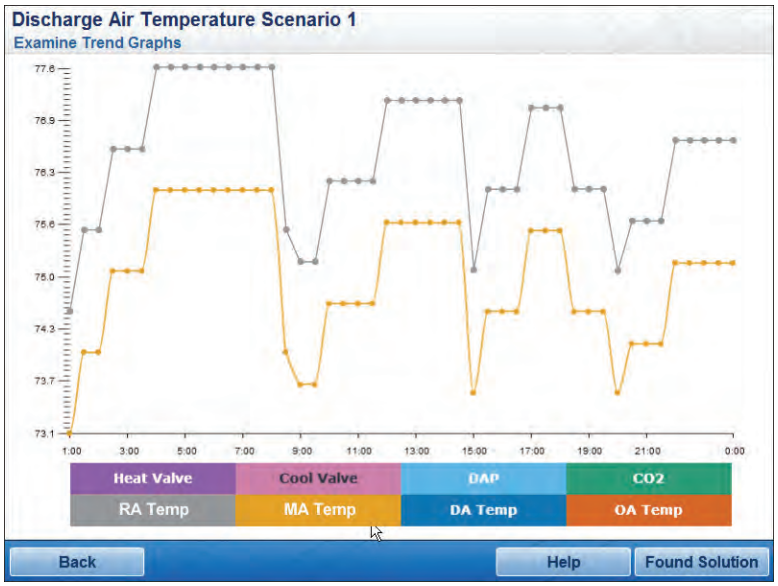
After learning the basics of the building re-tuning process and working through the data collection and analysis steps, learners are ready to be challenged by some realistic re-tuning situations. Learners work through more than a dozen interactive scenarios, using all of the knowledge and skills gained throughout the course, to investigate and diagnose a variety of issues in the virtual building. They discover re-tuning opportunities by talking to occupants, running and analyzing trend data in the BAS, and examining equipment in the air handler, the rooftop units, offices, ceilings, and more. Learners must decide which steps they want to take and then determine the best re-tuning solution to the issues presented.



In this re-tuning scenario, the learner can click each door of the air handler to inspect the equipment inside. The learner can also examine the pipes and valves outside the air handler.



Inside one of the air handler doors, the learner can inspect the equipment within. Notice that at any time the learner can click the Found Solution button; there is no requirement to examine everything in a given scenario.



In the re-tuning scenarios, learners select the data to trend and look for abnormalities that may provide insight into the issue's cause.

Access the Training

Ready to try it out? Go to http://retuningtraining.labworks.org. There, you may register for a free training account and can then take the online Building Re-Tuning course.

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Learning Assessment

Because one primary goal of the building re-tuning process is to correctly identify opportunities for energy efficiency improvement and make the right decisions to correct efficiency issues, each of the interactive re-tuning scenarios demands a 100% success rate. Learners do not receive a score based on partially correct performance. Instead, incorrect solutions result in more practice until the correct solution is discovered. With this approach, more experienced learners can work through scenarios more quickly, while those less experienced get the needed practice to help them solidify their understanding of the re-tuning process. In the end, everyone achieves 100% success. This approach is consistent with e-learning research that shows how repeated practice in relevant, realistically challenging activities provides far more effective, retentive learning than quizzes focused on memorized facts, which all too often are forgotten almost as soon as soon as the learner completes the course.

About PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,900 staff, has an annual budget of nearly $1.1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

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