IUOE National Training Fund

National HAZMAT Program

Green Chemistry and Green Jobs Awareness Course

Instructor Manual

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- It is not the intent of the content developers to provide compliance-based training in this presentation, the intent is to address hazard awareness in the hazardous waste operations and emergency response (HAZWOPER) industry, and to recognize the overlapping hazards present in many construction workplaces.

- It should NOT be assumed that the suggestions, comments, or recommendations contained herein constitute a thorough review of the applicable standards, nor should discussion of "issues" or "concerns" be construed as a prioritization of hazards or possible controls. Where opinions ("best practices") have been expressed, it is important to remember that safety issues general and HAZWOPER jobsites specifically will require a great deal of site- or hazard-specificity – a "one size fits all" approach is not recommended, nor will it likely be very effective.

To: Users of IUOE National Training Fund Programs

The IUOE National Training Fund -- National HAZMAT Program offers a broad spectrum of safety and health training, as well as training support to other users of the National HAZMAT Program's resources. The National HAZMAT Program has available, at no cost, the following:

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- Safety and health regulations and standards interpretation assistance
- Technical safety and health, emergency/disaster response, and energy security and restoration assistance
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- Expertise to provide best practices and information sharing, develop scenarios, and conduct exercises to prepare all stakeholders to protect and restore critical infrastructure should an event, manmade or natural, occur
- Training information on HAZWOPER, OSHA, emergency/disaster response, and other safety and health classes held at other IUOE Local Unions nationwide

Inquiries regarding the services the IUOE National Training Fund -- National HAZMAT Program have to offer can be directed to Barbara McCabe at 1293 Airport Road, Beaver, WV 25813, called in at (304) 253-8674, faxed to (304) 253-7758, or emailed to hazmat@iuoehazmat.org. Forms requesting classes and materials can also be submitted via the Internet at www.iuoehazmat.org.

The IUOE National Training Fund encourages all workers to take advantage of the National HAZMAT Program's services to assist you to be employable, competitive, and safe in the workplace.

Sincerely,

Jeffrey R. Vincent
Executive Director,
IUOE National Training Fund

This training program was developed for the IUOE National Training Fund by

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Table of Contents

An Introduction to Green Chemistry -- Instructor's Notes

This training will cover:

- What is "Green Chemistry"?
- What led to the development of Green Chemistry?
- The 12 principles of Green Chemistry
- How can Green Chemistry help the environment and workers?
- Health and safety issues of Green Chemistry
- How Green Chemistry relates to operating engineers

After completing this module students will be able to:

- Provide a definition of Green Chemistry
- State two other environmental and worker "friendly" chemical control methods
- Be able to look up the 12 principles of Green Chemistry
- List at least three hazards associated with Green Chemistry
- List at least three ways Green Chemistry can help protect workers
- Define three areas where Green Chemistry can help operating engineers

Module background and key points for you to understand as the instructor

This is an awareness-level module on Green Chemistry. The main purpose of delivering this module is to introduce students to Green Chemistry and to provide them with an understanding that there are still health and safety hazards associated with the use of Green Chemistry principles. Advanced learning on this topic, beyond the awareness level, will investigate how Green Chemistry can be used, or is used, in specific products related to Operating Engineers and any associated health and safety issues. For this module, keep it simple. Make sure students leave the course feeling confident that they possess a basic understanding of Green Chemistry, how it can affect Operators and that there may be hazards associated with its use. The module does not intend to transform IUOE members into chemists, however, in order to be able to institute changes in the work place and to advise chemists, engineers and employers who research and manufacture equipment or design processes and work methods that IUOE members use, students need to be able to "talk shop."

Module delivery and classroom management

Allow 120 minutes to present this module, including discussion. Module delivery should focus on using group discussion and student input. You will need:

- Green Chemistry student manual
- Green Chemistry instructor manual
- Green Chemistry Power Point presentation
- Projector, screen and laptop
- Access to the internet will be required to complete Activity 1: Assessing the health and safety issues with green chemicals and Activity 2: How IUOE members can bring Green Chemistry to the job.

Training materials for course

Assertion Evidence Power Point Presentation: use the Green Chemistry Power Point presentation and follow assertion evidence methodology. It is a good idea to familiarize yourself with the assertion evidence method and structure of the Power Point slides. Many of the slides will have a question or statement in the title (assertion) that will be backed up by visual evidence (photo or graph, etc.). With many of the slides, there will be a question with the evidence/answer on an entrance animation. Give students time to discuss situations and answer questions before presenting them with the answers.

The slides have robust instructor's notes to aid your delivery of the module, provide background on topics, and to help you provide answers to question posed in the slides and questions that may arise from students.

Assertion evidence presentation format:

The following text was developed, in part, from the article, "Rethinking the Design of Presentation Slides: The Assertion-Evidence Structure', which may be found, along with other assertion evidence training aids, at http://www.writing.engr.psu.edu/slides.html.

This method for developing and using PowerPoint presentations, which features a sentence-assertion headline supported by visual evidence, is documented in Chapter 4 of The Craft of Scientific Presentations[1], a November 2005 article in Technical Communication[2], and the presentation "Rethinking the Design of Presentation Slides[3]."

1 http://www.writing.engr.psu.edu/csp.html
2 http://tc.eserver.org/26457.html
3 http://www.writing.engr.psu.edu/speaking/rethinking_psu.pdf

Four key assumptions apply when using the assertion-evidence presentation format. These assumptions are discussed below:

1. Slides are an appropriate visual aid for the presentation. Too often, slides are projected when no visual aid would better serve the presentation.
2. The success of the presentation hangs on the audience understanding the content
3. The slides projected during the presentation differ significantly from the handout that a speaker might leave with the audience. For instance, the slides projected during the presentation cannot afford to have as much text on them as the handout does, because the audience is not only reading the projected slides, but listening to the speaker as well.
4. Finally, the primary purpose of the slides is to help the audience understand the content, rather than to provide talking points for the speaker.

There are disadvantages to using the assertion-evidence method. The disadvantages are due to the investment of time needed to develop the course materials and for the instructor to prepare for the course. The disadvantages are not related to the actual transfer of knowledge. First, the design requires more time on the part of the presenter than the traditional topic/subtopic format. More time is required to create visual evidence and more time is needed to craft a succinct sentence headline that states the main assertion of the slide. To create those sentence-assertion headlines, the presenter has to understand the purpose and relative importance of details. Another disadvantage is that presenting the slides is more challenging when using this method compared to the traditional topic/subtopic method. A third disadvantage is that because this design is so different from what commonly is projected in meeting rooms, classrooms, and professional conferences, a resistance sometimes arises from co-presenters and supervisors to try a different approach. However, by understanding the assertion-evidence approach you, as an instructor, with practice, will see a better transfer of knowledge from your presentations to the students. Also, this method allows for group participation and readily flows into small group activities and class participation.

Student manual: refer students to the Green Chemistry Student Manual. It is for their reference. It expands on the material presented in the Power Point slides.

Group discussions and activities

There are two activities that will allow students to investigate green chemicals and their health effects on Operating Engineers. They are: Activity 1: Assessing the health and safety issues with green chemicals and Activity 2: How IUOE members can bring Green Chemistry to the job. Both activities are outlined in the student manual and instructor manual. In the instructor manual, a few examples are presented. You should complete each activity for yourself and use examples you are comfortable with. Make a note of where you located the information so you can repeat it in class if necessary. Also, there are multiple opportunities for questions and group discussion throughout the presentation.

Where to go if students need further assistance

If students still have questions after the course that you cannot answer, refer them to:

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Module 1: Green Chemistry

Green Chemistry and Green Jobs Awareness Course

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Introduction to Green Chemistry

This module covers the following:

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This module discusses pollution. Why does it matter?

Understanding Green Chemistry requires that you to understand how it was developed and why. In order to understand this, a brief introduction to some environmental issues must be given, such as pollution. As you will see throughout this module, chemistry was responsible for some very good things and, some very bad things in our society. Some achievements attributed to chemistry have helped the environment and human health. Chemistry made possible many products that we use and that make life easier or more enjoyable; just think of that new flat screen TV your watching (or want to buy)—chemistry made that TV possible. However, sometimes chemistry creates products and pollution that harm human health and the environment. These harmful aspects from the use of chemistry could be in the form of hazardous waste, products that were later found to cause cancer, or other unwanted health effects in humans; or chemical processes that are at high risk of causing industrial accidents. By understanding a little about pollution, we will see the need for Green Chemistry and why it is important.

Smoke stack belching pollution into the air

What is a sustainable society?

Chemistry has allowed us to produce some great things, at a low cost; however, when we make and use things, waste keeps building up and we need more and more of everything to keep up with population growth.

A sustainable society is a society that meets the needs of current generations without compromising the needs of future generations. This may be very important to you if you have children, grandchildren or even great-grandchildren! We know that we live in a finite world. Many of the raw materials that we rely on to make products, fuel and food will run out if we do not use them in a sustainable manner. Let's look at an example. How does a finite supply of oil affect you as an Operating Engineer? What if it started to run out? Overuse of diesel and other oil-based products you use to run and maintain your equipment will become extremely expensive in the near future. How would that affect your job? Maybe there was enough oil to last through your working career, but what if your child went into the IUOE to be an operator? What would steep rising costs, due to a finite supply of oil, do to their career and livelihood? There are three main components to a sustainable society:

- Environment (including human interactions)
- Economy
- Equity

When you consider the above three items and how they inter-relate to one another in terms of human beings, you can understand why they are important. Let's look at them!

Without the environment, there is no "us." Everything we use to make our products, energy and food comes from the environment. We usually refer to these things as resources. Some resources are renewable, while others are not. With the exception of some renewable resources (such as solar and wind power), they are finite and will run out if not properly managed. We must ensure that the earth is allowed to replenish what we take from it. A good example of proper resource management is not overfishing waters or using fast growing products like bamboo that can be used for flooring and clothing. We must also be sure not to waste non-renewable resources, such as aluminum and steel; with products like these we should look for efficient ways to recycle or reuse them. In general, we must make sure that we are using resources in such a way that they will be available for us, our kids, grandkids, etc.

When looking at how a society operates, you must consider the economy. Whatever we are doing or planning, we must make sure there is a stable economy that uses energy and resources efficiently. One of the reasons that recycling of resources has taken so long to catch on is because some recycling methods were too costly and not very efficient. Many of our current, new and improved recycling techniques became economically feasible after we started to invest research and development money in recycling techniques. We must consider the economy in developing a sustainable society.

In order to have a sustainable society, you must also have social and political systems that lead to a just society. This will ensure that everyone will have the same opportunity to secure life's basics, such as food, shelter, clothing, education, living wage jobs, etc.

You can now hopefully understand that the interactions of the environment, economy and equality will determine if a society can become sustainable. Now let's look at how societies typically develop—they grow.

What is Growth?

In our efforts to improve society and to meet the needs of the growing population, we have been on a fast track toward growth. You hear the word growth all the time: economic growth, population growth, food production increases, oil production increases, etc. We can define growth as an increase: a process of becoming larger or longer or more numerous or more important, as well as a progression from simpler to more complex forms. Does this remind you of our world today?

Is it possible to sustain growth, to grow forever? The answer is "No." To grow forever, whether we are speaking about the economy or the housing market, use of resources (raw materials, energy, physical space, etc.) will collapse or run out.

What role does chemistry play?

Prescription drugs; positive and negative impacts of chemistry

Does chemistry affect the environment and human health? How about the economy? Does chemistry make people and societies more or less equal? The answer to all of these questions is "YES!" Chemistry does affect all of these components of a sustainable society and chemistry can have both positive and negative impacts. Let's look at a few examples.

Here are some positive and negative ways chemistry has impacted the environment and human health & safety

Positive impacts:

- Plastics (containers, siding, toys, lawn chairs, the list goes on and on)
- Prescription drugs (Antibiotics, cardiac meds, etc.)
- Cleaning products (bleach, laundry detergent, soap, etc.)

Negative impacts:

- Non-biodegradable products (anything made from plastics!)
- Waste from products (think of everything in your trash every week, what did chemistry make?)
- Toxic products (this list is long, any product or by-product that causes harm to humans or the environment)

Here are some positive and negative ways chemistry has impacted the economy

Positive impacts:

- Creates skilled jobs (scientists, chemical plant operators)
- Many new products are bought and sold (think of all the products made of plastics)

Negative impacts:

- Clean up costs (hazardous waste sites, chemical spills)
- Facility accidents (destroys property, releases chemicals that must be cleaned up, harms people and the environment)

Here are some ways that chemistry has made members of society more equal

Positive impacts:

- Prescription drugs (antibiotics, etc.)
- Water sanitization (the main reason for the U.S. population boom in the early 1900's)
- Increased food production (bioengineering requires the use of chemistry, fertilizer use, etc.)

Negative impacts:

- Harms communities (chemical releases can damage the surrounding community, pollution can affect food supply and later the community that depends on it)
- Contamination often occurs in less developed socio-economic areas (although pollution does occur in developed countries, it is now mostly occurring in less developed nations such as India, China, and many Latin American nations)
- Not all societies can benefit from chemistry due to lack of development (requires education and capital investment)

Green Chemistry is long-term worker protection

Chemistry's direct impact on workers

Chemicals are commonly used in work, with over 100,000 chemicals in use and with only knowing the health effects for 10% of them, urgency is required to stop the poisoning of workers. For years, workers have been the guinea pigs for determining health effects of chemicals on the workforce.

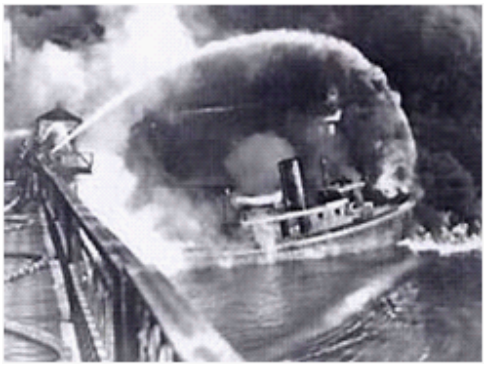
You could probably make very long lists for both the positive and negative contributions that chemistry has made to society. **Our goal is to make the negative list shorter and the positive list longer!** To answer how that may be accomplished, we will soon look at how chemistry can aid in this goal. But first, let's look at some very devastating outcomes where chemistry was part of the issue.

Devastating impacts of chemistry

There have been instances throughout our history that show chemistry and its effects on us and the environment in a very negative light. Why? Chemistry can be a powerful tool used for good and that can benefit society, but if used incorrectly and without limits, it can have some very devastating effects on our world. There is an old environmental saying, "there is no free lunch." What does this mean? It means we will pay for our actions one way or another. Below are three examples of harmful effects of chemical use. These are extreme examples, but the potential for them to be repeated is very real. These types of events can happen again if the use of chemistry is not re-examined.

Negative chemical impacts – Cuyahoga River

The Cuyahoga River is located in Northeast Ohio in the United States. The Cuyahoga River was one of the most polluted rivers in the United States between the mid 1800's to late 1900's. The segment from Akron to Cleveland was once devoid of fish. According to the EPA, there have reportedly been at least thirteen fires on the Cuyahoga River, the first occurring in 1868. The largest river fire, in 1952, caused over $1 million in damages to boats and a riverfront office building. Fires erupted on the river several more times before June 22, 1969, when a river fire captured the attention of Time magazine, which described the Cuyahoga as the river that "oozes rather than flows" and in which a person "does not drown but decays." – Time magazine 1968. For more information on the Cuyahoga River, its history and its recovery, visit the Environmental Protection Agency at www.epa.gov, or the Ohio Environmental Protection Agency at www.epa.stat.oh.us.



Cuyahoga River on fire

Negative chemical impacts – Bhopal India

In 1984, a Union Carbide pesticide production plant in Bhopal India had a devastating release of Methyl-isocyanates. Twenty years later, tens of thousands of Indian people still suffer appalling effects from the Bhopal gas leak. Over 20,000 people have died from the disaster according to Amnesty International. There are many thought as to why this accident occurred. Most evidence points to poor operations and maintenance of plant equipment and inadequate monitoring and emergency response systems.

Aftermath of Bhopal India incident

Negative chemical impacts – Love Canal

The following is an excerpt from the Environmental Protection Agency's website dedicated to Love Canal.

Love Canal is a neighborhood in Niagara Falls, New York. It became the subject of national and international attention, controversy, and eventual environmental notoriety following the discovery of 21,000 tons of toxic waste buried beneath the neighborhood. Love Canal officially covers 36 square blocks in the far southeastern corner of the city, along 99th Street and Read Avenue. Two bodies of water define the northern and southern boundaries of the neighborhood: Bergholtz Creek to the north and the Niagara River one-quarter mile to the south. In this area, Grand Island is situated on the south shore of the Niagara River.

Resident protesting at Love Canal. Sign states, "We've got better things to do than sit around and be contaminated," courtesy EPA

The Niagara Falls School Board chose to construct a school on this site, despite being fully aware of the fact that Hooker Chemical had dumped an appreciable amount of hazardous waste there. The City of Niagara Falls permitted the building of homes and rental units on this tainted property. The construction activity released the chemical waste, leading to a public health emergency, an urban planning scandal, and a finding of liability on the part of the former owner. The EPA stated "Love Canal is one of the most appalling environmental tragedies in American history."
Twenty five years after the Hooker Chemical Company stopped using the Love Canal as an industrial dump, 82 different compounds, 11 of them suspected carcinogens, have been percolating upward through the soil, their drum containers rotting and leaching their contents into the backyards and basements of 100 homes and a public school built on the banks of the canal.

How can we reduce or eliminate negative effects of chemicals?

Let's look at some recent techniques used to reduce the negative impact of chemicals on the environment, human health, safety, and the economy.

Have you heard of Pollution Prevention; what is it?

Pollution Prevention, also known as P2, is the use of material processes or practices that reduce or eliminate the creation of pollutants or wastes at the source. Another way of looking at P2 is to say that it reduces or eliminates "point source" pollution. Point source pollution is an easily identifiable discharge of pollution into the environment, such as a smoke stack or effluent pipe discharging into a water way.

Example of "Point Source" pollution

What is Toxics Use Reduction (TUR)?

TUR is an approach to P2 that targets and measures reductions in the upfront use of toxic materials; thus emphasizing the more preventive aspects of point source reduction. With TUR, it is important to understand how much of an ingredient goes into making a product, how much product comes out, and what happened to the rest of the ingredient.

TURI
TOXICS USE REDUCTION INSTITUTE

Umass Lowell based Toxics Use Reduction Institute

What is Green Chemistry?

Now we come to the main focus of this module. **Green Chemistry consists of environmentally friendly, sustainable chemicals and processes that result in reduced waste, safer outputs, and reduced or eliminated pollution and environmental damage.** Green Chemistry encourages innovation and promotes the creation of products that are both environmentally and economically sustainable.

Green Chemistry represents an emerging, innovative approach that can reduce both worker and environmental health risks. - Joseph "Chip" Hughes, Director, NIEHS Worker Education Training Program

How can Green Chemistry help create a sustainable society?

By using Green Chemistry, chemical products can be created that do not harm the environment or human health. Industrial processes can be designed that reduce or eliminate hazardous chemicals. Finally, efficient processes can be implemented that minimize waste materials and decrease the consumption of non-renewable energy and finite resources. Green Chemistry can also help with P2, eliminating or reducing the need to clean up waste after it gets released into the environment. Also, Green Chemistry provides us a margin of safety when working with chemicals. This is great for workers since elimination is the first step in the Hierarchy of Controls! By employing techniques previously mentioned, we will be saving money by not having to spend it on waste cleanup, emergency response and control, and countermeasures for human and environmental disease.

The 12 Principles of Green Chemistry

The following twelve principles are important. They are the basic formula for using Green Chemistry. In order for something to be considered Green Chemistry, not all of the twelve principles will necessarily be used together. You may be using one, three or seven principles— it is unlikely that all 12 principles of Green Chemistry will be employed. **Also, the use of Green Chemistry does not mean that it is necessarily safe for the worker!**

The following 12 principles of Green Chemistry are the actual principles of Green Chemistry from the EPA. They were pioneered by John C. Warner and Paul T. Anastas and can be found, fully discussed, on their website: www.warnerbabcock.com or on the EPA's website: www.epa.gov under Green Chemistry.

It is not the intent of this module to transform IUOE members into chemists; however, in order to be able to institute change in the work place and to advise chemists, engineers, and employers who research and manufacture equipment or design processes and work methods that IUOE members use, you need to be able to "talk shop." Also, if you are a IUOE Hazmat Trainer, this additional information on chemistry will be useful when you deliver modules that use chemistry, health effects or hazard communication. If you have any questions please let an instructor know, use one of the additional resources on Green Chemistry, or contact the NTF - National HAZMAT Program for further guidance.

Principle 1: Prevent Waste

Design chemical syntheses to prevent waste, leaving no waste to treat or clean up. Obviously it is better to prevent something than to attend to it after the fact. Isn't it better to "not" break your leg than to have to go through surgery, rehab, time away from work and play, medical bills, and the pain? It is the same with waste. It costs far less in the long run to prevent waste than it does to clean up the mess. A good example of this is to design a process that will allow most of the starting ingredients to end up in the final product and not as by-products or waste.

Worker cleans up Love Canal, courtesy EPA

Principle 2: Design safer chemicals and products

Design chemical products to be fully effective, yet have little or no toxicity to humans and the environment (with the exception of pesticides that affect the target organism and only the target organism). One of the fundamental principles of Green Chemistry is to design chemicals and processes to significantly reduce or eliminate hazards to the environment or human health. One example is water based paints which use low toxicity pigments. Here, the water, used as a solvent for the pigment, has a very low volatility and will not easily reach your respiratory system. If the pigment (or paint) does get on your skin or later flakes off and falls on the ground, it will be less harmful to your health and the environment due to the less toxic pigments. Another example that has affected families with children was during 2055-to-2007. In that period, over 1.5 million wooden train toys were coated with lead-based paint and found their way into American homes! If all paints were created to be non-toxic, this event would not have occurred.

Lead painted toys made in China from 2005-2007

Principle 3: Design less hazardous chemical syntheses

Design syntheses to use and generate substances with little or no toxicity to humans and the environment. From 1932-to-1968 the Chisso Corporation in Minamata, Japan dumped an estimated 27 million tons of methyl mercury compounds into Minamata Bay. The Mercury compound was used as a catalyst. In the 1950's, residents of Minamata began showing signs of degenerating nervous systems, including deformities in children, uncontrolled shaking and muscle degeneration. The health problems were ultimately traced to mercury poisoning from eating mercury contaminated fish and other seafood from the Bay. Since then, more than 3,000 people worldwide have been recognized as having "Minamata Disease." Eliminating harmful, toxic catalysts in the reaction stream is an excellent example of principle 3.

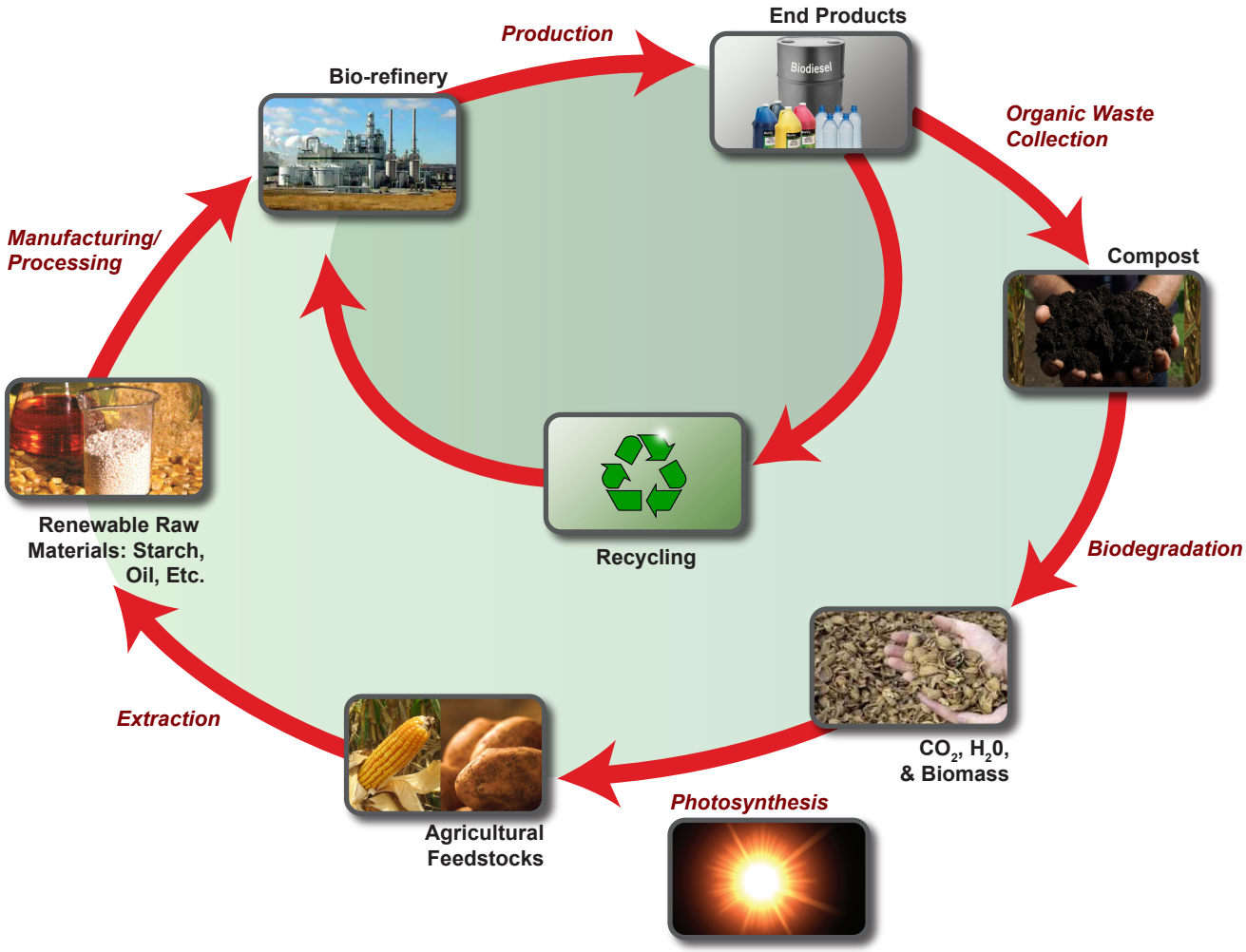
Survivor of Minamata Bay disease

Principle 4: Use renewable feedstocks

Use raw materials and feedstocks that are renewable rather than depleting. Renewable feedstocks are often made from agricultural products or are the wastes of other processes while depleting feedstocks are made from fossil fuels or are mined. A good example of a renewable feedstock product is biodiesel. A good example of non-renewable feedstock is any product made from crude oil. As Operating Engineers, diesel is a very important part of your work. Oil is running out and the price will start to increase at a dramatic rate. Think of the benefit of putting principle 4 to work and creating a renewable, cheap diesel fuel!

Production of Biodiesel, courtesy Ken Costello

Renewable feedstock cycle



Principle 5: Use catalysts, not stoichiometric reagents

Minimize waste by using catalytic reactions. Catalysts are chemicals added to a chemical process to "assist" the reaction. They are used in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and work only once.

What are stoichiometry and stoichiometric reagents? Three things can happen to chemicals during chemical processes:

1. be used in the final product
2. be reclaimed and used again or
3. end up as waste.

Any additional material added to the process of making a usable chemical will usually end up as waste if it is not used in the final product. Even if it is a chemical used for one small step, it could become waste. By using catalysts instead of stoichiometric reagents, there is a recycling component used with the catalysts since they do not become directly involved in the creation of the wanted chemical; they are also used in small amounts. However, catalysts can be very harmful to human health and the environment so care should be taken not to discharge them into the environment and workers should have proper training and equipment when handling catalysts.

Stoichiometric reagents have a measurable relationship with each other in terms of how much reactant (starting material) you will put into the reaction in order to get a certain amount of desired product. It is rare that for a given chemical synthesis (or chemical creation) reactant A and reactant B will combine and 100% of each will be used and go into forming the product. In most cases, some amount of one starting reactant will not be used and will become waste. In most cases the amount of product you get will depend on one reactant, this is called the limiting reagent; and you will only get as much product as the limiting reagent will allow. This entire process is known as chemical yield. The important thing to remember is that materials will not just "disappear" during a chemical reaction. Some will become the final product and some will become waste. Some chemicals, such as a catalyst, will not be used in the final product but will help create the necessary reaction. The catalyst can be reclaimed and used again or disposed of as waste.

Principle 6: Avoid chemical derivatives

Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste. These agents are used during a reaction to "hold" a position on a molecule or are used to prevent or "block" another molecule from becoming attached to the desired product. Since they do not become part of the final chemical, they usually end up as waste.

Principle 7: Maximize atom economy

Design syntheses so that the final product contains the maximum proportion of the starting materials. There should be few, if any, wasted atoms. So, atoms in (ingredients) should equal atoms out (product), with little left over as waste. This is a new name for an old concept—chemical yield. "Atoms in" always equals "atoms out" in chemical reactions. However, the issue is that some of the atoms will end up in the desired chemical product and some will end up as waste. Prevent waste! We should try to design reactions where most of the atoms in end up in the final product and not in a waste stream.

Principle 8: Use safer solvents and reaction conditions

Avoid using solvents, separation agents, or other auxiliary chemicals. If these chemicals are necessary, use innocuous chemicals. A good example here is to use a less harmful solvent. For example, instead of using Benzene (which causes cancer in humans), use Toluene. Since Toluene is not considered a "non-toxic" solvent, use a solvent even less harmful than Toluene!

Principle 9: Increase energy efficiency

Run chemical reactions at ambient temperature and pressure whenever possible. Also, by designing processes for energy efficiency, less strain will be placed on the environment. Aluminum provides a great example of energy efficiency. According to the DOE, it takes 95% less energy to recycle aluminum into another product than it does to create new aluminum from bauxite ore.

Principle 10: Design chemicals and products to degrade after use

Design chemical products to break down into innocuous substances after use so they do not accumulate in the environment. This concept has been around for a long time. If a chemical does get released into the environment, it should break down easily and not persist. This will diminish a chemical's ability to cause environmental damage.

Example of non-toxic, biodegradeable detergent

Principle 11: Analyze in real-time to prevent pollution

Include in-process, real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts. A similar technique has been used for emergency response and fugitive emissions monitoring for a long time. This method gets even more technical; it will monitor the chemical processes in real-time to ensure conditions are correct, resulting in less waste.

Principle 12: Minimize the potential for accidents

Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents, including explosions, fires, and releases to the environment. This principle is likely to find its way into the emergency response realm. How many chemicals do you know of that cause accidents because they are inherently dangerous? Wouldn't it be nice to replace those chemicals with less harmful ones? Good examples of an inherently harmful chemical used in chemical processes are pyrophoric gases. Pyrophoric gases have an ignition temperature equal to room temperature! If these gases are released to the ambient atmosphere; you have a flame!

How has Green Chemistry helped?

Below are four achievements that occurred from applying Green Chemistry. They are:

- Reduction of lead pollution
- Creation of "green" fire suppressants
- Cleanup of "dry cleaning"
- Introduction of safer pesticides – Serenade

Examples of products developed with Grenn Chemistry techniques.

Green Chemistry was used to remove lead from gasoline and to significantly reduce the amount of lead in the environment. Evidence from many countries suggests that human exposure to lead is one of the most serious health problems facing populations, especially children. Exhaust fumes from vehicles using leaded gasoline typically account for roughly 90 percent of airborne lead pollution. In countries that still use, or recently phased out, leaded gasoline, elevated learning development issues can be seen in children.

Green fire suppressants: A class of fire suppressant compounds that have labile bromine atoms bound to atoms other than carbon have been discovered to be more effective at suppressing fires than Halon 1211 and Halon 1301. Moreover, this class of fire suppressant compounds hydrolyzes or oxidizes rapidly in the troposphere. As a consequence, they have minimal ozone depletion potential.

The dry cleaning compound commonly known as "perc" is very harmful to humans (respiratory disease, skin disease, carcinogen) and harmful to the environment. New cleaning equipment, combined with aqueous-based cleaners have done as good a job at cleaning clothes as their harmful perc counterparts, but have significantly reduced negative effects on humans and the environment.

Agraquest-Serenade product won the 2003 Presidential Green Chemistry Award for a small business. The product is a biofungicide with greatly reduced human and environmental toxicity; it is also biodegradable.

Will the use of Green Chemistry increase workplace safety?

It is the intent of Green Chemistry to make chemicals and chemical processes safer and more benign. Using Green Chemistry may not equal safer work environments. There will still be a dose-response. There will still be safety and health issues for workers who work with or near chemicals. The National Institute of Occupational Safety and Health (NIOSH) has stated, "[o]ne chemical or process may be more environmentally beneficial than another, but the benefits for the environment do not necessarily make the substitute chemical or process safer for workers." Below are some examples of Green Chemistry that increased harm to workers:

- The substitution of hydro chlorofluorocarbons for chlorofluorocarbons reduced damage to the ozone layer, but it created both a carcinogenic and flammability risk to workers
- Water-based paints eliminated volatile organic solvents but created a biocide hazard for workers

Activity 1: Assessing the health and safety issues with green chemicals

Time for activity: 30 minutes (20 minutes for group work and 10 minutes for report back)

Objective: Give students practice looking up hazards of chemicals and contrasting effects of traditional chemicals and green chemicals on workers and/or society.

Task: Each group member should research one green chemical, along with the chemical it replaced, state the process it was used in (why the chemical was used) and what hazards are associated with the old chemical and the green chemical. Once the table is filled in, discuss your findings briefly with your group. The course facilitator will conduct a final report back session.

Note to Instructor: The first row has been filled out for reference

Green Chemical Hazards			
Old Chemical	**Process Used**	**Green Chemical**	**Hazards of Green Chemical**
chlorofluorocarbons	propellant and coolant	hydro chlorofluorocarbons	created both a carcinogenic and flammability risk to workers

How does Green Chemistry affect Operating Engineers?

This is one of the last and most important objectives of this module. How does Green Chemistry affect Operating Engineers? You now know the 12 principles of Green Chemistry. Are any of the products you use on your job developed from one or more of these principles? You should find out! You are in a position to demand safer and more cost effective products at work.

Below are some examples of how Green Chemistry is currently affecting Operating Engineers.

Case Study: biodiesel use in heavy equipment

Heavy equipment is dirty! All veteran IUOE members know this. Pollution from heavy equipment damages the health of Operators, workers on the ground and people in the nearby community. Look what a 2006 study found concerning heavy equipment diesel emissions in the state of California.

In 2006, using established U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB) methods to quantify the impact of air pollution, the Union of Concerned Scientists (UCS) published a report that identified construction equipment as one of the largest sources of diesel pollution in California. According to the report, in 2005, pollution from construction equipment in California was responsible for roughly 1,132 premature deaths, 183,000 lost work days and 1,086 hospitalizations; reflecting an annual cost of $9.1 billion. The report can be viewed at www.ucsusa.org/clean_vehicles/california_driving/digging-up-trouble.html.

Out of 18 categories of construction equipment identified in the 2005 California Air Resources Board (CARB) emission inventory, the five highest-polluting categories are responsible for 65% of PM and 60% of Nitrogen Oxides (NOx) emissions. In descending order, they are excavators, tractors/loaders/backhoes, crawler tractors, rubber-tired loaders, and skid-steer loaders.

In New England, air pollution that comes from non-road diesel engines accounts for 20% of the emissions of NOx and 40% of PM emissions from mobile sources.

What can be done?

You could keep using regular diesel fuel and install emission controls. However, that method will deal with the hazard after it is created, which is an engineering control. We could use an elimination control by substituting the dirty burning petroleum based diesel with a cleaner burning biomass fuel, known as biodiesel.

UCS Clean Vehicles Engineer Don Anair asserts that biodiesel has an important role to play in helping to clean up construction sites. "Refueling with cleaner alternatives, like biodiesel, combined with other particulate controls…" "[biodiesel] is an excellent solution for reducing harmful diesel exhaust particulates from construction and off-road diesel equipment."

It's all in the mix

Blends of biodiesel with petroleum diesel can be used in unmodified diesel engines. Depending on the mix, PM and NOx will be lower or higher. Biodiesel can be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems. Pure blends of biodiesel may not be suitable for cold climates. A blend of 20% biodiesel (called B20) and 80% regular diesel reduces emissions of PM by about 10%, but increases NOx emissions by about 2%. B20 costs about 15 to 30 cents more per gallon than Low Sulfur Diesel (LSD). B100 reduces emissions of PM by roughly 40% and costs about 75 cents to $1.50 more than LSD. There are also biodiesel blends specified as B5 (up to 5% biodiesel) and biodiesel blends of 6-20% (labeled as B6-B20 blends). All of these biodiesel rated fuels are designated under ASTM International (see www. ASTM.org).

Some success stories

As reported in Concrete Products online Magazine, Turner Construction Co. turned to biodiesel to help protect workers' health at a Quincy, WA job site. The company began using about 1,200 gallons a week of biodiesel in 20-25 pieces of equipment, including excavators, dump trucks, bulldozers, loaders and forklifts, required for the construction of an 80,000 sq. ft. data center. "The welfare of our workers —a top priority for us — is the primary reason we made the switch to biodiesel fuel in our diesel equipment," explains Turner Construction Safety Manager, Darrin Nelson. "Biodiesel has helped us reduce diesel emissions and soot to provide an improved environment for our employees and all the people who enter our job site."

Also, Brooklyn, Iowa-based Manatt's, Inc., is running all its diesel construction machinery on biodiesel blends. The Des Moines Metro Division alone uses B5-B20 blends in about 100 pieces of diesel equipment. Vice President Curt Manatt reports, "Since switching to biodiesel, we haven't had any fuel-related problems with our equipment. In fact, I didn't tell our mechanics at first that I had switched fuel, because I wanted to see if they noticed a difference. They didn't notice at all."

What's your experience with running heavy equipment on biodiesel?

Case Study: The Department of Energy (DOE) Green Carpets

Members of LU 564, topside

The Environmental Protection Agency's (EPA) Environmentally Preferable Purchasing (EPP) program has selected the DOE as a model in the "Green" movement; showcasing their green carpet program. Since carpet takes over 50 years to decompose and many landfills no longer accept carpet, the DOE decided to actively pursue a carpet recycling program. The persistent efforts of the purchasing team culminated in the successful awarding of a five-year, $5.3 million Blanket Purchase Agreement (BPA) with environmentally preferred qualities at both the manufacturing and disposal stages. This BPA saves over 63,000 pounds of virgin nylon, diverts over a million pounds of carpet from the landfill, and saves the disposal of 831 adhesive buckets (about 650 cubic feet of landfill space). All of these environmental attributes were achieved at a price below the GSA's discount price for carpets and related services.

In contract solicitation, the Statement of Work evaluated firms under a three phase process incorporating performance, environmental attributes, and price.

An ever-present concern for workers is the materials and methods used to install the carpet. Once carpets are installed, they may become an issue for occupants as they off-gas any volatile organic compounds into the buildings atmosphere. This can quickly become an issue for the Stationary Engineer; as indoor air quality complaints rise.

Phase II of the DOE's green carpet program consisted of the environmental health and safety attributes as follows:

- Minimum recycled content of 60% in the backing
- Minimum recycled content of 15% of the nylon face
- Information on recycling plans. None of the old carpet could be placed in a landfill or incinerated. The President or Chief Executive Officer (CEO) of the carpet company had to sign a certificate of compliance. Additionally, the selected vendor would be required to submit monthly reports on recycled carpet totals.
- Asbestos-free
- Indoor air quality standards, including provisions allowing highly sensitive people or those with respiratory conditions to request no carpet in their space. The vendor had to demonstrate compliance with either the CRI Green label voluntary standards or State of Washington Indoor Air Quality (IAQ) specifications.

Lessons learned from the green carpet program

Over the 15 months when the carpet contract was researched and awarded, the DOE team working on the project emphasized a few key lessons they learned from the process. First, the new procurement project involved much trial and error, especially in the absence of other precedents. Second, researching industry standards is an essential part of deciding what standards to include in an awards solicitation. Finally, requiring company certification of claims was an important factor in ensuring honest bidding. A few firms withdrew their bids when they realized all claims would be verified and required a certificate of compliance signed by the company president.

As a Stationary Engineer, what is your experience with Green building materials?

As you can see, Green Chemistry has a large part to play in the fueling of heavy equipment in the present and near future as well as products that will go into buildings. As and Operating Engineer, being able to understand Green Chemistry will help you identify where you can implement changes in the workplace that will not only help the environment but increase worker safety and health.

Things to look for in a "Green Carpet"

- To be sure that the carpet being purchased and installed has the lowest emissions of VOC's possible, look for the Green Label Plus, or other low VOC labels on any carpet being considered
- Look for rubber adhesives and backing to be paired with the carpeting
- VOC's may also be hazardous to the health of workers installing the carpet and later to those occupying the building
- Use natural, instead of synthetic materials whenever possible, recycling old carpet
- If damp or water infiltration may be an issue, use another type of flooring

What about the other liquid products you use: engine and hydraulic oil, grease, antifreeze, starting fluid, to name a few. Don't forget, the opportunity for applying Green Chemistry in buildings is endless; from cleaners to actual building products. You know your equipment, work areas and tasks best—look for ways Green Chemistry can improve your work, health and the environment! If you have an idea, how can you institute those changes? Here are some other examples. Equipment fluids and grease, could it be made from a renewable feedstock? Paint used on equipment, could the process to make it use Green Chemistry? Cleaning products for equipment and buildings, could they be made less toxic and biodegradable? Could biocides be used for HVAC systems?

Activity 2: How IUOE members can bring Green Chemistry to the job

Time for activity: 30 minutes (20 minutes for group work and 10 minutes for report back)

Objective: Give students an opportunity to brainstorm, research and discuss with fellow IUOE members about potential green chemical substitutions for hazardous chemicals currently in use on the job.

Task: The group should choose a job process where harmful chemicals are used and where Green Chemistry could have an impact on worker health and safety. Finally, look up whether or not a green chemical exists for the chemicals you have selected. Each group will share their results according to available time.

Note to Instructor: The first row has been filled out for reference

How IUOE members can bring Green Chemistry to the job			
Operating engineer job process or task	**Chemical product used in process**	**Worker impact if changed (i.e., lower toxicity)**	**Is there a green chemical replacement?**
O&M of equipment	Organic degreaser, solvents, (toluene, xylene, etc.)	Skin, eye, and respiratory sensitization, flammable, just to name a few...	Water-based clean (Safety Kleen)

An Introduction to Green Jobs -- Instructor's Notes

This training will cover:

- An introduction to the environmental problem
- What are "green jobs"?
- What projects and jobs are considered green
- Sources of alternative energy
- Green construction
- Green building materials
- Green jobs and worker health and safety
- Conducting a Green Job Hazard Analysis
- How will the Operating Engineers fit in?

After completing this module students will be able to:

- Give two examples of why we must start doing things in a green way
- Provide the definition of a green job
- Define green construction
- Give two examples of green building materials
- Discuss how green jobs affect worker health and safety
- Conduct a Green Job Hazard Analysis
- List five green projects that will involve Operating Engineers

Module background and key points for you to understand as the instructor

This is an awareness-level module on green jobs. The main purpose of delivering this module is to introduce students to green jobs and to provide them with an understanding that there are still health and safety hazards associated with green technologies and green methods of work. Advanced learning on this topic, beyond the awareness level, will investigate different green technologies for health and safety issues as they pertain to Operating Engineers. For this module, keep it simple. Make sure students leave the course feeling confident they can recognize green jobs and are aware that green jobs are not hazard free.

Module delivery and classroom management

Allow 120 minutes to present this module, including discussion. Module delivery should focus on using group discussion and student input. You will need:

- Green jobs student manual
- Green jobs instructor manual
- GJHA Activity packet
- Extra GJHA
- Green jobs Power Point presentation
- Project, screen and laptop

Training materials for course

Assertion Evidence Power Point Presentation: use the Green Jobs Power Point presentation and follow assertion evidence methodology. It is a good idea to familiarize yourself with the assertion evidence method and structure of the Power Point slides. Many of the slides will have a question or statement in the title (assertion) that will be backed up by visual evidence (photo or graph, etc.). With many of the slides, there will be a question with the evidence/answer on an entrance animation. Give students time to discuss situations and answer questions before presenting them with the answers.

The slides have robust instructor's notes to aid your delivery of the module, to provide background on topics, and to help you provide answers to question posed in the slides and questions that may arise from students.

Assertion evidence presentation format:

The following text was developed, in part, from the article, "Rethinking the Design of Presentation Slides: The Assertion-Evidence Structure', which may be found, along with other assertion evidence training aids, at http://www.writing.engr.psu.edu/slides.html.

This method for developing and using PowerPoint presentations, which features a sentence-assertion headline supported by visual evidence, is documented in Chapter 4 of The Craft of Scientific Presentations[1], a November 2005 article in Technical Communication[2], and the presentation "Rethinking the Design of Presentation Slides[3]."

1 http://www.writing.engr.psu.edu/csp.html
2 http://tc.eserver.org/26457.html
3 http://www.writing.engr.psu.edu/speaking/rethinking_psu.pdf

Four key assumptions apply when using the assertion-evidence presentation format. These assumptions are discussed below:

1. Slides are an appropriate visual aid for the presentation. Too often, slides are projected when no visual aid would better serve the presentation.
2. The success of the presentation hangs on the audience understanding the content
3. The slides projected during the presentation differ significantly from the handout that a speaker might leave with the audience. For instance, the slides projected during the presentation cannot afford to have as much text on them as the handout does, because the audience is not only reading the projected slides, but listening to the speaker as well.
4. Finally, the primary purpose of the slides is to help the audience understand the content, rather than to provide talking points for the speaker.

There are disadvantages to using the assertion-evidence method. The disadvantages are due to the investment of time needed to develop the course materials and for the instructor to prepare for the course. The disadvantages are not related to the actual transfer of knowledge. First, the design requires more time on the part of the presenter than the traditional topic/subtopic format. More time is required to create visual evidence and more time is needed to craft a succinct sentence headline that states the main assertion of the slide. To create those sentence-assertion headlines, the presenter has to understand the purpose and relative importance of details. Another disadvantage is that presenting the slides is more challenging when using this method compared to the traditional topic/subtopic method. A third disadvantage is that because this design is so different from what commonly is projected in meeting rooms, classrooms, and professional conferences, a resistance sometimes arises from co-presenters and supervisors to try a different approach. However, by understanding the assertion-evidence approach you, as an instructor, with practice, will see a better transfer of knowledge from your presentations to the students. Also, this method allows for group participation and readily flows into small group activities and class participation.

Student manual: refer students to the Green Jobs Student Manual. It is for their reference. It expands on the material presented in the Power Point slides.

GJHA activity packet: use this activity packet to conduct a group activity with the IUOE GJHA. Students will review some basic job steps for a wind turbine or green roof installation, break the steps down into tasks and then identify hazards and controls for each task (see GJHA activity directions). As the instructor, it is a good idea to complete the activity.

Group discussions and activities

There is one main activity in this module; the GJHA activity. This activity should drive the concept of green jobs not necessarily being safe for workers. There are also multiple opportunities for questions and group discussion throughout the presentation.

Where to go if students need further assistance

If students still have questions after the course that you cannot answer, refer them to:

IUOE National Training Fund –
National Hazmat Training Program
1293 Airport Road
Beaver, WV 25813

(304) 253-8674

www.iuoeiettc.org

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Module 2: Green Jobs

Green Chemistry and Green Jobs Awareness Course

International Union of Operating Engineers
National Training Fund National HAZMAT Program
(304)-253-8674 • iuoehazmat@hazmat.org • www.iuoehazmat.org

An Introduction to Green Jobs

This training will cover:

- An introduction to the environmental problem
- What are "green jobs"?
- What projects and jobs are considered green
- Sources of alternative energy
- Green construction
- Green building materials
- Green jobs and worker health and safety
- Conducting a Green Job Hazard Analysis
- How will the Operating Engineers fit in?

A crane hoists the nacelle of a windturbine. The operator's job is considered a green job. Courtesy Marty Turek

After completing this module you will be able to:

- Give two examples of why we must start doing things in a green way
- Provide the definition of a green job
- Define green construction
- Give two examples of green building materials
- Discuss how green jobs affect worker health and safety
- Conduct a Green Job Hazard Analysis
- List five green projects that will involve Operating Engineers

It is the goal of this awareness level module to provide you an understanding of green jobs and to impress upon you that there are still health and safety hazards associated with green technologies. Advanced learning on this topic, beyond the awareness level, will investigate different green technologies for health and safety issues as they pertain to Operating Engineers.

What does "green" mean?

When something is green, it means that it is environmentally friendly. This is an important concept because we have now realized that what we do can affect the environment. So whether we are cutting pollution, using solar power, or simply turning down the thermostat in the winter, we can say we are doing something green. As we will see throughout this module, because something is green, does not necessarily make it safe for the worker; especially when you are constructing, installing and maintaining green technology.

A natural landscape devoid of construction, pollution, or unnatural influence

Are there environmental issues that could use some attention?

As we look around at what is going on in our environment and society we notice that there are some specific issues that are causes for concern. Many people do not have an awareness that these environmental issues exist or that they are severe. We will briefly visit some of those concerns here so that we can develop an understanding as to why going "green" is a good thing. Of the many environmental and societal issues, we will look at the following:

- Climate change in regards to severe weather;
- Peak oil;
- Population Growth and overpopulation; and,
- Pollution

It is not the intent of this module to transform you into an environmental expert. You must however understand some basics about what has led to the green movement and that there are health and safety issues associated with this work.

Climate Change: Severe Weather

There is strong evidence supporting the claim that we are currently in a period of rapid climate change. Most environmental scientists agree and the evidence supports, that this is due to human interaction with the natural world through industrial processes and population growth. In short, we are affecting the planet with what we are doing and how we are living. It is also important to realize that climate change has come about with only a few of the smaller nations being developed and that the change has occurred over a short time period. What will happen when large countries such as India, China and Brazil become as developed as the U.S., Great Britain and Russia?

A secion of imelting ice falls from an iceberg in the Arctic Ocean

With climate change, severe weather is seen more and more often and its effects on communities can be devastating. We have to look no further than hurricanes Katrina and Rita, the monthly tornados throughout the midlands of the U.S. or the multiple wildfires that are occurring more and more frequently. This is a concern for Operating Engineers since severe weather outcomes often require skilled support response from Operators for emergency rescue, incident control and cleanup. This work can be extremely dangerous since there are many unknown hazards, stress and fatigue run high and the work is being conducted in a chaotic environment.

Flooding in Demois Iowa, 2008

Peak oil

"Peak oil" is the point at which the amount of oil that can be extracted from the earth in a given year begins to decline, because geological limitations are reached. Extracting oil becomes more and more difficult, so that costs escalate and the amount of oil produced begins to decline. The term peak oil generally relates to worldwide production, but a similar phenomenon exists for individual countries and other smaller areas. This is a concern for Operators since many aspects of your jobs depend on diesel and other oil-based products to run and maintain your equipment. Peak oil will also be discussed during the energy section of this module.

Heavey traffic . Courtesy of DOT

Population growth and over population

We currently have 6.7 billion people on the planet. The world population increased from 3 billion in 1959 to 6 billion by 1999, a doubling that occurred in just over 40 years. The U.S. Census Bureau's latest projections suggest that population growth will continue into the 21st century, although more slowly. The world population is projected to grow from 6 billion in 1999 to 9 billion by 2040. How will we be able to shelter, feed, clothe and educate a population of this size when we can't do these things for our current population? Since the world's population is growing so fast, it is unlikely science or technology will develop at a speed necessary to accommodate the projected increase; in fact, science and technology have not been able to meet the needs of the current 6.7 billion people. Going green may be able to help lessen some of the population growth impact; but it will not eliminate it.

Wheat harvester. Courtesy of Dept. of Energy

Pollution

As our population grows, so to does our need for food and products of every kind. Most industrial processes produce waste. In many cases, the products that we use end up being tossed in a landfill and/or become pollution. We have many examples of environmental pollution and its effects on communities. Pollution can cause disease, harm the environment, and be very expensive to clean up. One example that is often discussed is Love Canal.

The following is an excerpt from the Environmental Protection Agency's website dedicated to Love Canal.

Woman protests at Love Canal, courtesy EPA

Love Canal is a neighborhood in Niagara Falls, New York. It became the subject of national and international attention, controversy, and eventual environmental notoriety following the discovery of 21,000 tons of toxic waste buried beneath the neighborhood. Love Canal officially covers 36 square blocks in the far southeastern corner of the city, along 99th Street and Read Avenue. Two bodies of water define the northern and southern boundaries of the neighborhood: Bergholtz Creek to the north and the Niagara River, one-quarter mile to the south. In this area, Grand Island is situated on the south shore of the Niagara River.

The Niagara Falls School Board chose to construct a school on this site, despite being fully aware of the fact that Hooker Chemical had dumped an appreciable amount of hazardous waste there, and the City of Niagara Falls permitted the building of homes and rental units on this tainted property. The construction activity released the chemical waste, leading to a public health emergency, an urban planning scandal, and a finding of liability on the part of the former owner. The EPA stated "Love Canal is one of the most appalling environmental tragedies in American history."

Twenty five years after the Hooker Chemical Company stopped using the Love Canal as an industrial dump, 82 different compounds, 11 of them suspected carcinogens, have been percolating upward through the soil, their drum containers rotting and leaching their contents into the backyards and basements of 100 homes and a public school built on the banks of the canal.

By using green methods, pollution will be minimized and the impact on our lives will be lessened. As we strive to have no occupational exposures, we should also strive to produce no pollution.

Is there a problem with garbage?

According to the Environmental Protection Agency, the average American produces about 1,600 pounds of garbage a year. Multiply this by our population (306,675,837 people) and we are talking 245 million tons of garbage per year! That is enough to reach from the earth to the moon with filled up garbage trucks. We will eventually run out of space to put the garbage we create. Some green building techniques will help to reuse, recycle, and reduce materials and prevent waste.

To attempt to curb the rising environmental issues…Ride the Green Wave!

The green wave is the phenomenon labeled by the Ella Baker Center for Human Rights as "The exploding economic activity in the 'environmentally sustainable' sector (i.e. the green economy)." By developing a new way of producing, building, using, recycling and disposing of energy, products, food and other items we need, we can slowly start to reverse the environmental (and human) damage that has occurred. You can learn more about the Ella Baker Center for Human Rights on their website: www. Ellabakercenter.org

Solar Highway construction, courtesy Oregon DOT

What are green Jobs?

As defined by the Ella Baker Center for Human Rights, a green job or, green collar job, is a paid position providing environmentally-friendly products or services; the term suggests high standards regarding fair wages, equal opportunity and healthy working conditions; employer may be a private business, government, non-profit or cooperative. Green jobs also include both lower and higher skilled employment opportunities that directly result in the restoration of the environment, increased energy efficiency, clean energy generation, the creation of high performing buildings and the conservation of natural resources. These jobs are in a current "boom" and will continue to rapidly grow as current and new green industries continue to develop and come into the market.

However, we need more than green jobs, we need a green economy! We need markets based on green energy, goods and services. This will make going green a new way of sustainable living and will protect us and the environment. Going green will create sustainable, living wage jobs.

Factors driving green job growth

The following factors have been found to contribute to green job growth:

- Economic conditions;
- Technological advances;
- Public policy;
- Clean Energy Program;
- Federal Economic Stimulus;
- Workforce strengths, geography, and infrastructure are also important drivers.

If you pay attention to recent and future news on green jobs and the green economy, you will notice that the factors mentioned above are setting the field for green job expansion. Another great place to gain insight to the green jobs movement is on the Department of Energy's web site (www.DOE.gov). They have a special alternative energy link that shows what they are currently considering, what projects are under way, and how much money there is for the work. Good insight!

What goes into a good job or trade?

Good jobs have:

- Living wages;
- Health benefits;
- Meaningful work;
- Occupational mobility;
- High levels of job satisfaction;
- Not able to be exported;
- Attractive to young workers; and,
- Low barriers to entry.

Green jobs will satisfy the above requirements of a good job. But be careful; just because a technology or business claims to be green doesn't mean it is truly green. For example, a company in Chicago designs and installs urban wind turbines that generate energy, blend in with the surrounding structure, and actually enhance a building's aesthetic appeal. This company has had such a high demand for these wind turbines that it recently contracted a manufacturer in India to produce a few thousand units.

How can this be green? This process fails to meet the above stated requirements of a green trade. Firstly, it wastes energy shipping the turbines from India. Secondly, it denies the involvement of local workers. An American green job or trade requires that a product or service be provided by American workers on American soil utilizing American materials. Thus, the installation of "green" products made by manufacturers outside of the U.S. cannot be considered a green job.

A few examples of green jobs

Below are a few examples of green jobs taken from a 2006 Pinderhughes survey. Operating engineers may come in contact with these jobs or assist in supporting these projects.

- Car and truck mechanic jobs, jobs related to bio-diesel, vegetable oil and other alternative fuels;
- Energy retrofits to increase energy efficiency and conservation;
- Hauling and reuse of construction and demolition materials and debris;
- Green building/construction
- Hazardous materials clean up;
- Sustainable landscaping;
- Water retrofits to increase water efficiency and conservation;
- Non-toxic household cleaning in residential and commercial buildings;
- Recycling
- Alternative energy installation and maintenance;
- Tree cutting and pruning;
- Green waste composting on a large scale; and,
- Parks and open space maintenance and expansion.

Green Industries

The industries that are creating or expanding green jobs are industries such as:

- Utilities;
- Business services;
- Personal services;
- Construction;
- Public Sector/Government;
- Biotechnology;
- Trucking;
- Waste management; and,
- Recreational.

Installation of insulated modular walls, courtesy DOE

When investigating green job potential, try starting with one of these industries and working your way through different companies to see what may be available. Example: look at an electrical utility and see if they have any green jobs (building wind turbines, solar panel production and installation, etc.)

Building green and green construction?

Building "green" is the process of designing, constructing, operating, and maintaining buildings and landscapes that produce healthier indoor and outdoor environments. Certain private organizations have been created that evaluate and certify green construction projects according to a set of parameters they have set forth (use recycled materials, south facing, insulation value, etc.) There are also some federal standards for specific products, such as Energy Star (see later in module). The following is an example of a certification for building green:

- U.S. Green Building Council (USGBC)
- Leadership in Energy and Environmental Design (LEED)

Remember, just because something is certified as a green building project, does not mean that it is safe for the workers doing the job! The traditional construction hazards may still be present and/or new, unique hazards may have been created by the green construction practices.

Major components of LEED

An in depth investigation of LEED is beyond the scope of this module, but you should be familiar with some of the components that comprise a LEED certification. They are:

- Integrated design;
- Sustainable sites;
- Water efficiency;
- Energy and atmosphere ;
- Materials and resources; and,
- Indoor air quality

What is a green building and why do it?

A "green" building is a high performance facility that reduces water, energy and resource consumption; lowers operational costs, improves indoor air quality, and mitigates negative environmental impacts. It may employ new construction methods and/or use new "green" building products. As we shall see later in this module, there is a fast developing "green construction products" industry.

It is also important to understand why we should start building green. According to the Green DC Initiative (a huge green undertaking for the greater DC area), "Because it makes sense for the economy, public health and the environment." We have already mentioned some issues with the environment and limited resources and waste generation; building green can help reduce those negative environmental and human impacts.

A recognized, energy-efficeint building in Manhattan. Courtesy Dept. of Energy

The costs of building

According to the Guide to Green Building:

- 40 percent of raw materials consumed globally are used by the building construction industry
- U.S. building construction:
  - Uses 68% of total electricity consumption
  - Creates 38% of carbon dioxide emissions
  - Uses 12% of potable water
  - Creates 272 million tons of construction and demolition waste annually

That is a lot of material use and waste production! Building green will reduce these numbers and create new job categories (such as deconstruction specialists) for Operating Engineers while keeping the traditional jobs intact.

Here are a few examples of green construction projects

Modular, insulated walls

Rooftop rain garden or "green roof"

Wind turbine installation

Background on green roofs

Green roofs are a unique method of landscaping on rooftops. In contrast to a traditional flat roof, green roofs or, rooftop gardens, offer many economic, environmental and aesthetic benefits. Green roofs provide jobs suitable for IUOE members—from crane operators and landscape crews operating heavy equipment, to the stationary engineers who will be required to oversee and maintain the new roof system. Although it is beyond this awareness course to teach the method of green roof construction, a list of benefits is found below:

Benefits include:

1. Energy savings

In the summer, green roof plantings shade the building from solar radiation and, through the process of evapotranspiration, can reduce, if not eliminate, any net heat gain. This shading decreases the amount of energy required to cool the building and in turn helps to cool the surrounding area. In the winter, the additional insulation provided by the growing medium helps to decrease the amount of energy required to heat the building. The extent of the energy cost savings is a function of:

- The size of the building
- Its location
- The depth of the growing medium
- The type of plants and other variables

In one or two storey complexes where the roof is a large portion of the building envelope, the cooling energy savings in the summer have been modeled as high as 25 percent, as reported by Pers. Com. Dr. Brad Bass, Environment Canada, Adaptation and Impacts Research Group, February 2001.

2. Roof membrane protection and life extension

Green roofs can add and additional 50years to the life expectancy of a roof membrane.

3. Sound insulation

Tests have shown that green roofs can reduce indoor sound by as much as 40 decibels, providing particular benefit to buildings in noise impacted areas, such as those close to airports or industry.

4. Fire resistance

Because soil is a naturally fireproof, a green roof will add increased fire protection of the building.

5. Urban Heat Island Effect

The cooling effect you get when you walk from a black asphalt parking lot to a shaded park on a summer day is called the Urban Heat Island Effect. It is also the difference in temperature between a city and the rural area surrounding the city. Dark surfaces absorb and radiate heat, raising temperatures as much as 6 to 10 degrees Fahrenheit. Have you ever walked on asphalt on a hot summer day in your bare feet? The result is more than uncomfortable. Although we mention "black asphalt," most hard surfaces can add to this heating effect. This heating effect is also able to influence the temperature of the surrounding suburban areas. The Urban Heat Island Effect increases the use of electricity for air conditioners and it increases the rate at which chemical processes generate pollutants, such as ground level ozone. It also exacerbates heat-related illnesses. The Urban Heat Island Effect has consequences for our environment, our finances and our health.

Green roofs intercept the solar radiation that would strike dark roof surfaces and be converted into heat, thereby improving energy conservation. Like urban forests and reflective roofing surfaces, they absorb and/or deflect solar radiation so that it does not produce heat.

An ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers) simulation conducted by the City of Chicago on their City Hall green roof showed that every one degree Fahrenheit decrease in ambient air temperature results in a 1.2% drop in cooling energy use. The study suggests that if, over a period of ten years or more, all of the buildings in Chicago were retrofitted with green roofs, (30% of the total land area), this would yield savings of $100,000,000 annually from reduced cooling load requirements in all of the buildings in Chicago. The cooling would also slow the chemical processes that produce ground level ozone, nitrous oxides and smog, and help to offset the production of sulfur dioxides from coal fired utilities.

6. Storm water retention

Rooftop gardens absorb rainfall and reduce urban runoff that otherwise would collect pollutants and empty into sewers. A rooftop garden filters and moderates the temperature of any water that is released to the sewer.

7. Air cleaning

In addition, plants actually filter the air. Plants improve air quality by using excess carbon dioxide to produce oxygen. Also, "1 m^2 (10.76 ft^2) of grass roof can remove 0.2 kg of airborne particulates from the air every year."

8. Creation of habitats and aesthetic beauty

A rooftop garden can add usable leisure space to a property that is attractive not just to people, but to wildlife, such as birds and butterflies.

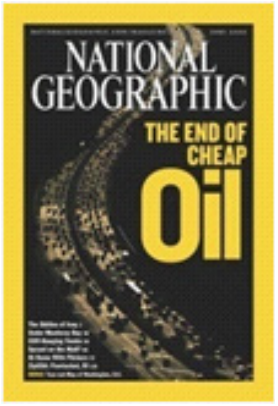
Considerations when planning a green roof

Important factors to consider when planning a green roof project include structural capacity of current roof system, process for future maintenance of roof system and cost. Green roofs typically cost about 50% more than a conventional roof.

Sustainable Revitalization

This is a concept presented by the EPA in the spring of 2009. What does it mean for IUOE members? New, specific jobs will open up with increased environmental standards and new health and safety issues. A good example of this, as mentioned earlier, is deconstruction. This differs from demolition, where you must go in and salvage all usable materials in the structure before it is demolished. This has increased health and safety hazards, yet it is environmentally friendly.

How long will our energy last?



The End of Cheap Oil. Courtesy National Geographic.

It depends on what type of energy you are talking about. Non-renewable sources such as oil and coal will run out. They will start to run out faster and faster as the population quickly grows and all the "easy" fuel is recovered. Renewable sources such as solar and wind power will last forever. A great example of the impact of non-renewable energy use is "Peak Oil", which we discussed at the beginning of the module. Peak Oil is a phenomenon that is currently starting to happen (or may have already happened) in this country. We must find alternative methods to power our equipment, vehicles and to produce electricity.

What are green energy jobs?

A green windturbine. Courtesy of DOE

Green energy jobs are jobs that reduce energy and lower carbon emissions. They may be traditional jobs with a "green layer" of skills and knowledge. They cover jobs in middle-skill construction or related occupations. Also, jobs in energy efficiency are considered green energy jobs.

Below is a short list of green energy jobs:

- Energy auditor/Rater;
- Air sealer;
- HVAC technician;
- Electrician;
- Solar power installer;
- Wind turbine technician;
- Energy engineer; and,
- Research scientist.

As you can see, between H&P and Stationary Engineers, there are 4 to 6 jobs on that list, depending on your job scope or in which type of projects you would like to become involved!

Condensers and cooling towers at the geysers geothermal power plant in California. Courtesy DOE.

Can you name some alternative energy sources?

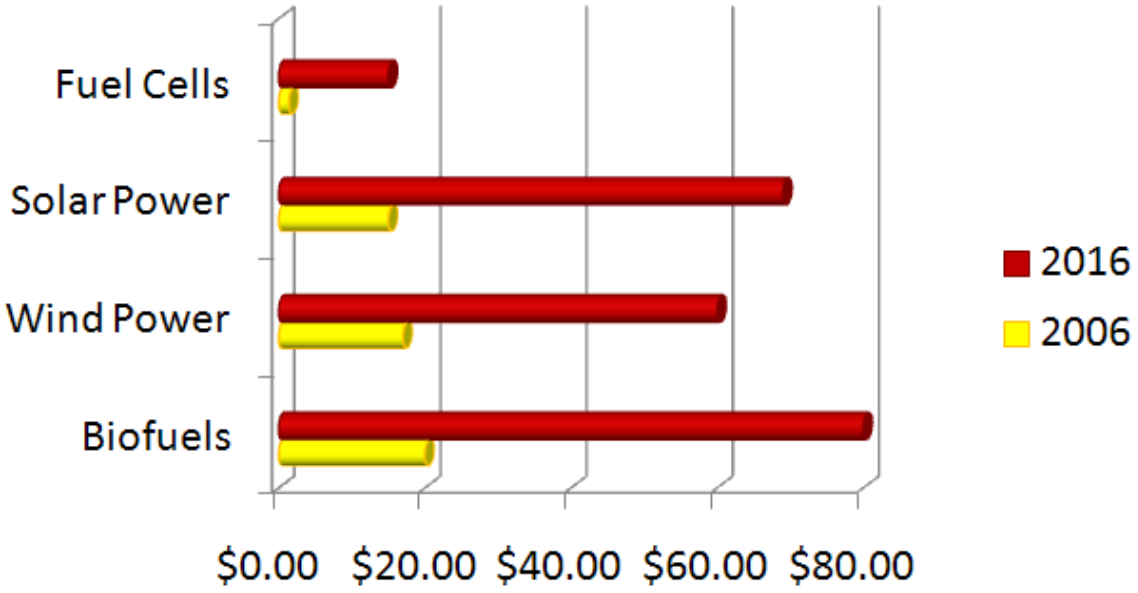
- Wind power
- Geothermal
- Hydro power
- Solar power
- Biofuels
- Fuel cells

It is the intention of this module only to introduce you to green jobs. Alternative energy installation and operations and maintenance have great potential to employ Operating Engineers. These topics will be covered in a longer, more in-depth module that will also cover specific safety and health hazards for each type of alternative energy.

How serious is the U.S. in developing its renewable energy program?

The following graph, created by Clean Edge in 2007, shows a dramatic investment in renewable energy over the next 10 years.

Renewable energy projected growth ($Billions) 2006:2016



What should you do before you install high tech energy systems?

Before installing high tech energy systems we should make sure it is not wasted. Weatherization and energy efficiency techniques should be employed before the investment in alternative energy is made. Once that is complete, an alternative energy system could be installed and the return on investment may be fairly quick (5-7 years), depending on the type of energy and the geographic location in which it is installed.

Weatherization of buildings

Weatherization is a method of insulating buildings from the outside climate. This includes construction of new buildings and renovation and retrofit of old buildings.

DOE's weatherization components

- National Energy Audit Tool
- Insulation
- Blower doors
- Air sealing
- Windows
- Heating
- Water heaters
- Air conditioning and warm climate weatherization measures
- Electrical appliances and weatherization base load measures

Building Envelope

A building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment as well as to facilitate its climate control. Building envelope design is a specialized area of architectural and engineering practice that draws from all areas of building science and indoor climate control.

Building envelope design includes four major performance objectives:

- Structural integrity;
- Moisture control;
- Temperature control; and,
- Control of air pressure boundaries between inside/outside and/or specialized rooms.

This aspect of green building will be further investigated in a higher-level class. For more information on building envelope, see The National Institute of Building Sciences (NIBS) Building Envelope Design Guide.

Energy Efficiency-Energy Star

Energy star is an international standard for energy efficient consumer products. It was first created as a United States government program in 1992. Devices carrying the Energy Star logo, such as computer products and peripherals, kitchen appliances, buildings and other products, save 20%-30% on average. Energy star is connected to LEED projects; if you are employing energy star products in your building, you will score LEED points for doing so.

Green Remediation

Green remediation is the practice of considering environmental impacts of remediation activities at every stage of the remediation process, in order to maximize the net environmental benefit of a cleanup.

Considerations include selection of a remedy, energy requirements, efficiency of on-site activities, and reduction of impacts on surrounding areas. Remediation activities can have a negative impact on the environment, such as greenhouse gas emissions from combustible fuels used by remediation technologies or from off-site water quality impacts of cleanup activities. Furthermore, many of the pump and treat (P&T) systems currently in place were designed and installed when energy was less expensive and designers did not consider the full impact of using non–renewable energy.

To counter these negative environmental impacts, decisions are being made at many sites to utilize alternative energy sources for powering more traditional remediation systems, such as P&T and soil vapor extraction (SVE).

What is a green cleanup?

Green cleanups are the practice of considering all environmental effects of a cleanup during each phase of the process, and incorporating strategies to maximize the net environmental benefit of the cleanup.

Opportunities to increase sustainability in site cleanups

According to the EPA, increases in sustainability can apply to all cleanup programs and be employed throughout site investigation, design, construction, operation, and monitoring.

EPA's green cleanup goals

- Minimize ancillary impacts such as CO2 emissions to the air;
- Minimize total energy use and promote use of renewable energy;
- Preserve natural resources;
- Maximize the recycling of material; and,
- Maximize reuse options for land.

Do you think Green = Safe?

Installing a green roof, Courtesy DCgreenworks.org

We have looked at this question a few times already. Employment of green construction techniques and green concepts does not mean a job is going to be safe for the worker. There will still be silica in the air when you dig for a green foundation, there will still be exposures to chemicals and products; there will still be a dose response. We know what and how the traditional hazards affect us, what about the new hazards created by green techniques or products? On the job, try to shoot for a zero exposure whether you're on a traditional job or a green job!

Inherently, a green job is no safer than a job in a traditional task that involves similar conditions or demands…-NIOSH

The following NIOSH matrix contrasts established traditional jobs with new, green jobs. It looks at the progression of health and safety as we move into the new green jobs market, where the health and safety hazards of green jobs are sometimes unknown.

Green Jobs Occupational Hazards

Old → New

Traditional Jobs ↓ Green Jobs

What we know • Utilize the body of knowledge from safety, industrial hygiene, and occupational medicine • Identify where old hazards are not being addressed adequately **How do we apply what we already know to a re-employed / re-deployed workforce?**	**What we know we don't know** • Develop research agenda and planning • Conduct ongoing assessment of guidance and regulations **How do we (quickly) support research, disseminate results and transfer it into practice?**
What we don't know we know • Determine the extent to which old hazards will be manifest in green jobs • Determine how to adopt old guidance to new jobs **How do we identify and apply "old" knowledge to these new jobs?**	**What we don't know we don't know** • Be alert for sentinel events • Consider leading indicators

Sustainability must include worker safety and green jobs must be safe jobs -NIOSH

Operating Engineers evaluated the safety of new DOE cleanup technologies, including Evaluation of over 150 technologies. The outcome of the evaluations was the creation of several guidance documents on the new cleanup technologies and Technology Safety Data Sheets (see following chart). Throughout these evaluations, the IUOE learned that new "greener" technologies could have old hazards, such as asphyxiation and eye hazards and ergonomic issues. From these evaluations the IUOE also learned that workers needed more safety information about the processes and products they would be employing in the new green cleanup methods.

IUOE evaluation of dry ice blasting for radiation cleanup

Green jobs still require construction and potential exposure to chemicals!

One example of chemical exposure is fiber-cement board. Fiber-cement board is a concrete-like material used in roof shingles, panel units, floor underlayment, and siding. It is strong, durable, mold and weather resistant, and non-combustible. It has a very long life, 50 years and beyond. It may also be created from recycled materials. It is however potentially dangerous to workers due to its crystalline silica composition. Workers who cut it or work with it in such a way as to produce dust are at risk of silica exposure. Nearby workers may also be affected by the silica hazard.

Fiber-cement siding

A review of MSDS reveals that Hardiplank contains 10-50% crystalline silica while Weatherboard contains 45-55% crystalline silica. While both of these products are green and are of little health risk once they are installed; workers who cut, grind or use other work methods that produce fine dust have an exposure risk to silica. If you are using products that produce exposure risks, use the hierarchy of controls to reduce the likelihood of harm from the hazard.

No matter what the green product is, read the MSDS and understand the risks and how to control them!

Matt Gillen, MS, CIH, Pietra Check, MPH and Christine Branche, PhD of NIOSH have developed six steps describing how to go green safely. These are the six steps:

WISHA inspection data: 5 of 7 workers using circular saws outdoors on fiber-cement siding were exposed above ACGIH-TLV for silica

1. Define, categorize, and track green jobs

Defining and categorizing green and sustainable jobs and work practices is a necessary first step for identifying and understanding how green jobs affect worker safety and health. Researchers, demographers, and industry partners need to work together to define and keep track of injuries, illnesses, and hazards associated with green jobs. Standardized terminology will reduce confusion, improve information sharing, and make it possible to identify the worker safety and health benefits and problems that arise over time.

2. Evaluate all green jobs, practices, processes, and products for hazards to worker safety and health

Sustainable practices and green technologies, products and processes need to be evaluated for worker safety and health, just like any other new job, product or practice. Such evaluation can identify work-related hazards that can then be prevented or controlled. The evaluation process can also help identify those green practices, products and technologies that improve worker safety and health so that they can be widely promoted.

In addition, the safety and health community can do more to evaluate and understand the energy costs and environmental impacts of safety and health practices. Green jobs, processes, products, and technologies can all benefit from research to find out how best to maintain a high level of safety and health while improving energy efficiency and reducing environmental impacts.

3. Integrate worker safety and health, energy conservation and environmental protection efforts

Occupational safety and health, energy conservation and environmental protection professionals often work independently, which increases the likelihood that costs and risks will be unintentionally shifted from the environment to workers or vice versa. Collaboration among these professionals would help establish approaches to sustainability that ensure workers, the environment and energy resources are all protected.

4. Plan early for prevention

Considering safety and health during the design phase of a project, when decisions are made regarding equipment and materials, is an important, cost-effective strategy. At NIOSH, this strategy is called Prevention through Design (PtD). The application of PtD principles can achieve sustainability through early planning and ensure that the resulting health, energy and environmental benefits are maximized for workers, the public and the environment.

5. Make safety and health part of green jobs training

Training will help workers develop the new skills they need to transition to green jobs or to learn how to use new products and technologies in their existing jobs. Safety and health should be considered essential components for all green job training, in addition to training on the skills workers need to complete job tasks.

6. Add safety and health to green benchmarks

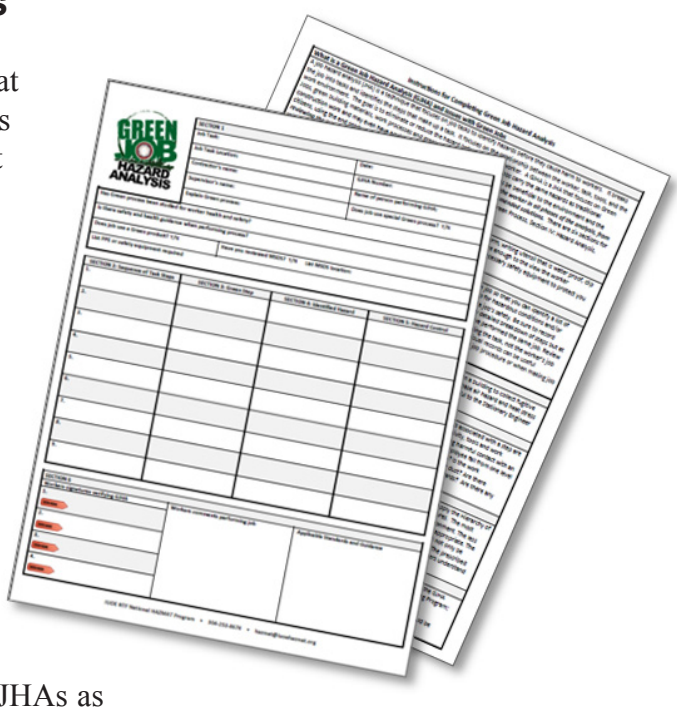
There are many different types of measurements and benchmarks to evaluate whether practices are green and sustainable. One example is the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System™. While these evaluation techniques are widely used, almost none of them directly consider occupational safety and health. Researchers and practitioners need to work together to determine whether or not a practice is good for worker safety and health, and then add that to the benchmarks for green and sustainable practices.

Great strides can be made in occupational safety and health, energy conservation and environmental sustainability if all three fields work together, share information and work toward common goals. December's Making Green Jobs Safe workshop started the conversation about how to integrate these fields. NIOSH welcomes your thoughts to continue the conversation about the considerations presented here. The ideas you share in response to this blog will be combined with what was discussed at the workshop to help NIOSH refine these considerations and guide future efforts.

By following these six steps, workers and employers should be able to create a plan for how they will tackle health and safety issues on green jobs. The planning should occur before work begins. Workers should receive proper training concerning green job health and safety hazards.

As with any job, remember to use the Hierarchy of controls to control hazards!

Introduction to Job Hazard Analysis



A job hazard analysis (JHA) is a technique that focuses on job tasks as a way to identify hazards and control them before they affect workers. It focuses on the relationship between the worker, the task, the tools, and the work environment. After uncontrolled hazards are identified, action is taken to eliminate them or to the reduce risk of suffering harm from them!

A JHA can identify and prioritize hazards and help to control the hazards. A JHA is also an excellent tool to train workers on workplace health and safety. In addition to these benefits, a JHA gets workers involved in the health and safety process and can help foster constructive communication between workers and management. OSHA also requires JHAs as part of their VPP initiative.

In the expanding green economy, which introduces new technology, work practices and products, a gap is developing in worker protection. The IUOE has developed (see handout) a Green Job Hazard Analysis (GJHA) tool to help the IUOE understand the spectrum of green job health and safety issues and to control identified hazards (See Appendix A). The Green Job Hazard Analysis tool focuses on green jobs and "green" aspects of traditional jobs. Therefore, it can be applied to green and traditional jobs.

The short course in conducting a GJHA

This short introduction to conducting a JHA or a GJHA will by no means make you an expert on this process. However, it will familiarize you with the process. With some additional training and practice you will be able to conduct JHAs like a pro! The basic steps to conduct a JHA (or GJHA) are:

- Involve workers!
- Review past data
- Prioritize jobs with the greatest degree of hazard and risk
- Break jobs into tasks
- Break tasks into steps
- Indentify hazards associated with each step
- Assign controls for each hazard
- Develop safe job procedures

Activity: Conduct a GJHA

Time for Activity: 45 minutes (30 minutes for group work and 15 minutes for report back).

Objective: There are two main objectives of this activity. 1) To familiarize participants with the job hazard analysis procedure and with the IOUE GJHA tool. 2) To help participants understand that green jobs are not necessarily safe jobs for the worker.

Task: Your group will be assigned a wind turbine or green roof installation. These green jobs are simplified for awareness-level training purposes. Use the provided IUOE GJHA tool and the supplied photos to conduct a GJHA (a smaller presentation of both the wind turbine and green roof graphics are provided in Appendix A). You may wish to use the internet to fill in any questions that you may have about the wind turbine or green roof installation process. After you have conducted the JGHA, select a group member to report back to the class.

Green jobs and economic development

We can imagine, from some of the examples of environmental and resource deterioration that we have covered, that green jobs will become a necessity. In 2009, $789 billion was distributed in the economic-recovery bill. The dispersed funds include roughly $62.2 billion for green initiatives! As of spring 2010, much of the money has not been spent. There is still ample opportunity for green collar work to boom. Discuss green construction opportunities with your local business managers to ensure that the IUOE gets the green jobs!

Let's look at a case study: Green DC

The following information on the Green DC project is an example of what is happening with green collar jobs and green construction in large cities and communities. The information comes from the District of Columbia Green Collar Jobs Demand Analysis Final Report, February 2009. The DC Green Construction effort could produce over 169,000 jobs between 2009 and 2018. Private sector real estate development and public sector real estate and capital projects are required to follow the DC Green Building Act and some voluntary private sector initiatives will follow suit.

The Green Building Act of 2006 phases in green building in DC. It requires commercial buildings to be certified, using the LEEDTM Green Building Rating System. Residential buildings must meet the Green Communities standards. The Green Communities checklist provides a clear, cost effective way to green multi- and single-family buildings. The act also launches a green building incentive program, a Green Building Fund and a Green Building Advisory Council. This is an act that releases funds for the new green work, and hence new green jobs, to be started.

In the Green DC example, who will get these green jobs?

- 37% of the green job opportunities require little to no preparation;
- 42% of the green jobs will require a moderate level of preparation;
- Some will require an Associate's degree; and,
- A few will require a Bachelor's degree or higher.

It is worth noting, a brief search of other, large-scale U.S. green initiatives shows similar data. Projects like these are going on in New York, Portland, LA, and many other large cities.

Green DC top 10 highest demanded jobs are the following:

- Carpenters;
- Construction laborers;
- First-line supervisors/managers of construction trades and extraction workers;
- Construction managers;
- Operating Engineers and other construction equipment operators;
- Plumbers, pipefitters and steamfitters;
- Roofers;
- Electricians;
- Cement masons and concrete finishers; and,
- Painters, construction and maintenance.

Wind turbine installation made possible by Operating Engineers. Courtesy DOE.

Operating Engineers are in the top ten percentile of in demand green jobs! Again, if you carry this search outside of DC, to other large cities, you will find Operating Engineers are also in the top in demand green jobs.

Where does the IUOE fit in to the green job market?

For many green construction projects, IUOE members (H&P and Stationary) will be required. We have seen examples of alternative energy construction (wind, solar, hydro, and geothermal) where H&P Operators will be required. We have learned that the new green building standards will require intricate monitoring of environmental systems where Stationary Engineers will be needed. These are but two of many examples!

The only barrier will be to become familiar with the new green construction building methods, materials and processes.

Don't forget about health and safety!

Green collar work has new, unique health and safety challenges, while still containing the old hazards. Green does not necessarily mean safe or healthy for the worker! Find the facts before you go green! If you have any further questions concerning any aspect of this module or would like further information on green jobs, contact the NTF - National HAZMAT Program.

Appendix A: Hazard Analysis Form

SECTION 1	
Job Task:	**Date:**
Job Task Location:	**GJHA Number:**
Contractor's name:	**Name of person performing GJHA:**
Supervisor's name:	**Does job use special Green process?** Y/N
Explain Green process:	
Has Green process been studied for worker health and safety?	
Is there safety and health guidance when performing process?	
Does job use a Green product? Y/N	**Have you reviewed MSDS?** Y/N **List MSDS location:**
List PPE or safety equipment required	

SECTION 2: Sequence of Task Steps	SECTION 3: Green Step	SECTION 4: Identified Hazard	SECTION 5: Hazard Control
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

SECTION 6		
Workers signatures verifying GJHA	**Workers comments performing job**	**Applicable Standards and Guidance**
1.		
2.		
3.		
4.		

Instructions for Completing Green Job Hazard Analysis

What is a Green Job Hazard Analysis (GJHA) and issues with Green Jobs

A job hazard analysis (JHA) is a technique that focuses on job tasks to identify hazards before they cause harm to workers. It breaks the job into tasks and identifies the steps that make up a task. It focuses on the relationship between the worker, task, tools, and the work environment. The goal is to eliminate or reduce the hazard before it harms a worker. A GJHA is a JHA that focuses on Green Jobs, green building materials, work processes and green building methods. Green jobs carry the same hazards as traditional construction work and may even have additional hazards. Not only should Green Jobs be beneficial to the environment and the citizens, using the end product they should not harm the workers on the job. ***Include the worker in all phases of the analysis, from reviewing the job steps and procedures to discussing uncontrolled hazards and recommended solutions.*** There are six sections for this GJHA. Section I: Background info, Section II: Sequences of basic tasks, Section III: Green Process, Section IV: Hazard Analysis, Section V: Hazard Controls and Section VI: Verification

Equipment considerations

You may want to have the following equipment on hand when conducting a GJHA; GJHA form, writing utensil that is water proof, clip board, digital camera or digital video recorder with zoom, binoculars (if you cannot get close enough to the view the worker performing task), lap top with GJHA electronic form (If collecting data electronically), any necessary safety equipment to protect you while performing the GJHA (ear protections, hard hat, safety shoes, etc.)

SECTION 2: Sequences of basic tasks - breaking down a job into small parts

Each job is comprised of a series of tasks. Tasks are comprised of a series of steps. Observe the job so that you can identify a list of tasks. Each task is then broken into steps. Once the step is clearly understood, analyze that step for hazardous conditions and/or unsafe behaviors. Developing the steps for a task is critical in the analysis process for improving a job's safety. Be sure to record enough information to describe each task step without getting overly detailed. Avoid long, overly detailed breakdown of steps but at the same time do not combine steps (look for "and" in the step). Get input from workers who have performed the same job. Review the steps with workers to make sure you have not omitted something. Ensure that you are evaluating the task, not the worker's job performance. It may be helpful to photograph or videotape the worker performing the task since visual records can be useful references when doing a more detailed analysis of the work as well as used in the creation of a safe job procedure or when making job modifications.

SECTION 3: Green Process

Record any step that is performed to make the job "Green" such as installing an exterior poly barrier on a building to collect fugitive airborne contaminants. This step protects the community from unwanted contaminants, but may increase air hazard and heat stress exposures for workers. Another example is use of any fertilizers on roof top gardens that may be harmful to the Stationary Engineer and staff who is responsible for maintaining the building and its systems.

SECTION 4: Analyzing hazards for each basic task

A hazard is a process or thing that has the potential to cause harm to the worker. To ensure that all hazards associated with a step are identified, analyze each step to identify potential as well as actual hazards produced by work process or activity, tools and work environment. Consider the following: Is there danger of striking against, being struck by, or otherwise making harmful contact with an object? Can the worker be caught in, by, or between objects? Is there potential for a slip or trip? Can the employee fall from one level to another or even on the same level? Can pushing, pulling, lifting, lowering, bending, or twisting cause strain? Is the work environment hazardous to safety or health? Is there potential for concentrations of toxic gas, vapor, fumes, or dust? Are there potential exposures to heat, cold, noise, or ionizing radiation? Are there flammable, explosive, or electrical hazards? Are there any other activities or items that may cause harm to the worker?

SECTION 5: Controlling the hazards

After reviewing your list of hazards with workers, consider what control methods will eliminate or reduce them. Apply the Hierarchy of Controls (elimination, engineering, administrative and PPE) and explore the application of different controls measures. The most effective measures are controls that remove or eliminate the hazards or physically change a machine or work environment. The less likely a hazard control can be circumvented, the better. If this is not feasible, administrative or PPE controls may be appropriate. The JHA itself can be an effective management control. Make sure the workers have input to ensure that the control will not only be effective for reducing or eliminating the hazard, but that the control will still allow the workers to perform their job. The prescribed control may change how workers do their job. If you plan to introduce new or modified job procedures, be sure workers understand what they are required to do and the reasons for the changes. Controls MUST NOT create an additional hazard

SECTION 6: Verification and final steps

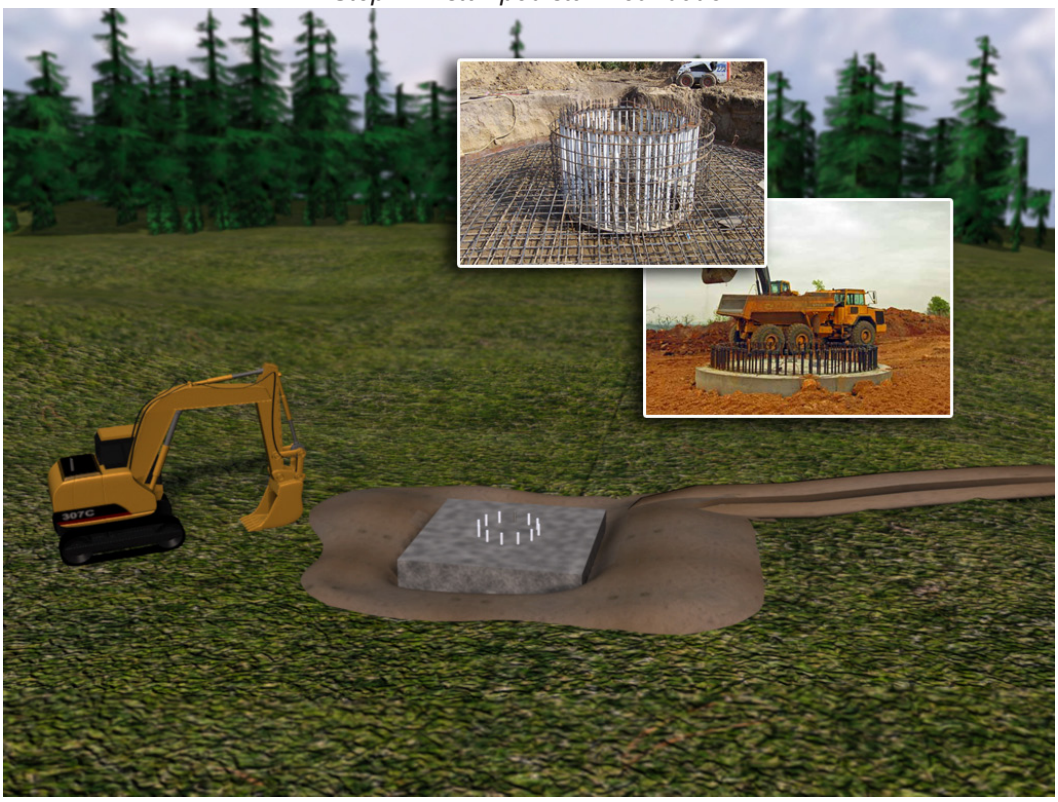
Now that the GJHA is complete make sure workers that were involved in the process have signed the GJHA form. Verify the GJHA form is filled out completely. Copy and send back form (or file if done electronically) to the IUOE National Hazmat Training Program; Attention Chip Booth; 1293 Airport Road; Beaver, WV 25813 or cbooth@iuoehazmat.org.

The GJHA may be used to create a safe job procedure or modify a job task, tool(s) or work environment. Job and tasks should be reviewed after controls are in place for effectiveness

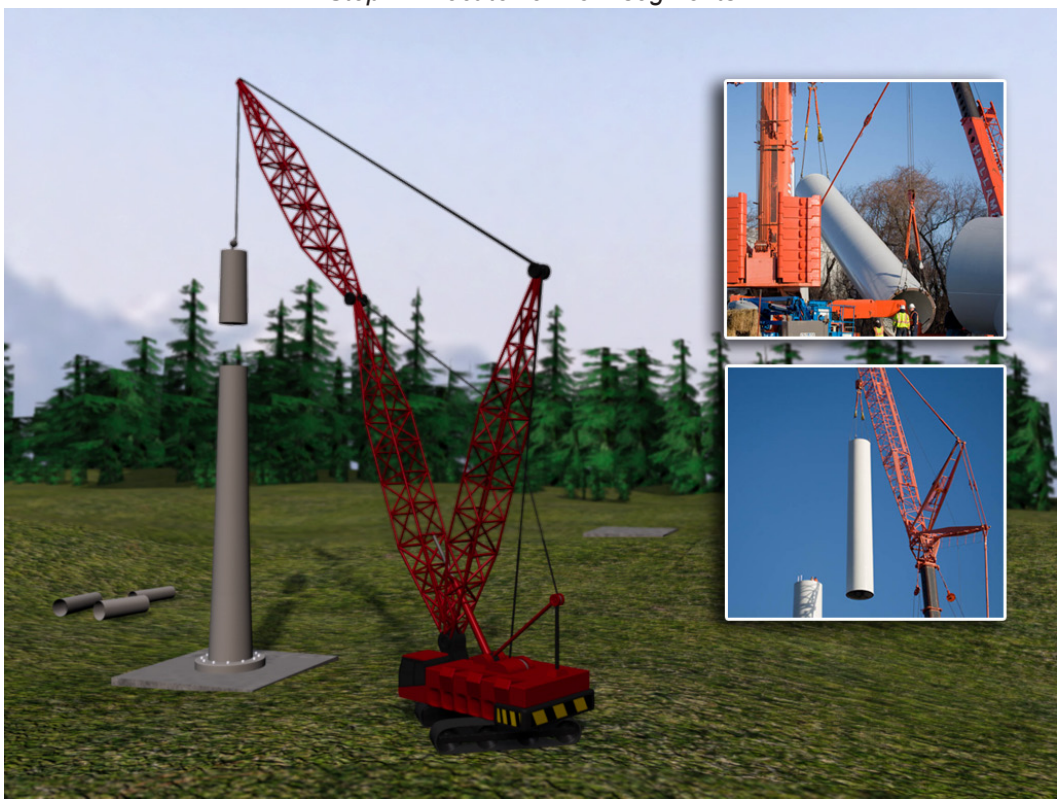
Appendix B: Section 1

General Steps of Wind Turbine Construction

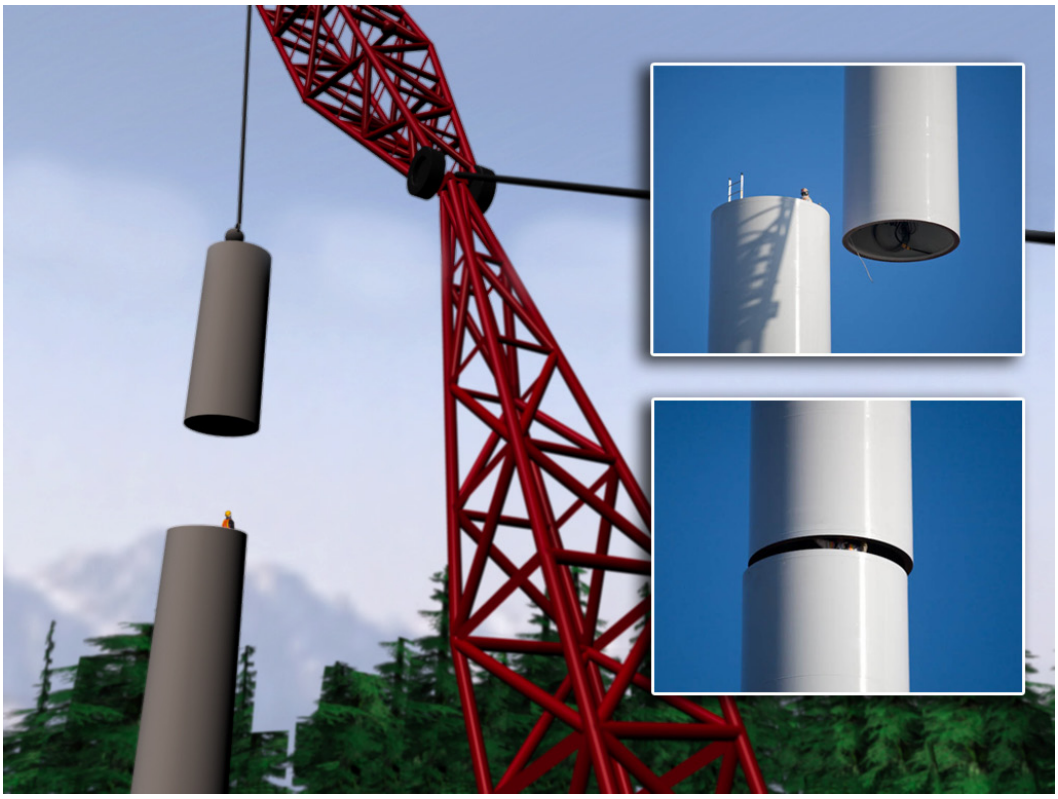
Step 1: Install pedistal / foundation



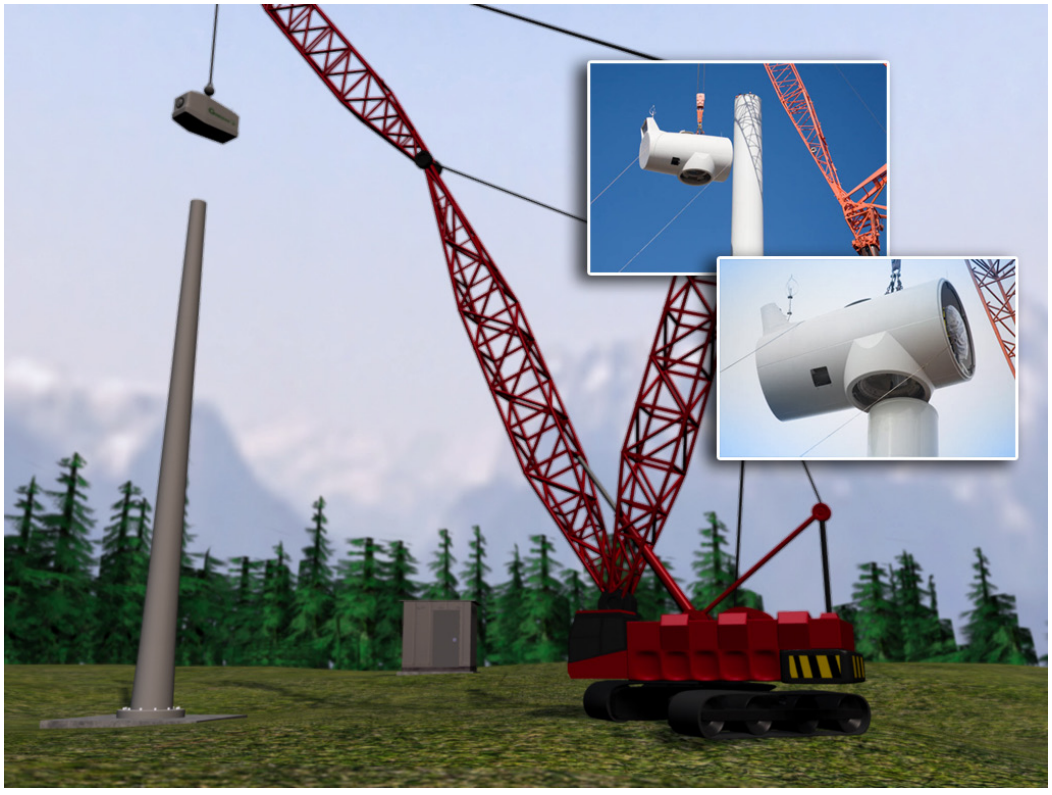
Step 2: Erect tower from segments



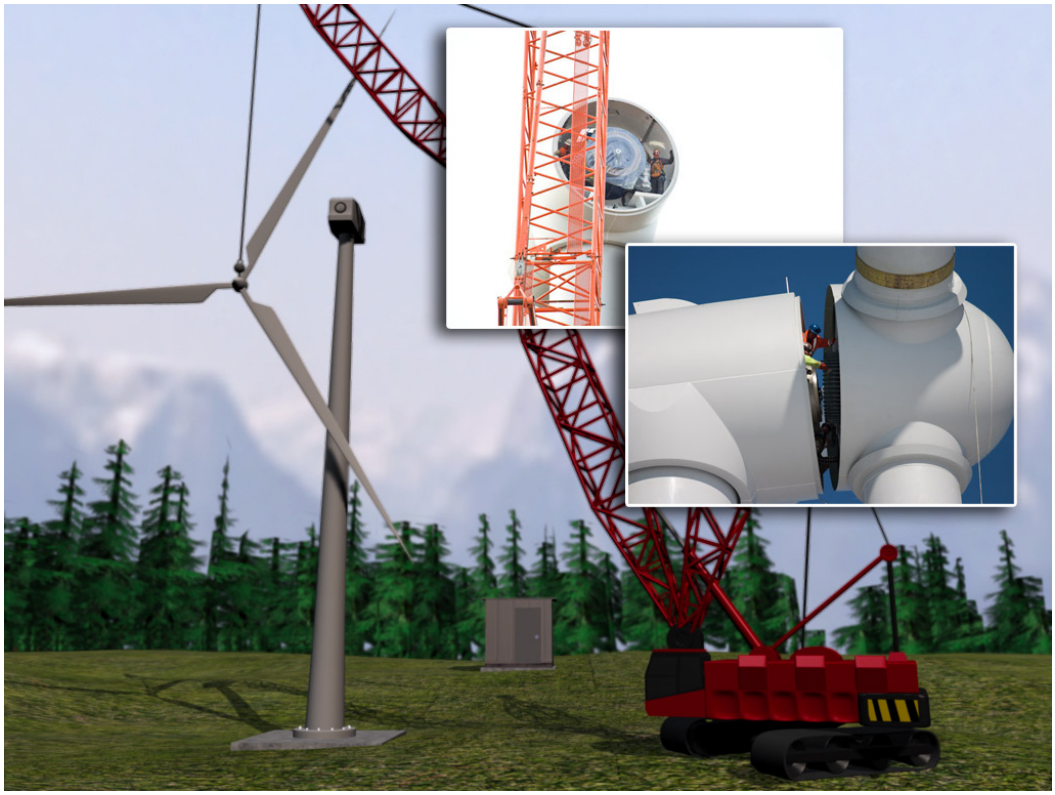
Step 3: Join segments from within



Step 4: Install nacelle



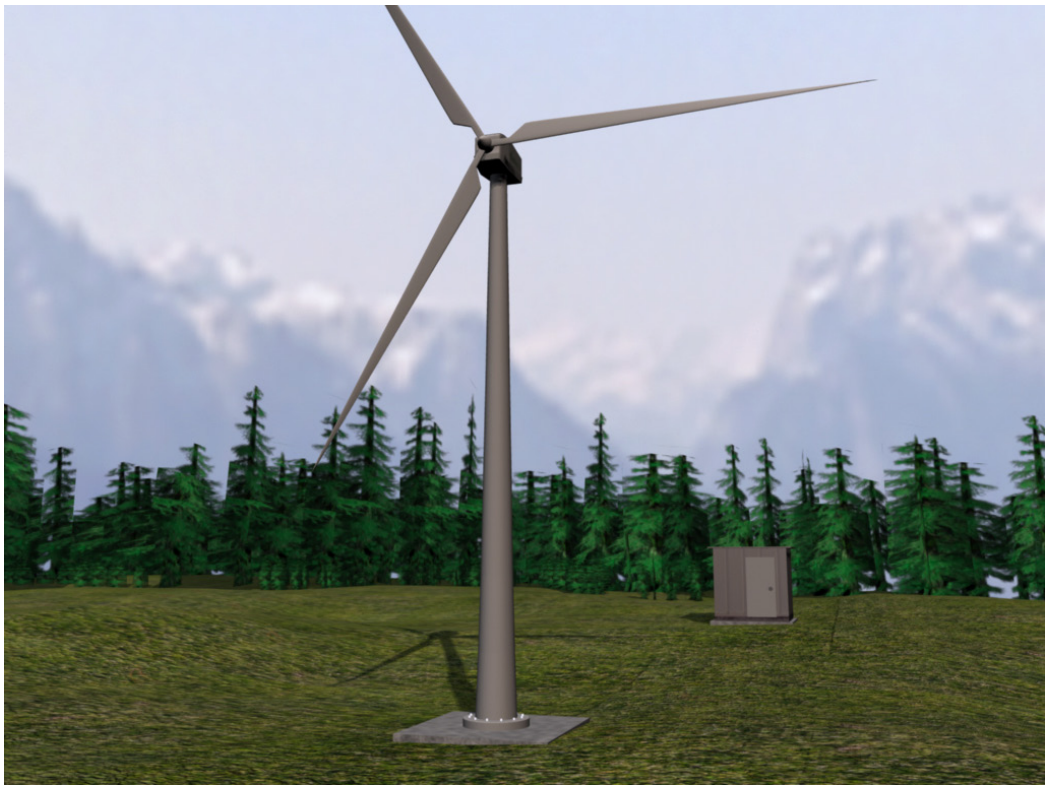
Step 5: Fasten blades together and hoist



Step 6: Attach blades to nacelle at the nose cone

Throughout construction, hoisted components are stablalized by a ground team

Completed wind turbine with power collector / transfer station



Appendix B: Section 2

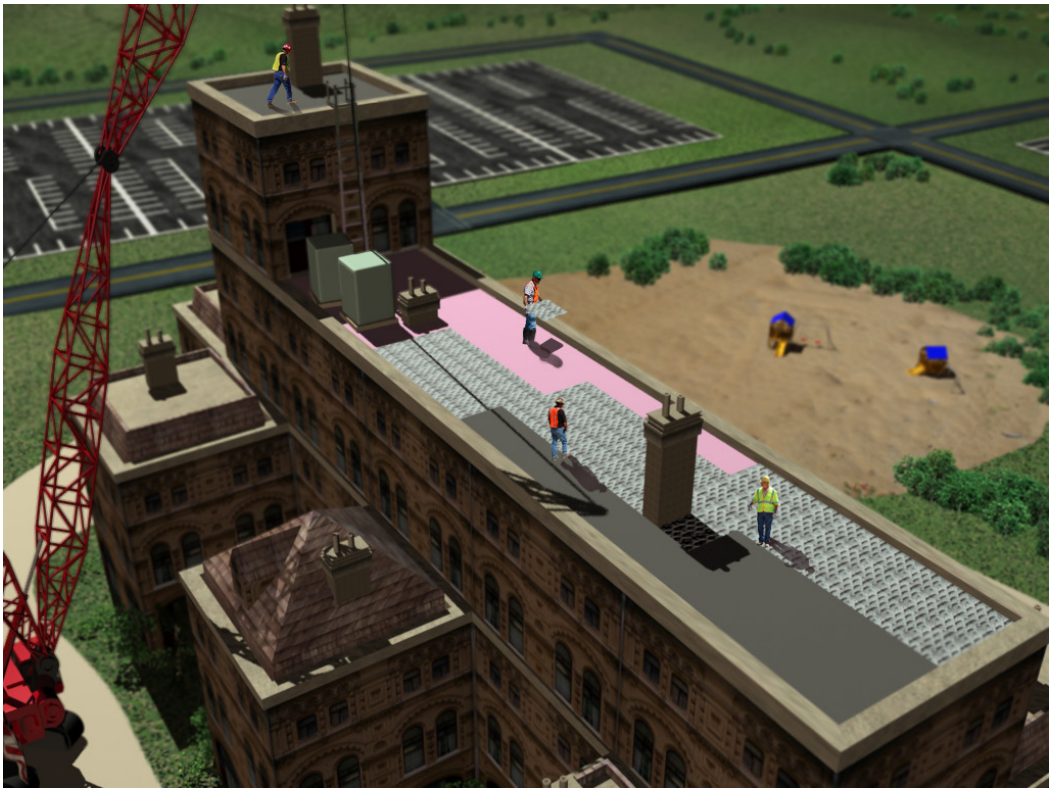
General Steps of Green Roof Construction

Step 1: Planning / design phase

Step 2: Receive supplies

Step 3: Install roofing membrane, root barrier, and insulation

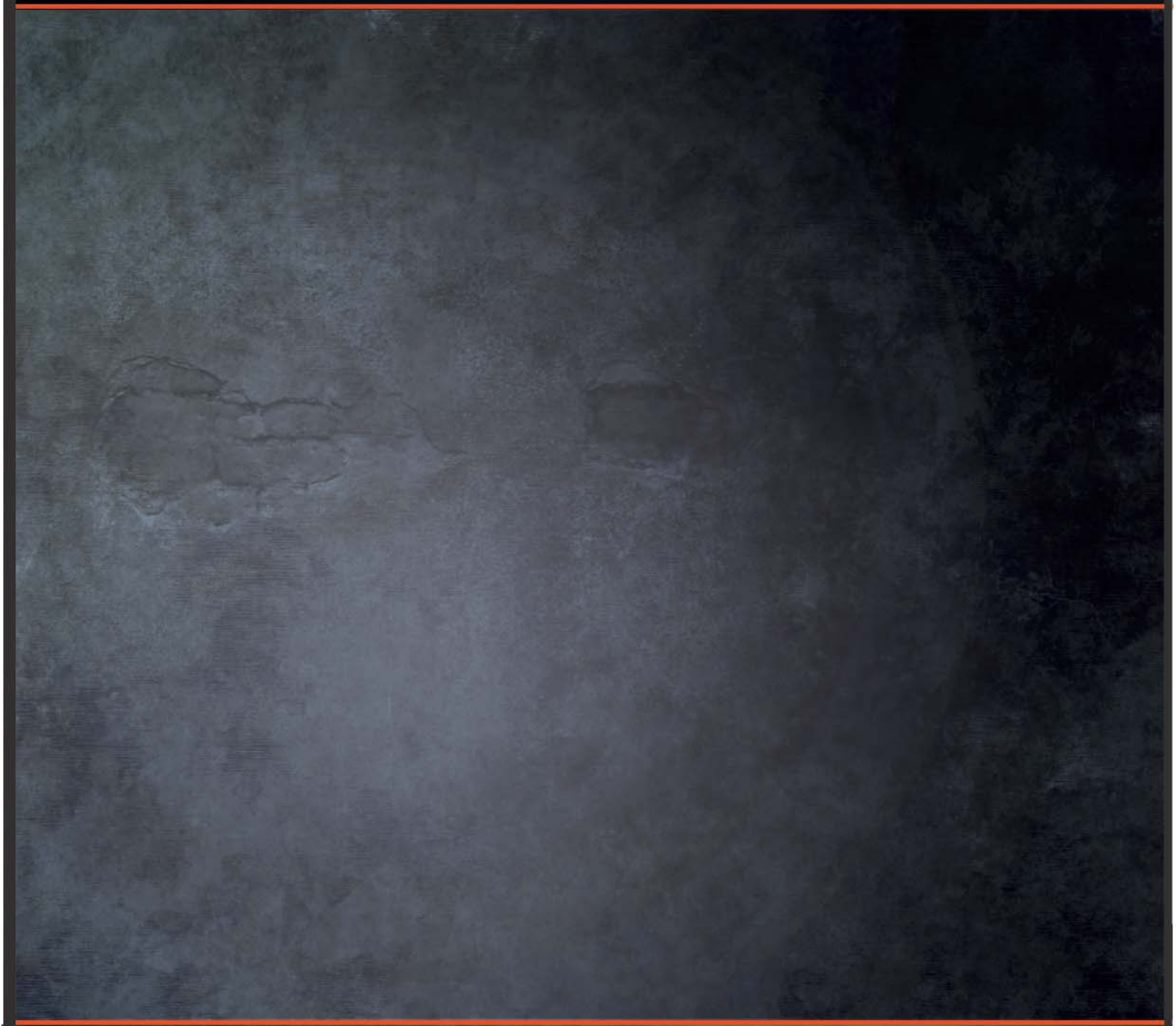
Step 4: Install drainage, root support, and primary root barrier



Step 5: Add soil / growing medium

Step 6: Add vegetation

Green Chemistry and Green Jobs Awareness Course



IUOE National Training Fund
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