Train-the-Trainer Workshop

April 29, 2022

Providing effective energy strategies for buildings and communities
Introduces community college students and young professionals to energy efficiency and energy code topics to prepare the next generation of professionals to integrate energy efficiency into their work.

Who Created BEE Fundamentals?

The Smart Energy Design Assistance Center (SEDAC), an applied research program at the University of Illinois.

SEDAC’s Mission:

Reduce the energy footprint of Illinois and beyond
BEE Fundamentals Partners & Participants

Lewis & Clark Community College
McHenry County College
Moraine Valley Community College
Southwestern Illinois College
Triton College
Illinois Central College
Kishwaukee College
Olive-Harvey College
Oakton Community College
Illinois Eastern Community College
John A Logan College
Hartland Community College
Rend Lake College
Harper College

University of Illinois
University of Chicago
Northern Illinois University
Chicago Public Schools

Ameren Illinois / Leidos
Illinois Green Alliance (IGA)
Illinois Green Economy Network (IGEN)

Village of Matteson
City of Rock Island
City of Naperville
City of Ottawa
Village of Midlothian
City of Peoria and many more

Kauai Community College
Honolulu Community College
UH Maui College
Brigham Young University-Hawaii

Leidos – Hawaii Energy
Hawaiian Electric

Island Green Architecture
Bowers + Kubota Consulting
STUDIO OXEYE
D.R. Horton
Saito Design Associates
Plumbing & Mechanical Contractors Association of Hawaii (PAMCA HI)
Islandwide mechanical service
Oahu Air Conditioning Service, Inc.
TMA Architects
Economy Plumbing & AC
Bowers and Kubota Consulting
Mason Architects
S. Biniaris Architect
Colliers

Kauai County
Maui County Office of Economic Development
City & County of Honolulu
County of Hawaii
Hawaii Community Development Authority
Hawaii Department of Education and many more

Western Nevada College
College of Southern Nevada
Truckee Meadows Community College

Clark County School District
Nevada Builders Alliance
Home Energy Connection
GRN Vision

Desert Research Institute
International Code Council (ICC)
Envirolution
Plumbing, Heating, Colling Contractors of Nevada (PHCC NV)
Home Energy Connection

Clark County
City of Las Vegas
City of North Las Vegas
City of Henderson
City of Mesquite
City of Elko
City of Sparks
City of Reno and many more

Nevada Governor’s Office of Energy

Clay County
City of Orange
City of Jacksboro
City of Sikeston
City of East River
City of Blytheville
City of Greenville
City of Magnolia
City of Little Rock and many more

Sustainable Energy Design Assistance Center (SEDAC)
Introductions

• Name, organization, position
• How are you involved in training?
• Why you are considering teaching BEE Fundamentals?
• What do you hope to learn in this workshop?
Agenda

• Why teach building energy fundamentals?
• Intro to BEE Fundamentals
• Example module: Introduction to Energy Codes
• Activities and discussion (Syllabus scavenger hunt)
• Wrap-up and call to action
Why Teach Building Energy Fundamentals?
All building related jobs address energy efficiency in some way

Why Teach Building Energy Fundamentals?

Architects & Engineers
- design for efficiency
- ensure code compliance and safety

Contractors and Construction Managers
- build efficiently
- make buildings more efficient when they renovate

Installers & Technicians
- install efficient equipment
- make sure it is operating properly

Building Operators
- ensure that buildings run smoothly and efficiently
- maintain efficiency
Why Teach Building Energy Fundamentals?

To inspire students to enter ...

Energy efficiency careers

86% of construction employers reported that it was difficult to find qualified job applicants

97% of professional and business service employers reported that it was difficult to find qualified job applicants

Building code careers

USEER 2021 Jobs Report
https://www.energy.gov/sites/default/files/2021-07/USEER%202021%20Main%20Body.pdf
The need for energy efficiency workers

Lots of demand

“We’ve got a number of agencies who have pretty sizable wait lists, but there is insufficient resources to provide assistance to all the people who need it.”

“In a perfect world I’d like to just do everybody. There’s so much need out there. But we have to prioritize.”

And not enough workers

“Regardless of the type of job you are always needing more people. We could constantly bring them in here.”

“The main thing we need is people on the crews doing the work.”

“We’re looking for more assessment folks. That would trickle down to needing more contractors.”
Federal Infrastructure Bill: $73 billion for **energy & power**

Will we have the workforce to do the work?
“We Want Qualified Candidates”

Skills of the trade + Energy efficiency basics + Workplace skills + Basic academic skills + Personal effectiveness skills
Lack of training in energy efficiency

Trade and community college programs are teaching people basic carpentry, mechanical, and technical skills

But

These programs may not cover much energy efficiency

“People don’t get a ton of exposure to energy efficiency in these programs.”

“Trade programs may not address whole building approaches.”
Lack of exposure to the energy code

• Many students have very little exposure to the energy code in their training

• Energy code training is focused on continuing education for existing professionals, not students
Department of Labor competency model

- Personal effectiveness competencies
- Academic competencies
- Workplace competencies
- Industry-wide technical competencies
- Industry sector technical competencies
- Occupation specific requirements

Building energy fundamentals
- Fundamentals of energy and power
- Energy efficiency
- Policies and regulations
What building energy fundamentals will your students need?

DOE’s Building Science Education Guidelines identify four core training areas:

1. Integration of the Whole-Building System
2. Building Science Principles
3. Operations and Maintenance
4. Building Testing (energy codes)
Building Science Principles Your Students Need To Know

**Bolded topics are addressed in our envelope modules**

- Heat transfer
- Moisture transport
- Convective mass (air) transport
- Material selection
- Control layers
- Hygrothermal analysis
- HVAC systems
- HVAC interactions with enclosure
- **Fenestration**
- Plumbing systems
- Electrical systems
- Lighting, appliances, misc. loads
- Control/automation systems
- Indoor environmental quality

See [DOE’s Building Science Education Guidelines](https://www.energy.gov/eere/buildings/building-science-education-guidelines)
Building Science Principles Your Students Need To Know

**Bolded topics are addressed in our mechanical & electrical modules**

- Heat transfer
- Moisture transport
- Convective mass (air) transport
- Material selection
- Control layers
- Hygrothermal analysis
- HVAC systems
- HVAC interactions with enclosure
- Fenestration
- Plumbing systems
- Electrical systems
- Lighting, appliances, misc. loads
- Control/automation systems
- Indoor environmental quality

See [DOE’s Building Science Education Guidelines](https://www.energy.gov/energy-efficient-buildings/building-science-education-guidelines)
Building Testing Principles Your Students Need to Know

**Bolded topics are addressed in our intro modules**

- Commissioning
- Diagnostics and forensics
- Performance monitoring & assessment
- **National codes and standards**
- Certification programs
Proficiency levels

In general, modules focus on proficiency levels 1-3. Higher proficiency levels will be required for some professions. These are **introductory courses** to the topics that should apply to most professions.
Proficiency levels

Presentations and videos help students **remember & understand**.

Worksheets, quizzes, discussion prompts, and in-class activities help students **apply** what they’ve learned.
### Proficiency levels by profession

**Guidelines for Building Science Education (pnnl.gov)**

Select the proficiency level that is most appropriate for your students

<table>
<thead>
<tr>
<th></th>
<th>Average general contractor</th>
<th>Average HVAC/Mechanical contractor</th>
<th>Average Energy Auditor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat transfer</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Material selection</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Controls layer</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
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<td>HVAC systems</td>
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<tr>
<td>National codes and standards</td>
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</tbody>
</table>

**Proficiency levels:**
- **0**: Remember
- **1**: Understand
- **2**: Apply
- **3**: Analyze
- **4**: Evaluate
- **5**: Create
Content starts out general and gets more advanced

More general

More advanced

Select the content that is most appropriate for your students
Intro to BEE Fundamentals Curriculum
Teach energy efficiency through energy code basics

Hands-on Curriculum | Instructor Training | Resources

Instructor Toolkit: How to Use our Curriculum

Access our Modules! Login to our Moodle Site
Where to start: Instructor Toolkit

https://smartenergy.illinois.edu/instructor-toolkit

Learn more about our program and how to use our curriculum.

ABOUT OUR PROGRAM

- What is this training program about?
- Why all the focus on energy codes?
- Who should use this program?
- Will this training prepare students for a job or certification exam?
- Who created this training program?
- How can I be involved and get updates?

USING OUR CURRICULUM

- Are the modules free to use?
- Do I need to use all of the modules?
- How should I select which curriculum to use?
- How do my students and I access the modules?
- Can my students work through the material on their own?
- How can I provide feedback?
Instructor Toolkit

https://smartenergy.illinois.edu/instructor-toolkit

Preview our modules to select modules or sections of modules to include in your class.
Preview lesson plans, presentations, and other activities to get a feel for the curriculum and how you might use it in your class.

**WHAT TOOLS CAN INSTRUCTORS USE?**

- Presentations
- Worksheets
- In-Class Activities
- Videos
Access the Curriculum on Moodle

https://learn.smartenergy.illinois.edu/

Next, login (for free) to our Moodle Site access our modules! Sign in as an instructor or student.
Example module:
3.1 What are Energy Codes & Standards?

Module 3. Introduction to energy codes & standards
Part 1
A. Energy codes & standards: some definitions
Energy conservation code: one of many building codes
Codes & standards to make buildings safe, healthy & accessible:

- Fire
- Mechanical
- Plumbing
- Electrical
- Structural
- Zoning
- Accessibility
- More...

Codes & standards to save energy and money:

- Energy Conservation

Purpose of Energy Codes
What are (building) energy (conservation) codes?

• The Energy Code establishes **minimum** requirements for design and construction of energy efficient buildings.

• The Energy Code is not intended to prevent the installation of any material or to prohibit any design or method of construction.
Energy codes apply to residential and commercial buildings

**Residential**
- A detached 1-2 family dwelling
- Multi-family housing 3 stories or lower (some codes differ)

**Commercial**
- Any commercial or public sector building
- Multi-family housing units 4 stories or higher (some codes differ)
Energy codes & standards apply to new & existing buildings

New Buildings
• Anything requiring a permit

Existing Buildings
• Any additions, alterations requiring a permit
Energy codes make allowances for different climate zones

Image source: Pexels.com

versus

Image source: Pexels.com

SEDAC
SMART ENERGY DESIGN ASSISTANCE CENTER
B. Energy code development and adoption
Energy code development

Model energy codes & standards are typically developed by a few national organizations.
The International Energy Conservation Code (IECC) is published by the International Code Council (ICC).

Contains both Residential and Commercial provisions

New version is updated every 3 years (ex. 2015, 2018, 2021...)

Example of model energy code
Example of model energy standard

ANSI/ASHRAE/IES Standard 90.1
Energy Standard for Buildings Except for Low-Rise Residential Buildings (ASHRAE 90.1) is published by ASHRAE, IES & ANSI.

Contains only Commercial provisions

New version is updated every 3 years (ex. 2016, 2019, 2022...
Energy code adoption

- Energy codes are adopted at state and local government levels.
- Some jurisdictions adopt the model energy code as is.
- Some jurisdictions adopt the model energy code with amendments.
The current (as of 2021) Illinois Energy Code is based on the 2018 IECC with Illinois Amendments.
The current (as of 2021) Hawaii Energy Code is based on 2015 IECC with Hawaii Amendments.
C. Energy code compliance and enforcement
Building design and construction professionals are required to comply with the energy code.
Energy codes affect design & construction

- Wall, floor, ceiling
- Doors, windows
- Heating, ventilating, & cooling systems & equipment
- Lighting systems & equipment
- Water-heating systems & equipment
Example: Home builders may use 2 x 6 studs instead of 2 x 4 for walls so that higher levels of insulation can be installed to meet the energy code.
Energy codes provide criteria for the size and efficiency of HVAC systems & equipment.
Energy codes provide criteria to support efficient lighting and controls.
Energy codes provide criteria to efficiently heat and deliver hot water.
Software developed by the DOE is widely used by design professionals (architects and engineers) to prove energy code compliance.
Building code officials enforce building codes, including the energy code.
Code officials

- Review design plans
- Inspect construction work
- Issue building & occupancy permits
This material was developed by the Smart Energy Design Assistance Center at the University of Illinois at Urbana-Champaign.

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www.smartenergy.illinois.edu
https://smartenergy.illinois.edu/bee-fundamentals/
Activities and discussion
True or false? Energy codes affect the design and construction of buildings
True

Energy codes and standards apply to two general types of buildings. What are they?
Residential and commercial

The energy code is generally administered on the _____ or ______ level (hint: geography)
State or local

Energy codes & standards apply to both _______ construction and _________ projects
New / Renovation

Name at least two major roles building code professionals play
Review design plans, inspect construction work, issue permits
Energy code basics worksheet

Match the organization or group with the energy code activity they are responsible for:

- **State or local governments**: Make sure designs comply with the energy code
- **International Code Council**: Develop the International Energy Conservation Code
- **Architects and construction professionals**: Review design plans, inspect, and issue permits
- **Building code officials**: Adopt or amend the energy code
# Syllabus Scavenger Hunt

Group 1 (Sumi) Building 160 Residential Energy Auditing

<table>
<thead>
<tr>
<th>Topic</th>
<th>BEE Presentations</th>
<th>BEE Activities or Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Energy Audits of Existing Buildings</td>
<td>Module X</td>
<td>Module x</td>
</tr>
<tr>
<td>Foundations, Floor Systems</td>
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<tr>
<td>Fenestration, Walls, Roofs, Total Envelope Calculations</td>
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<tr>
<td>Air Infiltration/Blower Door and Duct Leakage Testing</td>
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<tr>
<td>HVAC System Calculations, Manual J</td>
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<tr>
<td>Ventilation Requirement Calculations</td>
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</table>
Group discussion

• What are the greatest training needs related to energy code and energy efficiency fundamentals?
• What kinds of learning materials are most helpful?
• What are the best ways to teach these fundamentals to current and future building professionals?
• What resources would help support you as you utilize the curriculum?
• What are the best ways to check in with you and your students?
How well does the curriculum help students master building energy fundamentals?

Help us measure outcomes to improve the program!

3 Action Items

1. **Check in with us:** We’ll schedule brief check-ins before, during, and after you teach your course.

2. **Report course metrics:** Report the number of modules used, number of students in course, etc.

3. **Help us gather information from your students:** Ask students to complete surveys to assess learning outcomes and gather feedback.
Please complete this survey

https://forms.gle/zeinAqmHbGGXhUF66

After attending the workshop, how likely are you to use parts of the curriculum in one or more of your courses or for on-the-job training?

1 2 3 4 5

Very unlikely  ○  ○  ○  ○  ○  Very likely

Name of course (if applicable)

Your answer

Anticipated number of students

Your answer
Questions?

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