Sketchbox for Building Energy Modeling

WTEA 8:45 am Friday, Mar 10

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slipstream

Accelerating climate solutions. For everyone.

We deliver research, technical assistance, financing, education and training, and programs for stakeholders.

www.slipstreaminc.org

James Reichling
Physics and math teacher, engineering background

Madison Metropolitan School District

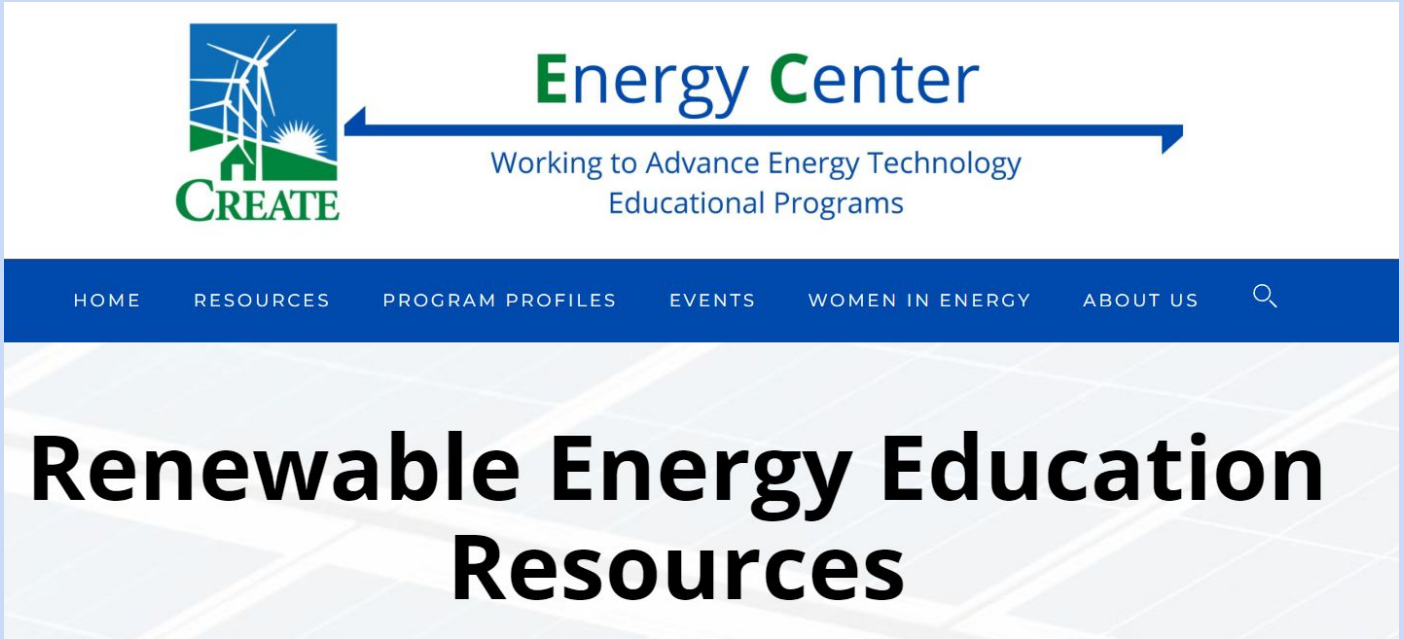
Introduction to Renewable Energy course
(dual credit with Madison College)

Energy Management and Energy Economics

CREATE

Center for Renewable Energy Advanced Technological Education

https://createenergy.org/resources/



Presentation Outline

Overview of building energy modeling and sketchbox

Sample lessons, course context and standards

Student reactions from class trials

Access and support

Q&A and feedback survey

Energy use in buildings

US EIA reports buildings account for 39% in 2021

Example strategies to save energy, reduce cost
- upgrade lighting
- scheduling and set points
- update mechanical systems
- building envelope improvements

Energy modeling helps make decisions about which strategies provide the greatest return on investment

US DOE provides DOE2 Building Energy Use and Cost Analysis Software

DOE provides E-Quest as a user interface

Download and install required, learning curve

Sketchbox by Slipstream as a teaching tool

Online user interface to DOE2

Free to use, no download required

Runs on a student chromebook

Preloaded building types, systems/technologies, weather data, utility rates, and many more data

Why teach this to students?

Awareness of resource utilization

Cost-benefit analysis and business connections

Energy DPI Pathway

Get students motivated/excited about climate solutions

Careers: Building manager, energy engineering,

Default Project Settings

PROJECT DESIGN SCHEDULES BASELINE MEASURES RESULTS

General

Project Name
My Project

Project Environment
Basic

State
Illinois

Nearest City
Chicago

Energy Code
IECC 2018

Financial

Rate Category
Commercial

Cost of Electricity
0.09 $/kWh

Cost of Natural Gas
0.693 $/therm

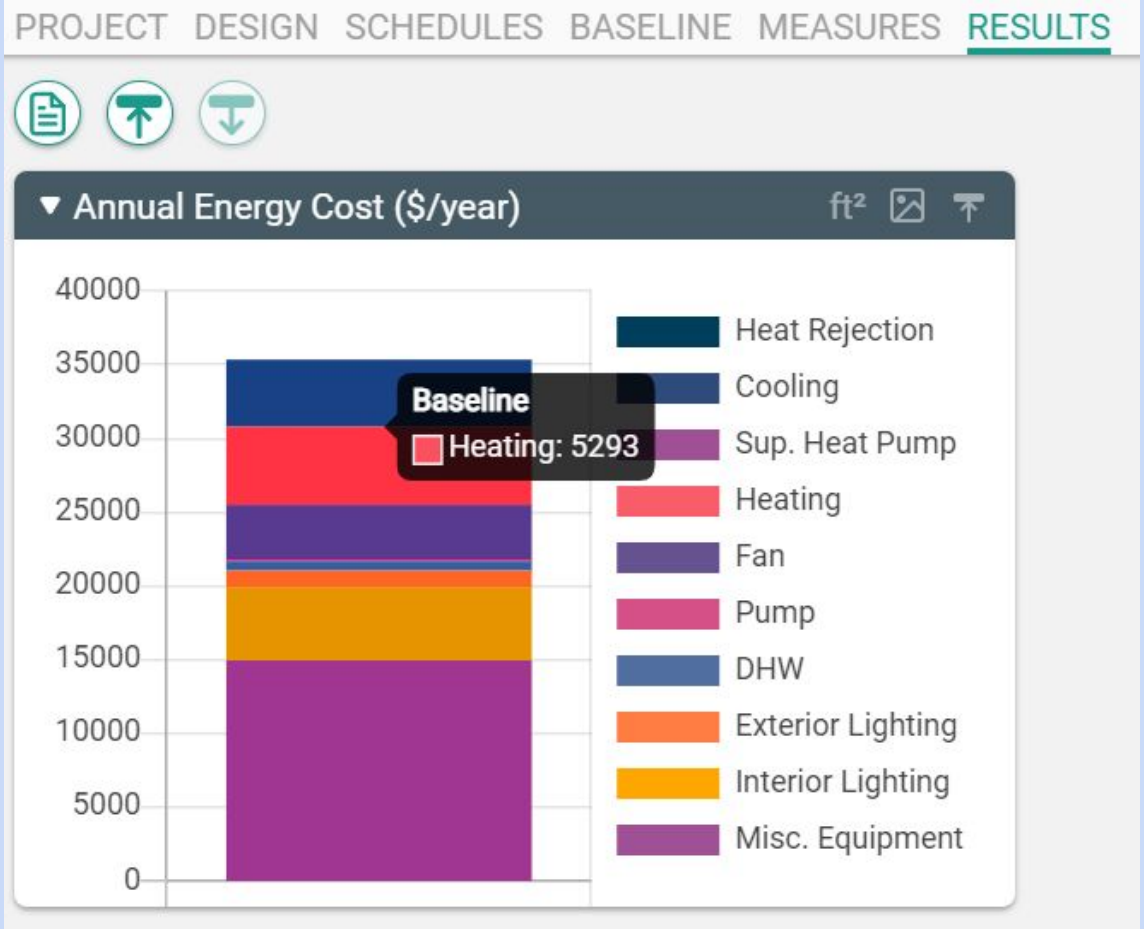
Emissions

Energy Source to Site Ratio

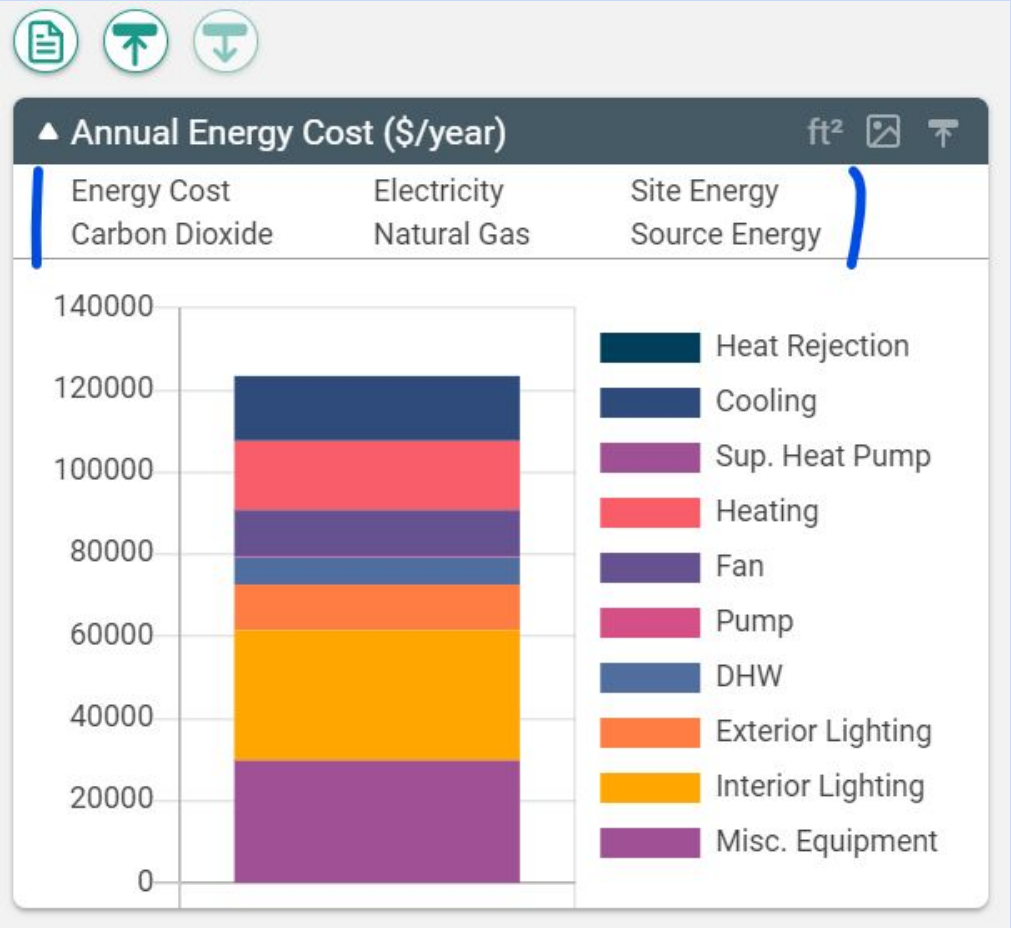
Electricity	*Natural Gas*
2.8	1.05

CO_2 Equivalence for Electricity
0.371 kg of CO_2e/kWh

CO_2 Equivalence for Natural Gas
5.3 kg of CO_2e/therm

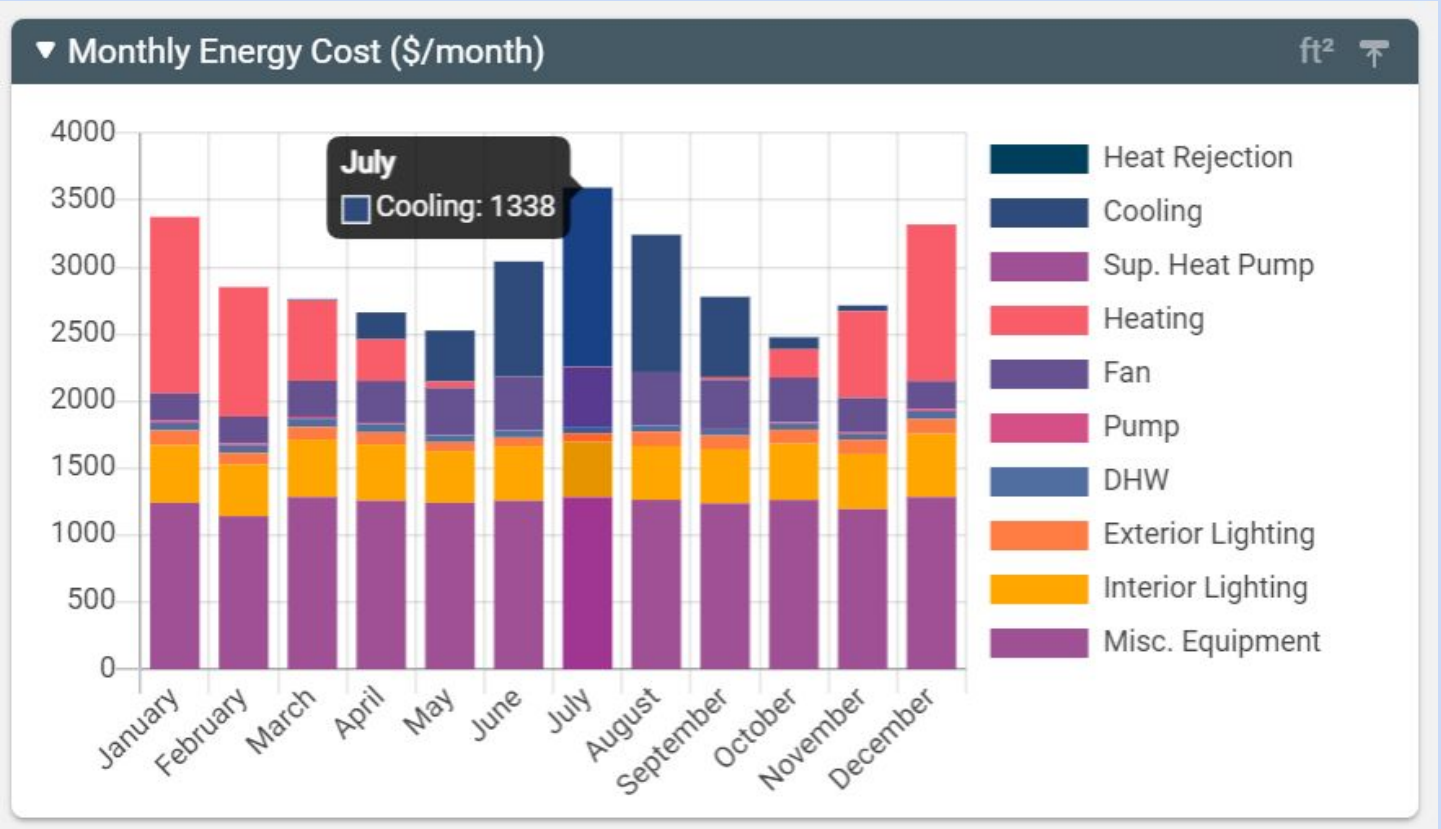


Energy Cost by Utilization



Other display options

Monthly breakdown



Annual Summary

Peak Cooling (kBTU/hr)	Peak Heating (kBTU/hr)	Peak Electric Demand (kW)	Annual Electric Consumption (kWh)	Annual Natural Gas Consumption (therm)	Annual Energy Cost ($)
878.1	751.8	127.9	326919	8539	35339

Students can change parameters to explore impact on energy utilization and cost

Building type (e.g. school, commercial)

Location

Window Fraction

Spatial Orientation

Energy Code

Lessons in development

Lesson 1 introduction to get students started quickly

Studies impact of size, location, window percentage

Demonstrates basic functions and model results

Lessons in development

Lesson 2 Energy code options (IECC and ASHRAE)

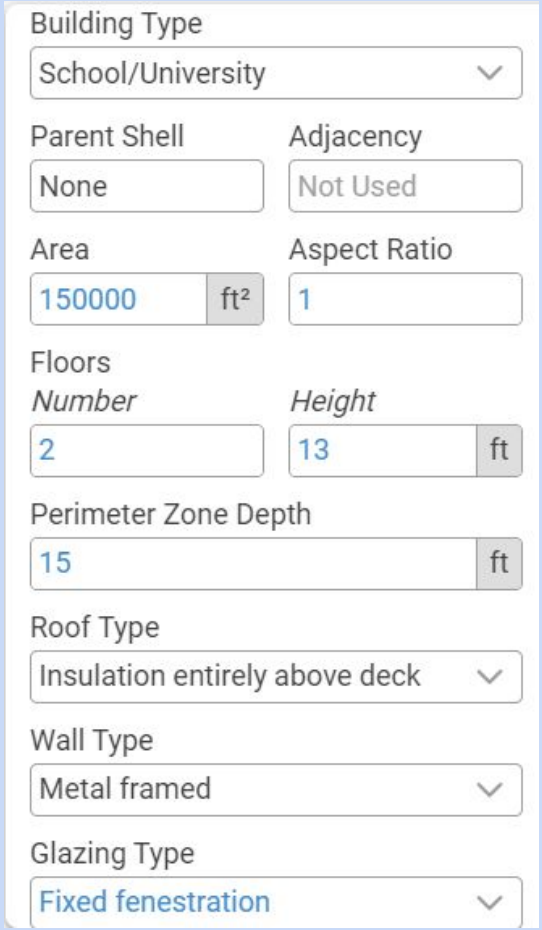
Measures sets, pre-built building upgrades to compare baseline (code), “better” and “best” (practical) options

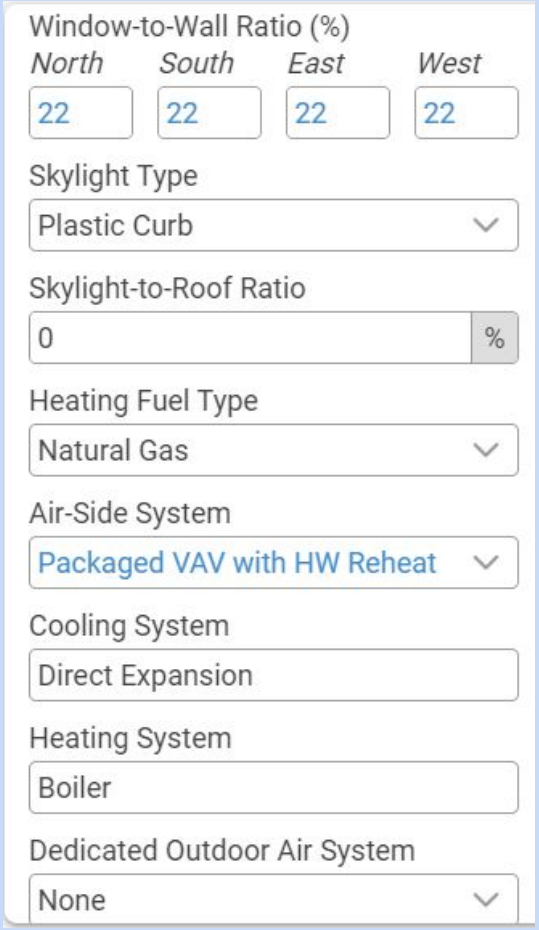
16 upgrade categories including roof insulation, interior lighting, wall R-value, window properties, air-sealing, DHW

Lesson One Instructions

Change building type to school or university

Design Tab Options





Lesson One Scenarios

Change building size

Change window percentage

Change location (to Los Angeles)

Participant discussion - what change in energy use and cost will each change create? Increase/decrease, by what percent?

Electricity, Natural Gas, Overall Cost

1. Cut building square footage in half

2. Double window percentage

3. Change location (Chicago to Los Angeles)

Participant discussion - RESULTS

Scenario	Electricity (MWh)	Natural Gas Therms	Total Cost Dollars
Baseline	1031	34,300	116,600
Half area (75,000 ft^2)	513	18,400	58,900
Double window area	1070	35,000	120,000
Move to LA	1060	9750	167,900

Lesson Two Scenarios

Change energy code

Change building components and construction, selected measures

Participant discussion

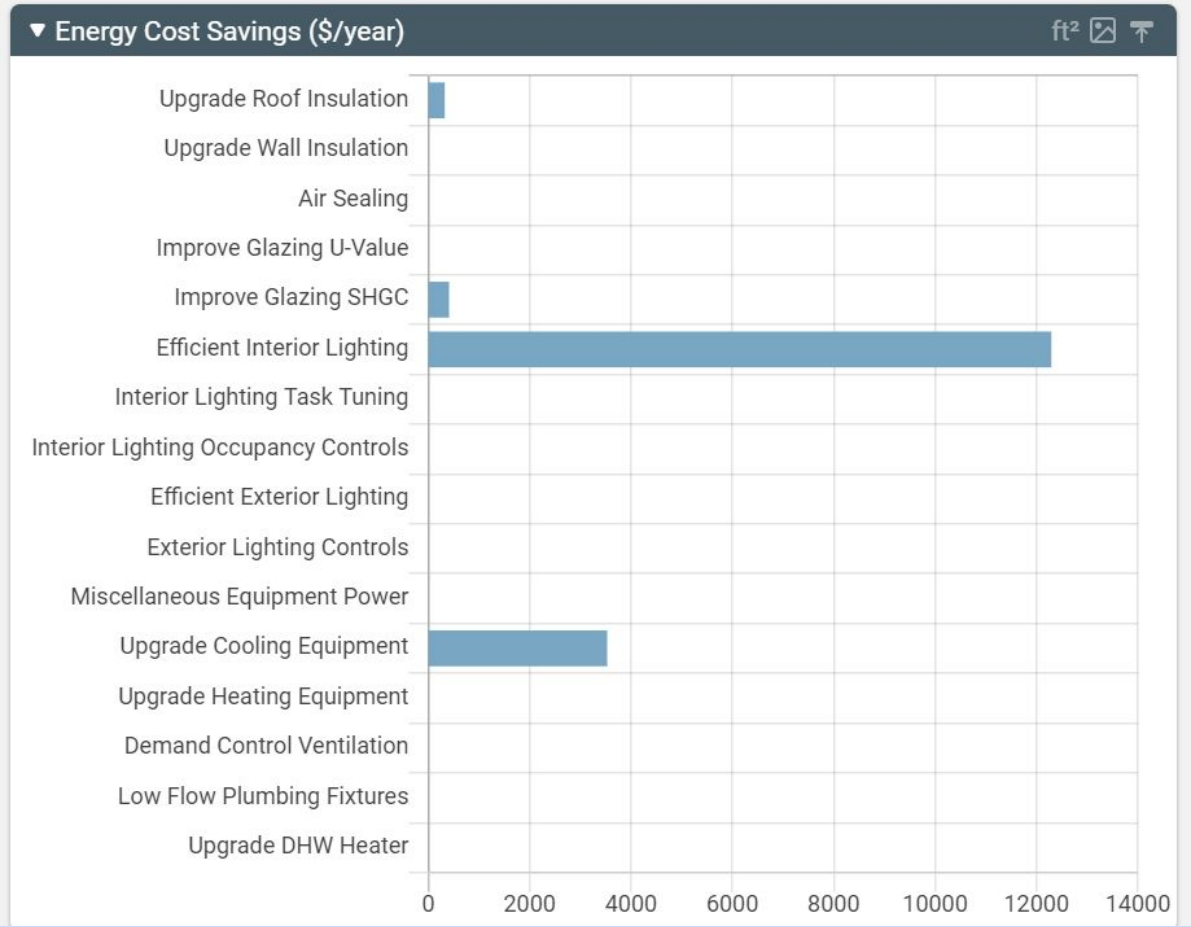
1. Change from IECC 2018 to IECC 2015
Change in energy cost? Increase/decrease, percent

2. Four measures, rank in by largest energy cost reduction
Upgrade roof insulation
Efficient Interior Lighting
Upgrade window solar heat gain coefficient
Upgrade Cooling Equipment

Participant discussion

1. Change from IECC 2018 to IECC 2015
Change in energy cost? Increase/decrease, percent
2018: $116,600 2015: $123,400

2. Four measures, rank in by largest energy cost reduction
Upgrade roof insulation: $326
Efficient Interior Lighting: $12,293
Improved glazing solar heat gain coefficient: $411
Upgrade Cooling Equipment: $3531


Energy Cost Savings ($/year)
ft²
Upgrade Roof Insulation
Upgrade Wall Insulation
Air Sealing
Improve Glazing U-Value
Improve Glazing SHGC
Efficient Interior Lighting
Interior Lighting Task Tuning
Interior Lighting Occupancy Controls
Efficient Exterior Lighting
Exterior Lighting Controls
Miscellaneous Equipment Power
Upgrade Cooling Equipment
Upgrade Heating Equipment
Demand Control Ventilation
Low Flow Plumbing Fixtures
Upgrade DHW Heater
0
2000
4000
6000
8000
10000
12000
14000

Future lessons in development

Will be available from CREATE website

Lessons being developed by other educators

Student reactions from class trials

High level of engagement

Easy access to results

Desire to independently explore

Students in pilot asking to participate in another round

What did students find most interesting about sketchbox?

“... how small factors can change so many things. I also found predicting them fun.”

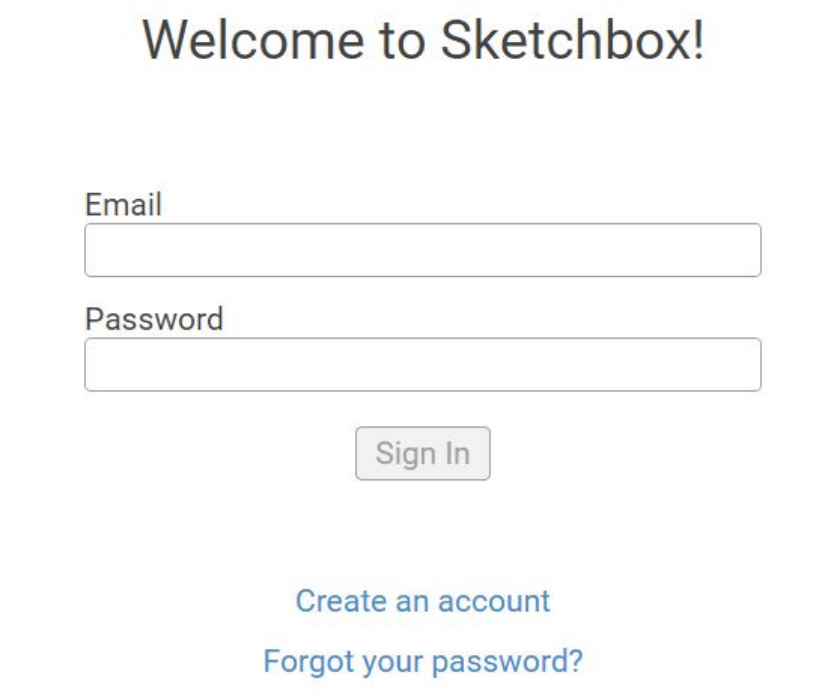
“How this ties into architecture and buildings”

“How [the building in] California uses less energy but costs more”

“How small changes in building design can greatly influence energy cost”

Access to Sketchbox: https://slipstreaminc.org/sketchbox

Login: https://www.sketchbox.io/login

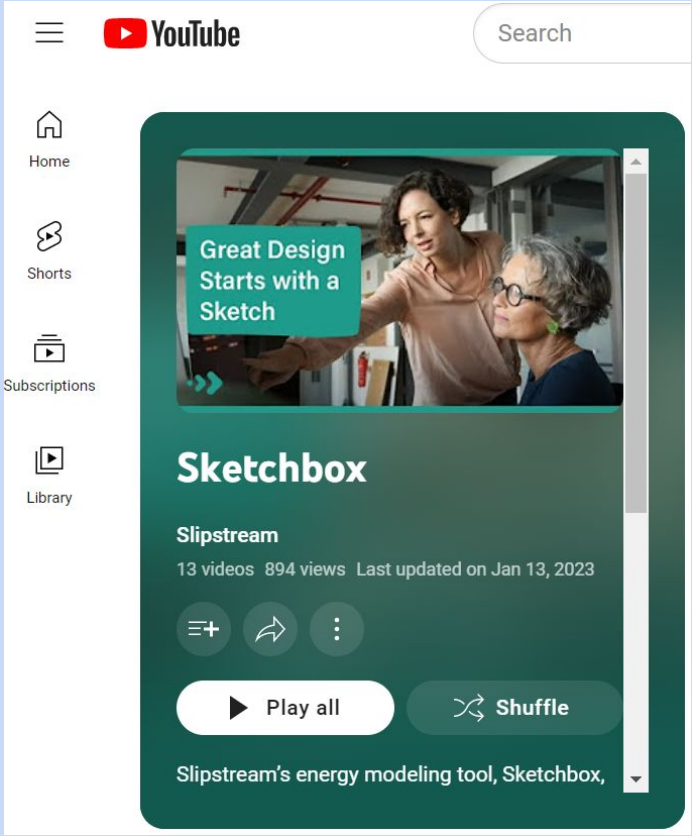


Sketchbox Support

Youtube tutorials at the sketchbox youtube channel

Support: tools@slipstreaminc.org

General building science resources and connection to Smart Start materials through CREATE



Join us for a virtual workshop to learn how to use Sketchbox in *your* classroom!

Professional development opportunity hosted by KEEP and Slipstream

Date/time: July 20, 2023 (9am - 3pm)

Participants who attend the full workshop are eligible to receive a $250 stipend upon completing and submitting an assignment that will be uploaded to DPI WiseLearn.

For more detail and to register scan QR code above, or please visit:

https://cnroutreached.asapconnected.com/#CourseID=283657

DPI Regional Career maps
https://dpi.wi.gov/sites/default/files/imce/pathways-wisconsin/2022_11_14_Final_Energy_Career_Pathway_11.14.22.pdf

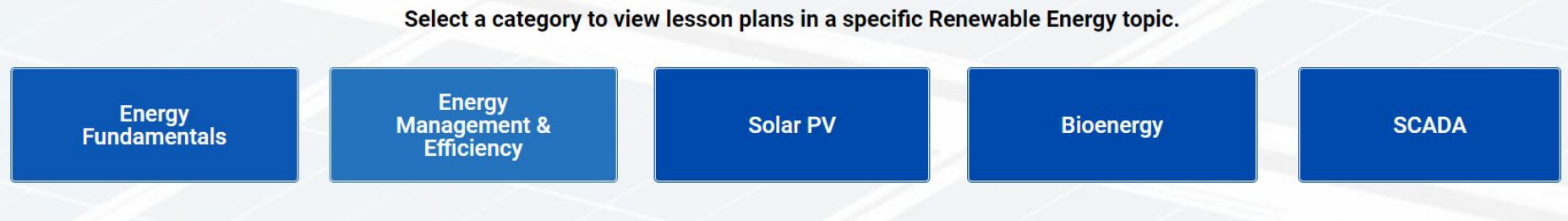
Energy Generation & Conservation

Energy Transmission, Distribution, & Storage

Training levels: H.S. Diploma, Certification or Technical Diploma, Registered Apprenticeship, Associates Degree, Bachelor's Degree and beyond

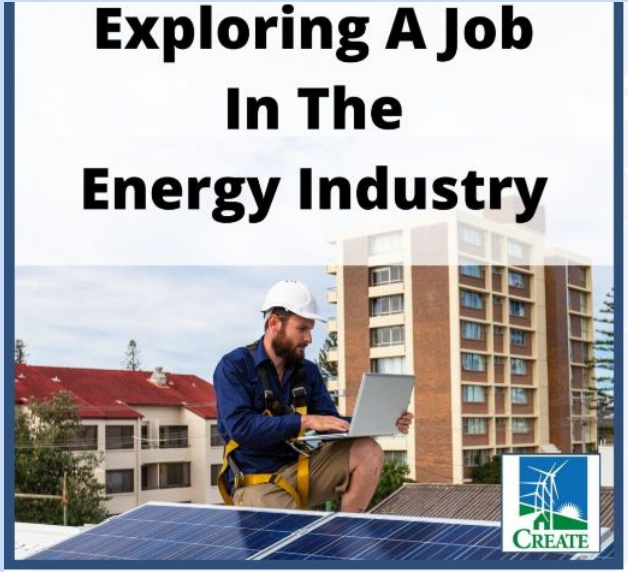
General building science resources and connection to Smart Start materials through CREATE

Teaching Materials, Energy Fundamentals



Energy Career Maps through CREATE

https://createenergy.org/resources/



Exploring A Job In The Energy Industry encourages students to explore a potential, future energy job. Using Career Maps, students research compensation, qualifications, job demands, and advancement opportunities for the job they selected.

Renewable Energy Career Maps

- Solar
- Climate Control
- Bioenergy
- Wind
- Green Buildings

8 video profiles

https://slipstreaminc.org/cleanenergycareers

Q&A and feedback forms

End of presentation