

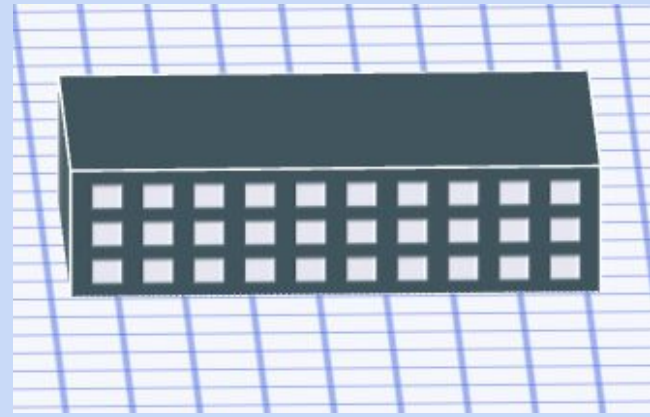
Sketchbox™ by Slipstream

Thursday, July 20, 2023

James Reichling, MMSD and
CREATE

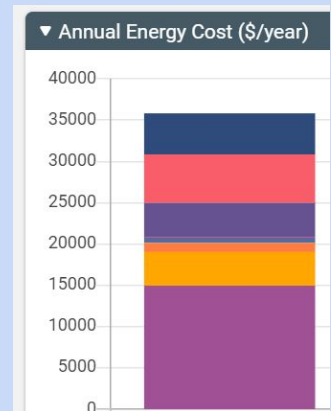
Samara Hamze, KEEP

Dave Vigliotta, Slipstream



My Project

PROJECT DESIGN SCHEDULES BASELINE



James Reichling

Physics and math teacher, Madison Metro School District
Instructor, CREATE center

Samara Hamze

Energy Educator, Program Manager at KEEP

Slipstream Staff

Dave Vigliotta

Director of Partnership Development

Lee Shaver

Senior Energy Engineer

Emily Golen

Energy Engineer II

Peggy Heisch

Project Manager

Participant Introductions

Your name

What level you teach / other profession

How long have you been teaching / in industry

Optional: Current work location

Working Groups

Group 1

- 1 Matt Aumann
- 2 Liliana Beltran
- 3 Handi Chandra Putra
- 4 Joerg Ruegemer

Group 2

- 1 Deborah Combs
- 2 Nihal Al Sabbagh
- 3 Allison Nofzinger
- 4 Noureddine Zemmouri

Group 3

- 1 Kimberly Garlie-Sukkert
- 2 Scott Williams
- 3 Farid Vahedi
- 4 Emily Meissner

Group 4

- 1 Craig Griffie
 - 2 Gabriel de Berm
 - 3 Kang Insung
 - 4 Korn Tantiwanit
-

Working Groups

Group 5

- 1 Scott Hanneman
- 2 Shoumik Desai
- 3 Ahmed Hussein
- 4 Gearoid Lydon

Group 6

- 1 Rick Kamps
- 2 David Luety
- 3 Shannon Krack-Levesque
- 4 Taylor Schneider

Group 7

- 1 Joseph Phillips
 - 2 Corey Gracie-Griffin
 - 3 Phalak Kaustubh
 - 4 Kevin Silveira
-

Slipstream Team

Dave Vigliotta

Lee Shaver

Emily Golen

Drew Morrison

Peggy Heisch

Recording in Progress!

For later training purposes today's large group sessions are being recorded

Thank you

SPONSOR



PARTNERS



Wisconsin K-12 Energy Education Program (KEEP)
College of Natural Resources
University of Wisconsin - Stevens Point



Energy Center

Working to Advance Energy Technology
Educational Programs



Accelerating climate solutions. For everyone.

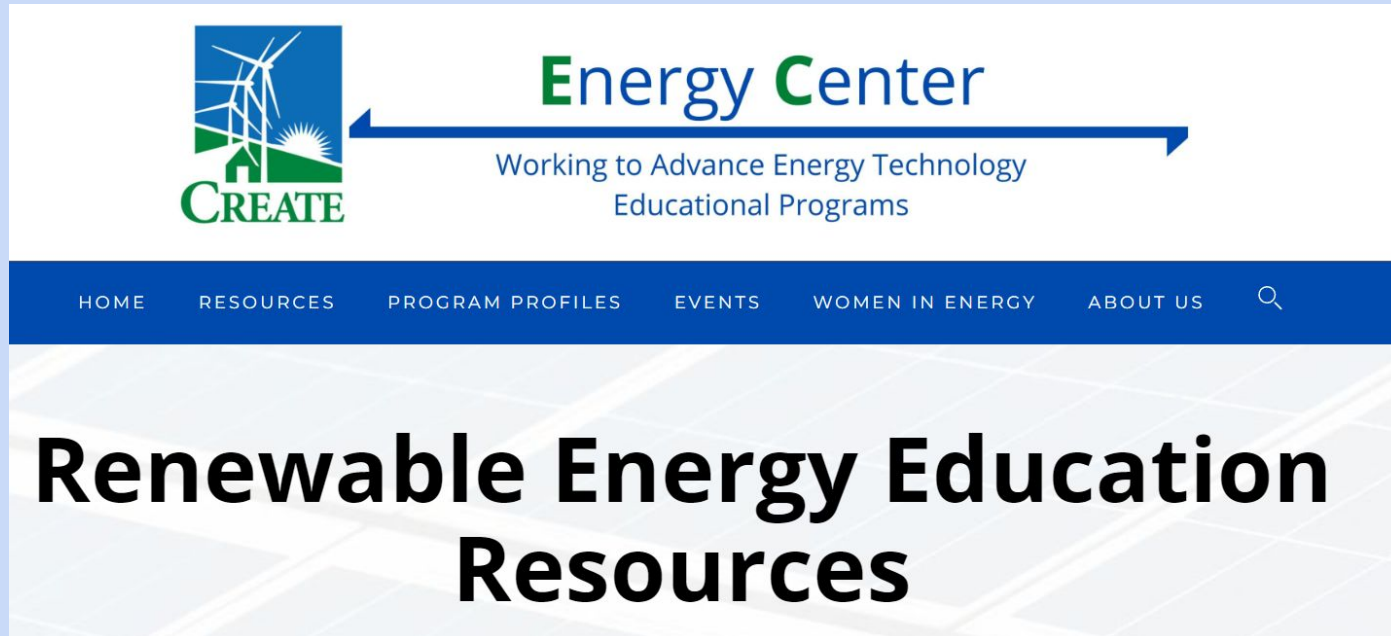
We deliver research, technical assistance, financing, education and training, and programs for stakeholders.

www.slipstreaminc.org

CREATE

Center for Renewable Energy Advanced Technological Education

<https://createenergy.org/resources/>



The image shows a screenshot of the CREATE Energy Center website. At the top left is the CREATE logo, which features a stylized green house with a white sun rising behind it, and two white wind turbines on a blue background. To the right of the logo, the text "Energy Center" is displayed in a blue serif font. Below this, a blue horizontal line with arrowheads at both ends spans across the page. Underneath the line, the text "Working to Advance Energy Technology Educational Programs" is written in a smaller blue font. A dark blue navigation bar contains the following links in white uppercase letters: HOME, RESOURCES, PROGRAM PROFILES, EVENTS, WOMEN IN ENERGY, and ABOUT US. A magnifying glass icon is positioned to the right of the navigation bar. The main content area below the navigation bar has a light gray background with a faint grid pattern. The text "Renewable Energy Education Resources" is centered in a large, bold, black sans-serif font.

Energy Center

Working to Advance Energy Technology
Educational Programs

HOME RESOURCES PROGRAM PROFILES EVENTS WOMEN IN ENERGY ABOUT US

**Renewable Energy Education
Resources**

Brief Agenda

1. Building energy modeling and sketchbox™
 2. Sample lesson one
 3. Building energy careers, sample lesson two
 4. Lunch
 5. Sample lessons three and four
 6. Technical Q&A
 7. Participant lesson development
-

Detailed morning agenda (part 1)

9:00 - 9:30 Introductions and overview

9:30 – 9:45 Sketchbox features, support, and results

9:45 – 10:00 Introduce lesson one and learning objectives
(NGSS, DPI Pathway)

10:00 – 10:10 break

Detailed morning agenda (part 2)

- | | |
|---------------|---|
| 10:10 – 10:40 | lesson one work in breakout groups |
| 10:40 - 11:00 | lesson debrief, technical questions list |
| 11:00 – 11:10 | break |
| 11:10 – 11:45 | career map, lesson two in breakout groups |
| 11:45 – noon | lesson debrief, frame individual lessons |
| Noon - 12:45 | lunch, outline individual lessons |
-

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

Motivate/excite students about climate solutions

Careers: Building manager, energy engineering, architecture, HVAC, energy analysts, construction/contractor, sustainability

Why teach this to students?

Energy DPI Pathway

Job growth in renewable energy

Green buildings career map

<https://greenbuildingscareermap.org/>

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

CO₂ Equivalence for Electricity

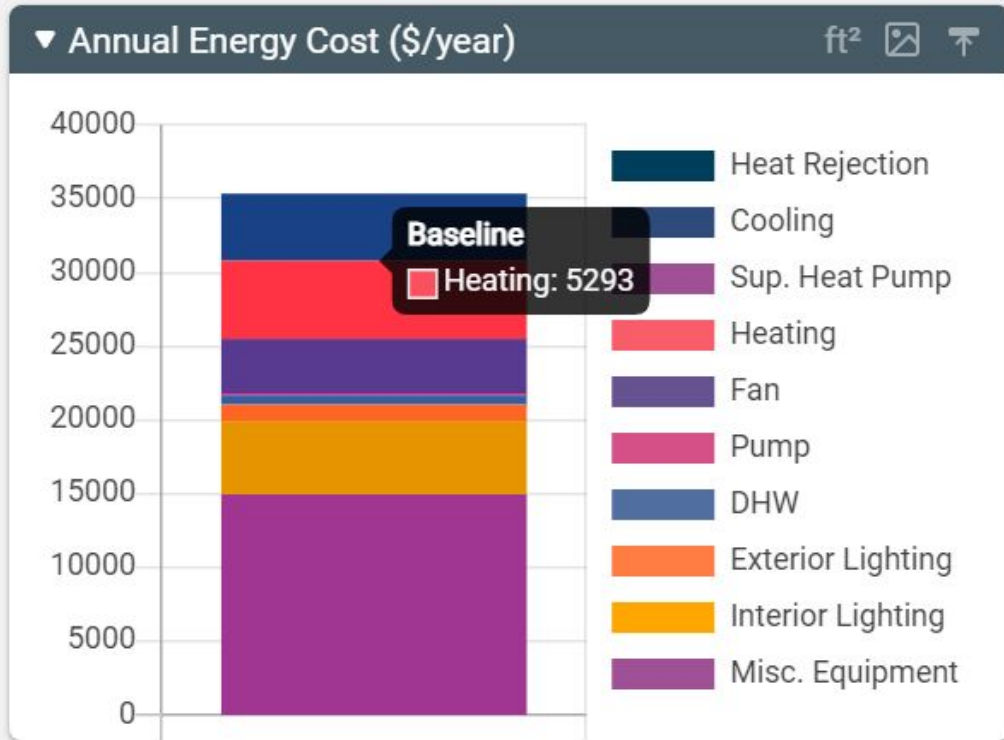
0.371

kg of CO₂e/kWh

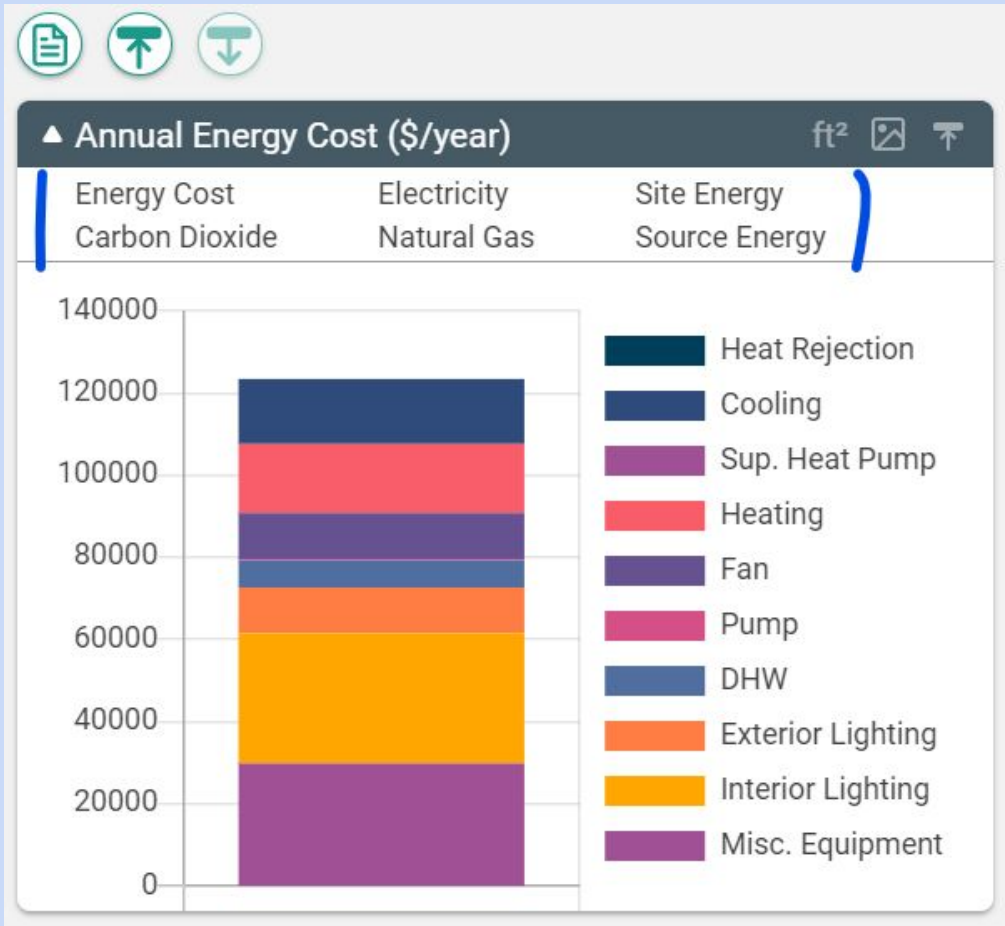
CO₂ Equivalence for Natural Gas

5.3

kg of CO₂e/therm

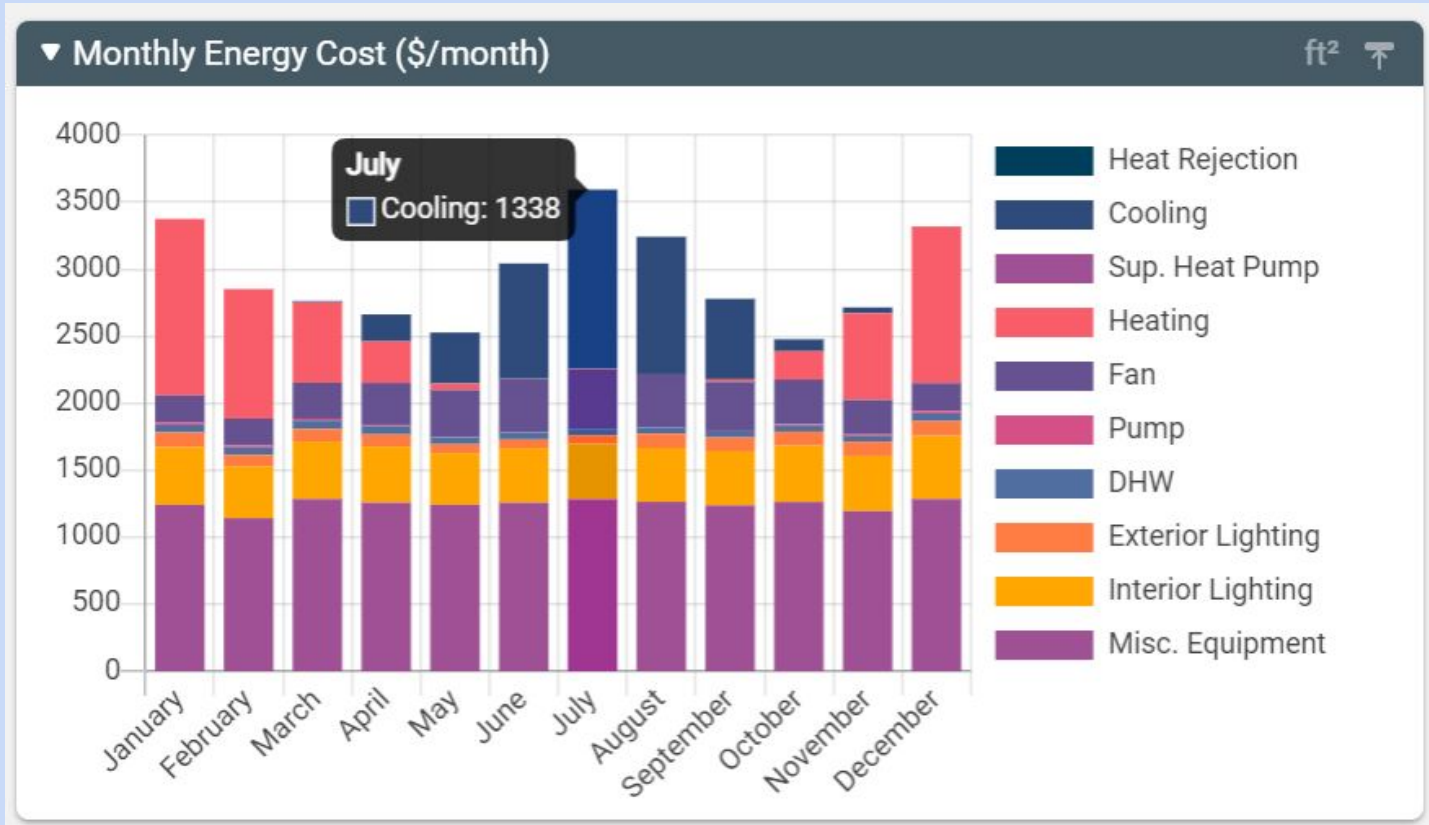


Energy Cost by Utilization



Other display options

Monthly breakdown




Annual Summary

Results Table

	Peak Cooling (kBTU/hr)	Peak Heating (kBTU/hr)	Peak Electric Demand (kW)	Annual Electric Consumption (kWh)
Baseline	972.1	785.3	134	325849

Annual Natural Gas Consumption (therm)	Annual Energy Cost (\$)	Annual Water Consumption (gal/yr)
9365	35816	700000



Design Tab Options

Building Type
School/University

Parent Shell: None
Adjacency: Not Used

Area: 150000 ft²
Aspect Ratio: 1

Floors
Number: 2
Height: 13 ft

Perimeter Zone Depth: 15 ft

Roof Type: Insulation entirely above deck

Wall Type: Metal framed

Glazing Type: Fixed fenestration

Window-to-Wall Ratio (%)
North: 22
South: 22
East: 22
West: 22

Skylight Type: Plastic Curb

Skylight-to-Roof Ratio: 0 %

Heating Fuel Type: Natural Gas

Air-Side System: Packaged VAV with HW Reheat

Cooling System: Direct Expansion

Heating System: Boiler

Dedicated Outdoor Air System: None

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

Building type (e.g. school, commercial, library, fitness center)

Location

Window Fraction

Spatial Orientation

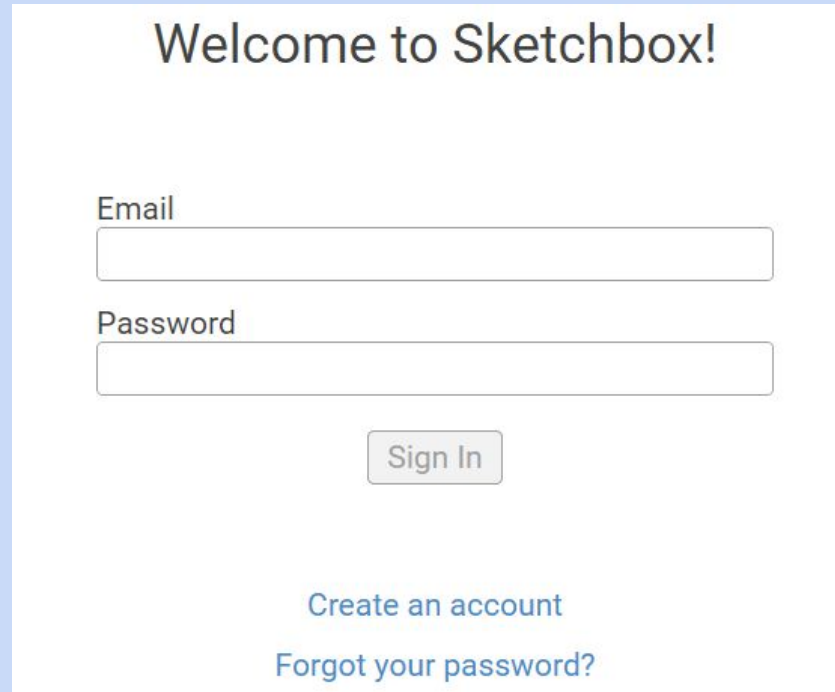
Energy Code

Example with sketchbox (Lesson one)

Switch to Sketchbox, demonstrate project, design, and results tabs

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

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



>Welcome to Sketchbox!

Email

Password

Sign In

[Create an account](#)

[Forgot your password?](#)

Time to take a break!

Create Account and Login to Sketchbox

<https://www.sketchbox.io/login>

Return in 10 min

Recording in Progress!

For later training purposes today's large group sessions are being recorded

Breakout room recommendations

Camera on during breakout groups when possible

One participant runs sketchbox and shares their screen

One participant records notes for the group and reports

Be kind! We have different levels of technical expertise

Example with sketchbox (Lesson one)

Breakout rooms (Re-introductions, choose spokesperson)

Group reporting

1. How would your students respond to this lesson?
2. What do you find yourself wondering about?
3. What extensions would you add?

Thirty minutes

Post-lesson discussion

Electricity, Natural Gas, Overall Cost

1. Cut building square footage in half
 2. Double window percentage
 3. Change location (Chicago to Los Angeles)
-

Example with sketchbox (Lesson one)

Group reporting

1. How would your students respond to this lesson?
 2. What do you find yourself wondering about?
 3. What extensions would you add?
-

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

Technical Questions for Q&A at 2:15 pm

Option to add questions to jamboard (link in chat)

<https://jamboard.google.com/d/1fYF9XmywP6mAvO5I9qZRqouYosOMjXFzeFPa50MpWc8/edit?usp=sharing>

Add your name to questions in case of clarification

Time to take a break!

Optional: Continue exploring Sketchbox

Return in 10 min

Sketchbox™ by Slipstream

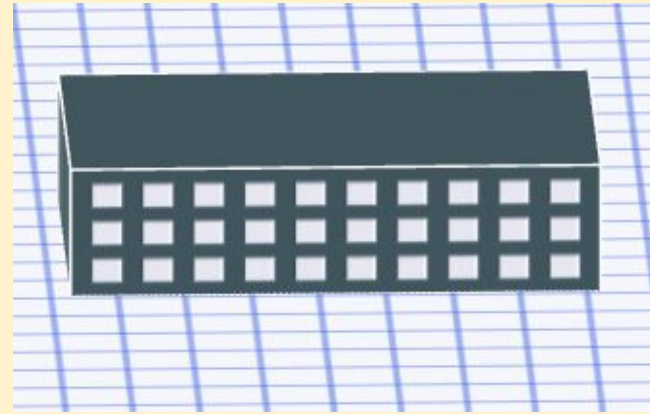
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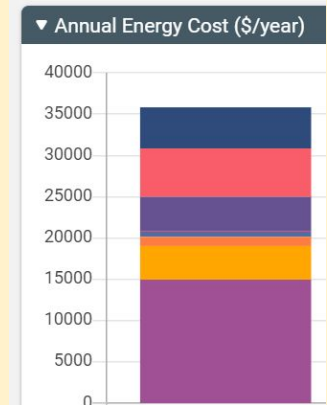
Dave Vigliotta, Slipstream

Session Two



My Project

PROJECT DESIGN SCHEDULES BASELINE



Brief Agenda

Building energy careers, sample lesson two

Lunch

Sample lessons three and four

Technical Q&A

Participant lesson development

Detailed morning agenda (Lesson 2)

- 11:10 – 11:45 career map, lesson two in breakout groups
 - 11:45 – noon lesson debrief, frame individual lessons
 - Noon - 12:45 lunch, outline individual lessons
-

Career Connections to Sketchbox

Example careers: building manager, energy engineer, architect, HVAC, energy analyst, construction/contractor, sustainability

<https://greenbuildingscareemap.org/>

createenergy.org

Resources → teaching materials → energy fundamentals → exploring a job in the energy industry

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

DPI Regional Career maps



Energy Career Pathway <Name of Region> 2022-2024

EXPLORE: Click on the links to find the job titles that seem most interesting to you to learn more! Save any jobs account so that you can create an Academic and Career Plan (ACP) later on.

Educational Level May also require work experience	Energy Generation & Conservation
High School Diploma, Certification	Solar PV Installer * <input type="radio"/> Electrical & Gas Power Line Helper * <input type="radio"/> Utility Lineman * <input type="radio"/> Range \$xxx,xxx-x
Certification or Technical Diploma	Distribution Generation Operator <input type="radio"/> Solar/Wind Energy Technician * <input type="radio"/> Building Automation Technician * <input type="radio"/> Energy Auditor <input type="radio"/> Residential HVAC Technician * <input type="radio"/> Range \$xxx,xxx-xxx,xxx
Registered Apprenticeship	Substation Electrician * <input type="radio"/> Apprentice Plant Attendant * <input type="radio"/> Range \$xxx,xxx-xxx,xxx

Exploring A Job In The Energy Industry



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



Clean Energy Careers Video Series

The clean energy sector is blossoming with career opportunities.

9 Clean Energy Career Video Profiles

Each video includes lesson slides and student assessment in Google format

<https://slipstreaminc.org/cleanenergycareers>

Energy Codes

International Code Council

IECC - International Energy Conservation Code

ASHRAE

American Society of Heating, Refrigeration, and Air
Conditioning Engineers

Codes updated on three cycles

Exceeding code

Roughly 40 building parameters on the “baseline” tab

Pre-set upgrades on the “measures” tab

Three values for each (no change, better, best)

Baseline categories

Envelope

Glazing

Skylights

Lighting

Internal Loads

Domestic Hot Water

Heating and Cooling

Ventilation

Baseline category example: Envelope

Envelope

Roof U-Value

0.032

BTU/hr·ft²·°F

Wall U-Value

0.064

BTU/hr·ft²·°F

Slab F-Factor

0.54

BTU/hr·ft·°F

Infiltration

0.6

ACH

Technical vocabulary for this lesson

Roof U-value

Solar Heat Gain Coefficient (SHGC)

Interior lighting power

% E_{th} (for heating)

Technical vocabulary for this lesson

Roof U-value

Solar Heat Gain Coefficient (SHGC)

Interior lighting power

% E_{th} (for heating)

Sketchbox demonstration

Change energy code

Baseline tab

Measures sets

Breakout room recommendations

Camera on during breakout groups when possible

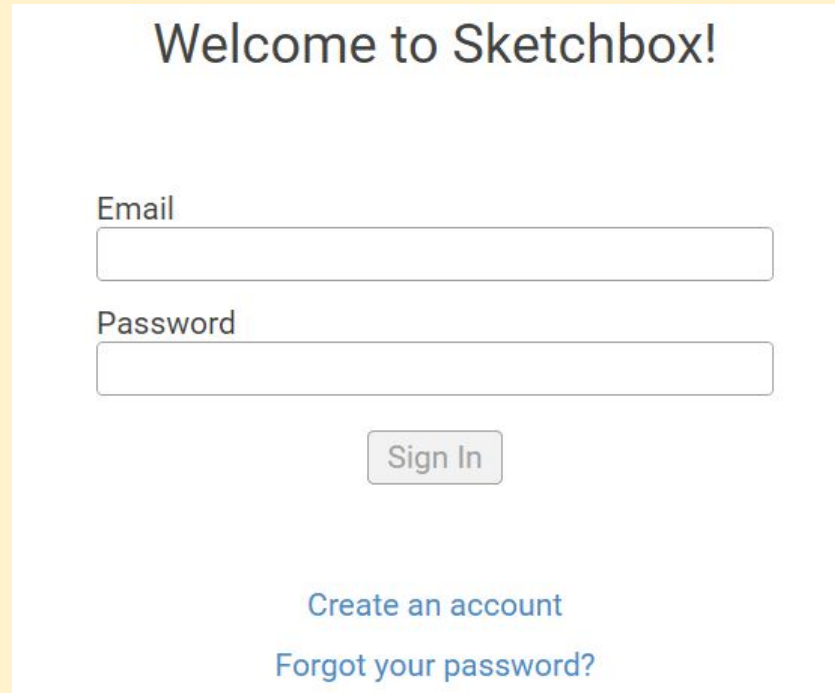
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One participant records notes for the group and reports

Be kind! We have different levels of technical expertise

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

A screenshot of the Sketchbox login page. The page has a white background and is centered on a yellow background. At the top, it says "Welcome to Sketchbox!". Below that are two input fields: "Email" and "Password". Under the "Password" field is a "Sign In" button. At the bottom, there are two links: "Create an account" and "Forgot your password?".

Welcome to Sketchbox!

Email

Password

Sign In

[Create an account](#)

[Forgot your password?](#)

Sketchbox Lesson Two

Breakout rooms (choose new spokesperson)

Group reporting

1. Summarize what you learned
2. Additional questions / ideas about energy code
3. What other measures are you most interested in?

Twenty-five minutes

Recording in Progress!

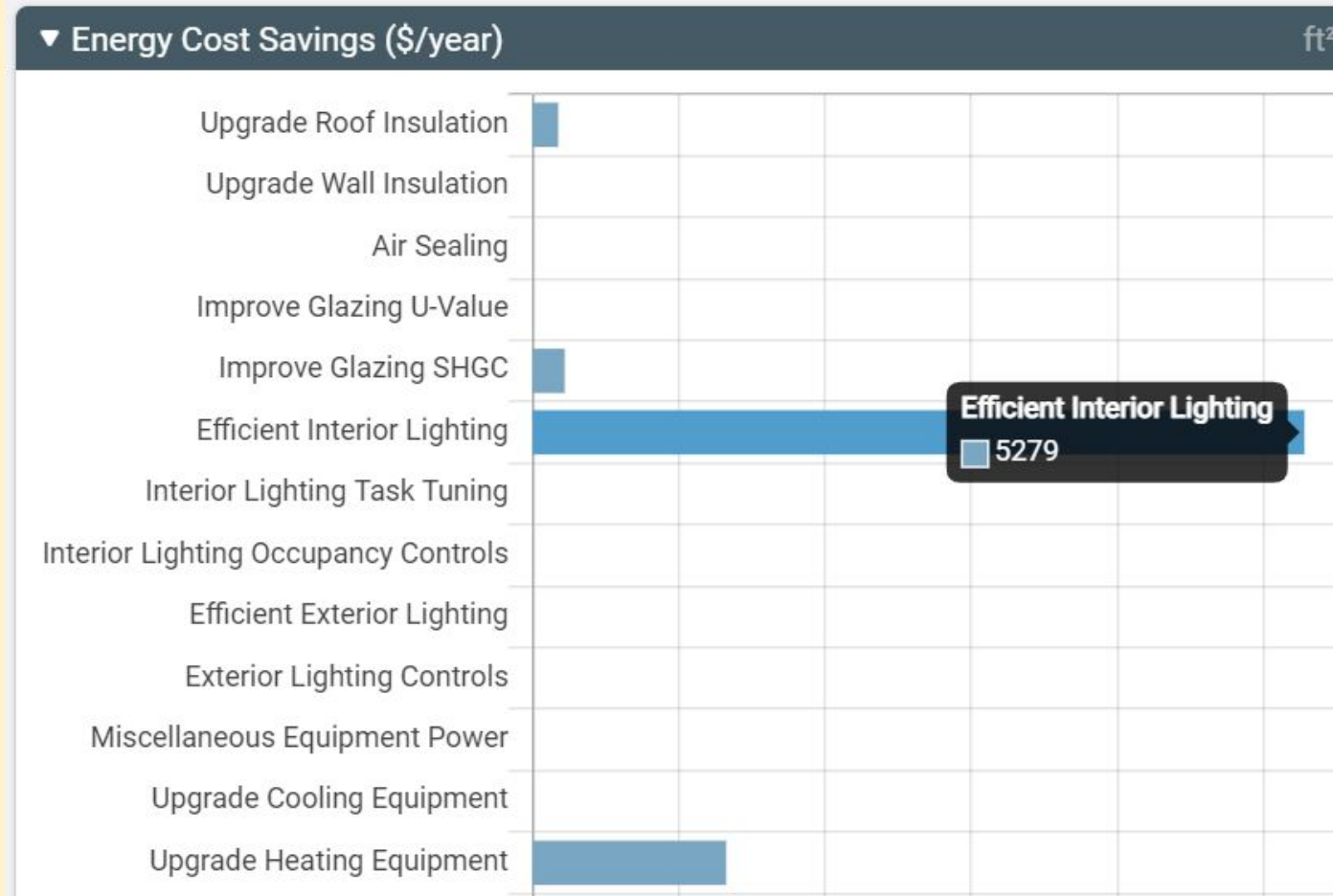
For later training purposes today's large group sessions are being recorded

Lesson two sample results

Table 1

Building model	Annual electric use (kWh)	Annual natural gas use (therm)	Annual energy cost (USD, \$)
Baseline (IECC 2018)	1,030,906	34,336	116,577
IECC 2015	1,111,081	33,763	123,395
ASHRAE 2016	1,066,255	33,384	119,099

Sample results



Lesson two sample results

Table 2

Building model	Annual electric use (kWh)	Annual natural gas use (therm)	Annual energy cost (USD, \$)
IECC 2018 “no change” (baseline- from table 1)	1,030,906	34,336	116,577
IECC 2018 Four selected improvements	947,063	33,981	108,784
IECC 2018 “best” measures set	686,592	14,533	44,498

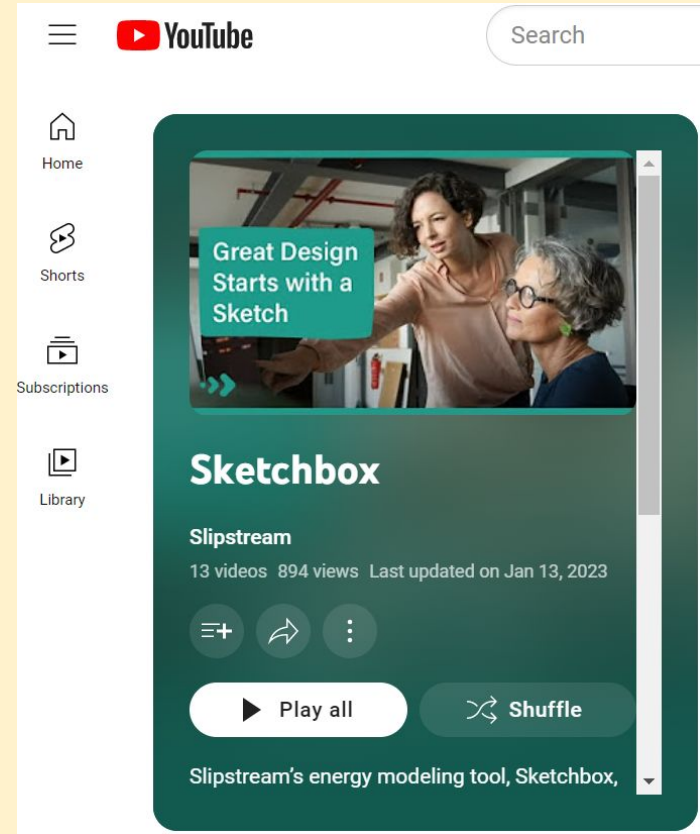
Sketchbox Support

Youtube tutorials at the sketchbox
[youtube](#) channel

Support: tools@slipstreaminc.org

Continue adding to technical Q&A

<https://jamboard.google.com/d/1fYF9XmywP6mAvO5l9qZRqouYosOMjXFzeFPa50MpWc8/edit?usp=sharing>



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Lesson development template: Objectives

- 1) Demonstrate energy, financial, or CO₂ savings from updating a building schedule
 - 2) Show how the CO₂ impacts of a building are different in different areas of the United States
 - 3) Compare estimated building energy savings from improved building schedules to the savings from adding energy efficient lights
 - 4) Estimate the added annual energy costs for a building expansion
-

Lesson development template: NGSS standards

HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

HS-ETS1-4 Engineering Design

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NGSS Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
 2. Developing and using models
 3. Planning and carrying out investigations
 4. Analyzing and interpreting data
 5. Using mathematics and computational thinking
 6. Constructing explanations (for science) and designing solutions (for engineering)
 7. Engaging in argument from evidence
 8. Obtaining, evaluating, and communicating information
-

Lesson development template: Metatags

Budget, building code, building design, building envelope, building science, carbon emissions, carbon footprint, computer model, data analysis, efficiency, electricity, energy, energy career, energy conservation, energy economics, energy efficiency, energy management, green building, heating and cooling, HVAC, kwh, natural gas, NG, simulation, sustainability, utilities, utility rates

End of morning session: Lunch 12:00 - 12:45 pm

Suggested activities:

Sketchbox youtube channel

<https://www.youtube.com/watch?v=F8dRupH33Jc&list=PL-mtgGdh8bvh3GsfC1Fpe8bJSO2uDRFo5>

Continue exploring Sketchbox

Start lesson development

Createenergy.org

**It Pays To Save
In Your Home**




**Smart PV:
Battery &
Charge Controller**



**Building A Passive
Solar Home**



**What's In An
Energy Bill?
Part 2**




**What's In An
Energy Bill?
Part 1**



**Exploring A Job
In The
Energy Industry**




**Solar PV:
Balance Of System
& System Design**




**Solar Site Analysis:
The Solar
Pathfinder**



**Dairy Waste
To Power**



**Measuring
Sunlight:
The Pyranometer**




By The Numbers




**What's The
Cheapest Watt?**



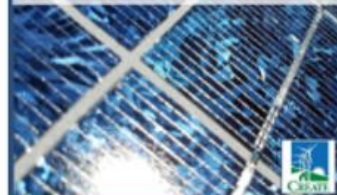
**Solar PV: Module
Performance
(Instructional Size Module)**



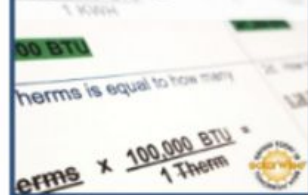
**Solar PV:
Watts From The Sun**




Solar PV Silicon



**Energy Conversions
& Beyond**



**Solar Location
Analysis:
The PVWatts
Calculator**



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

Teaching Materials, Energy Fundamentals

Select a category to view lesson plans in a specific Renewable Energy topic.

Energy
Fundamentals

Energy
Management &
Efficiency

Solar PV

Bioenergy

SCADA

Energy Career Maps through CREATE

<https://createenergy.org/resources/>

SOLAR TOOLKIT



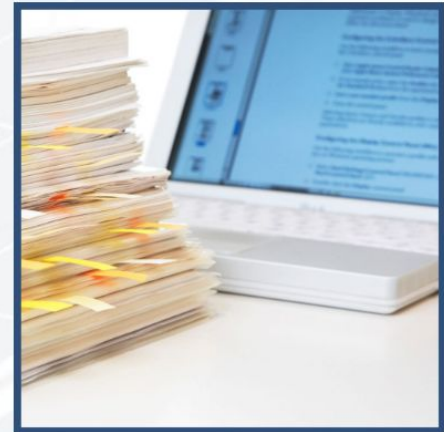
TEACHING MATERIALS



CAREER MAPS



PUBLICATIONS



Brief Agenda

Welcome back from lunch!

Sample lessons three and four

Technical Q&A

Participant lesson development

Recording in Progress!

For later training purposes today's large group sessions are being recorded

Detailed afternoon agenda (part 1)

- | | |
|--------|--|
| 15 min | review objectives, student responses, |
| 25 min | lessons 3, 4 and open exploration
add to tech questions, share lesson ideas |
| 20 min | lesson review, resources, objective discussion |
| 5 min | break |
-

Detailed afternoon agenda (part 2)

- | | |
|--------|---|
| 30 min | technical Q and A with slipstream,
additional career connections |
| 15 min | workshop evaluation, closing remarks |
-

Lesson 3 and 4 objectives

Investigate scheduling and its impact on building energy

Calculate carbon equivalent emissions avoided due to energy savings

Explore electrification of heating and its impact on emissions

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”

Recording in Progress!

For later training purposes today's large group sessions are being recorded

Sample Lesson three results

Table 1

Building model	Annual electric consumption (kWh)	Annual natural gas consumption (therm)	Annual energy cost (\$)
Baseline (<u>simple</u> thermostats)	1,027,748	33,651	115,817
Simple thermostats Weekday 8am – 8 pm	1,030,906	34,336	116,577
Simple thermostats Weekday 8am – 4 pm	1,026,151	33,382	115,488
<u>68 degree</u> heating setpoint <u>77 degree</u> cooling setpoint	998,770	32,249	112,238

Sample Lesson four results

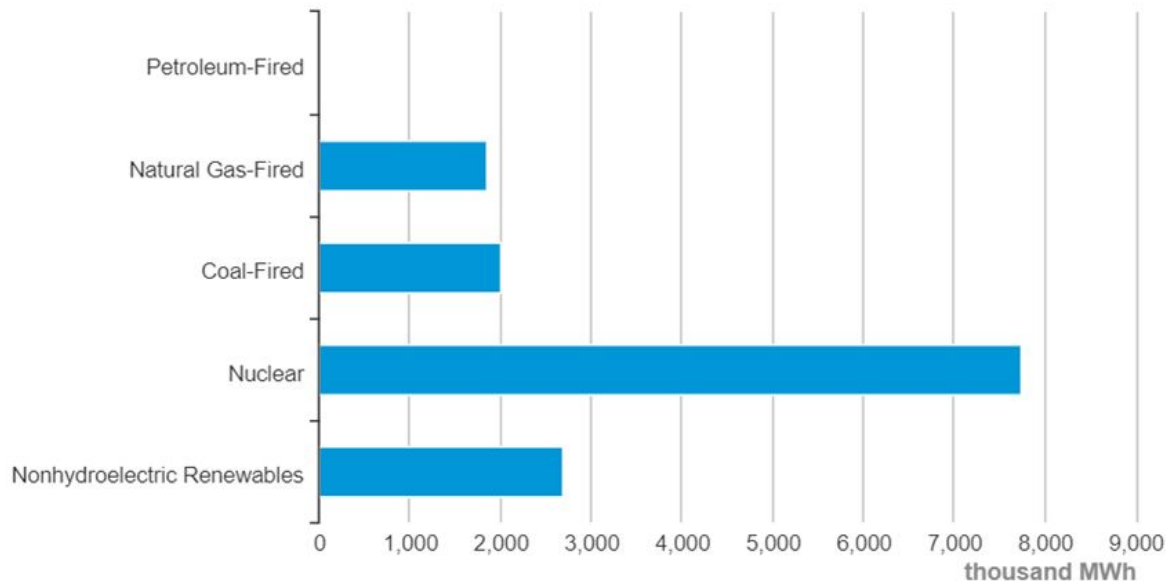
Table 1

Building model	Annual electric consumption (kWh)	Annual natural gas consumption (therm)	Annual Kg-CO ₂ e
Baseline	326,919	8539	166,544
Energy efficient lights	301,874	8829	158,789
Demand control ventilation	325,514	7568	160,876
Move to Madison, WI	322834	10109	257,932

EIA state energy profiles: <https://www.eia.gov/state/>

Illinois Net Electricity Generation by Source, Mar. 2023

DOWNLOAD



Source: Energy Information Administration, Electric Power Monthly

After lessons 3 and 4 what is needed next?

PV watts demo

<https://pvwatts.nrel.gov/>

LEED: <https://www.usgbc.org/leed>

Leadership in Energy and Environmental Design

U.S. Green Building Council

Lesson development / Model Exploration

WI educators may contribute a lesson and receive a stipend

Submit lessons in Word or Google Doc format to Jim:

jpreichling@madisoncollege.edu and CC Samara:

samara.hamze@uwsp.edu

Deadline: Tuesday, August 8th

If needed, take a break during work session

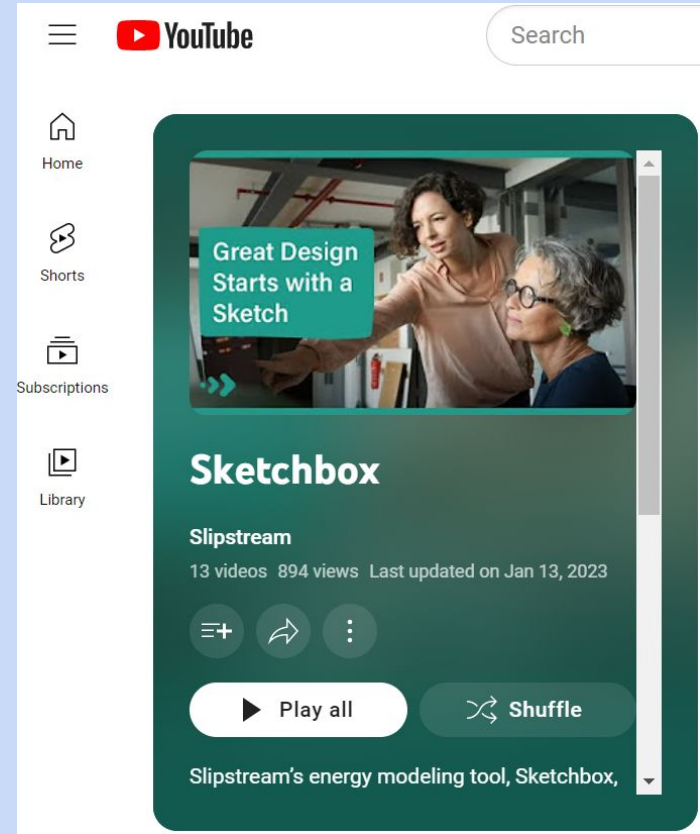
Return at 2:15 pm for technical Q&A

Sketchbox Support

Youtube tutorials at the sketchbox [youtube](#) channel

Support: tools@slipstreaminc.org

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



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Recording in Progress!

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Technical Q&A

Lee Shaver

Senior Energy Engineer

Emily Golen

Energy Engineer II

Closing remarks, workshop evaluation

Workshop evaluation:

https://uwsp.az1.qualtrics.com/jfe/form/SV_doPONzXjVnW0FxA

QR:



End of presentation

Additional presentation notes follow on the next slides

Links to Sketchbox lessons 1 - 4 in google doc form

<https://docs.google.com/document/d/1fj2sXF77KSPGMQqkucsKC4C8kxyMpLXMhAJ0U3wJfrA/edit?usp=sharing>

<https://docs.google.com/document/d/12ksKAdrpxvzbYqLVu1RnP-KTPbrxNwLtUIO3EI8p2Rk/edit?usp=sharing>

<https://docs.google.com/document/d/16c0ITKcOpXZkV5R925S7FArZy7w752yUsV4o0qTTCZk/edit?usp=sharing>

<https://docs.google.com/document/d/1qGTBNiFDhQyqxo5LgDvcXzc2FNZ0zOGmrjzdYribnnE/edit?usp=sharing>

Links to Sketchbox lessons 1 - 4 in google doc form

[Lesson 1 introduction](#)

[Lesson 2 energy code](#)

[Lesson 3 schedules and measures](#)

[Lesson 4 carbon emissions](#)

Createenergy.org

**It Pays To Save
In Your Home**



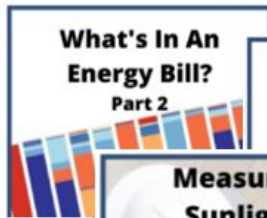
**Solar PV:
Battery &
Charge Controller**



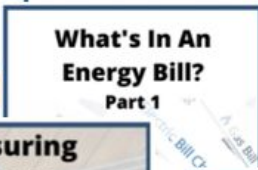
**Building A Passive
Solar Home**



**What's In An
Energy Bill?
Part 2**



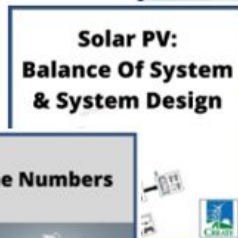
**What's In An
Energy Bill?
Part 1**



**Exploring A Job
In The
Energy Industry**



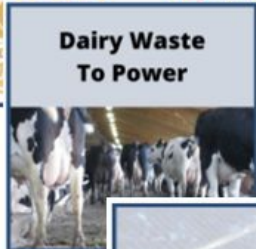
**Solar PV:
Balance Of System
& System Design**



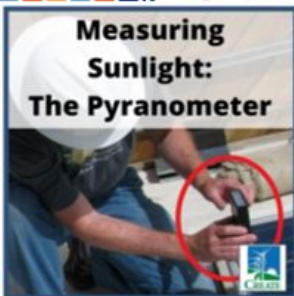
**Solar Site Analysis:
The Solar
Pathfinder**



**Dairy Waste
To Power**



**Measuring
Sunlight:
The Pyranometer**



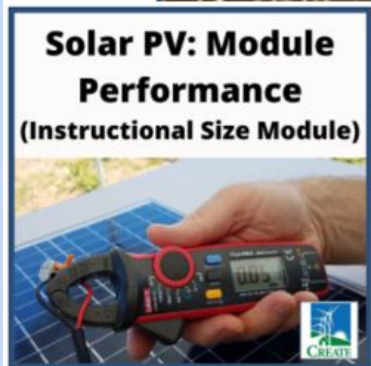
By The Numbers



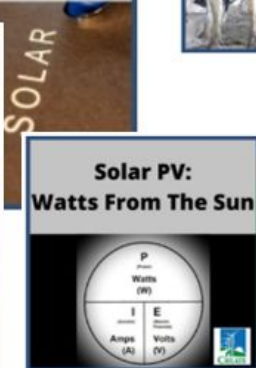
**What's The
Cheapest Watt?**



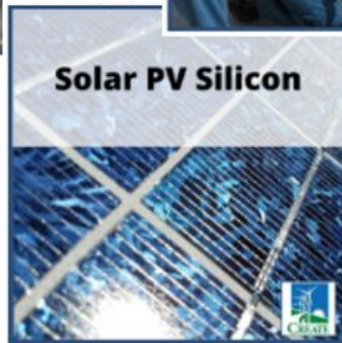
**Solar PV: Module
Performance
(Instructional Size Module)**



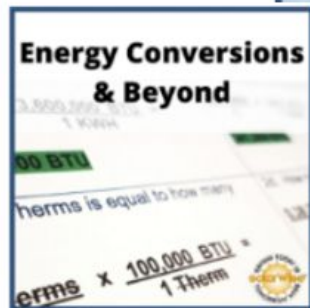
**Solar PV:
Watts From The Sun**



Solar PV Silicon



**Energy Conversions
& Beyond**



**Solar Location
Analysis:
The PVWatts
Calculator**

