Welcome to the Energy 101 Online Dialogue 1#

Energy in the Classroom

Today's Agenda

1) Introduction
Energy 101 Initiative: Framing the Issue - Matt Garcia **(3-3:10)**
2) Instructors in Energy Education Series
Energy in the Classroom presentations (**3:10-4:00)**
3) Online Energy Education Discussion Forum (4:00-4:30)
Interactive and pre-populated discussion points and comments
4) Resources Discussion 4:30-5:15
5) Conclusion (5:15)
Summary, take-aways, action items, and next steps

We encourage you to bring up topics of discussion using question function on your gotowebinar panel for the online virtual panel we will have following the Instructors in Energy Presentations.

#Energy101

The Energy 101 Initiative
Framing the Issue
#Energy101

Dr. Matthew Garcia[1]

Science & Technology Policy Fellow
Department of Energy

September 20th, 2013

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[1] All opinion presented are my own

All image rights and credits to original creators

Energy 101: Framing the Issue

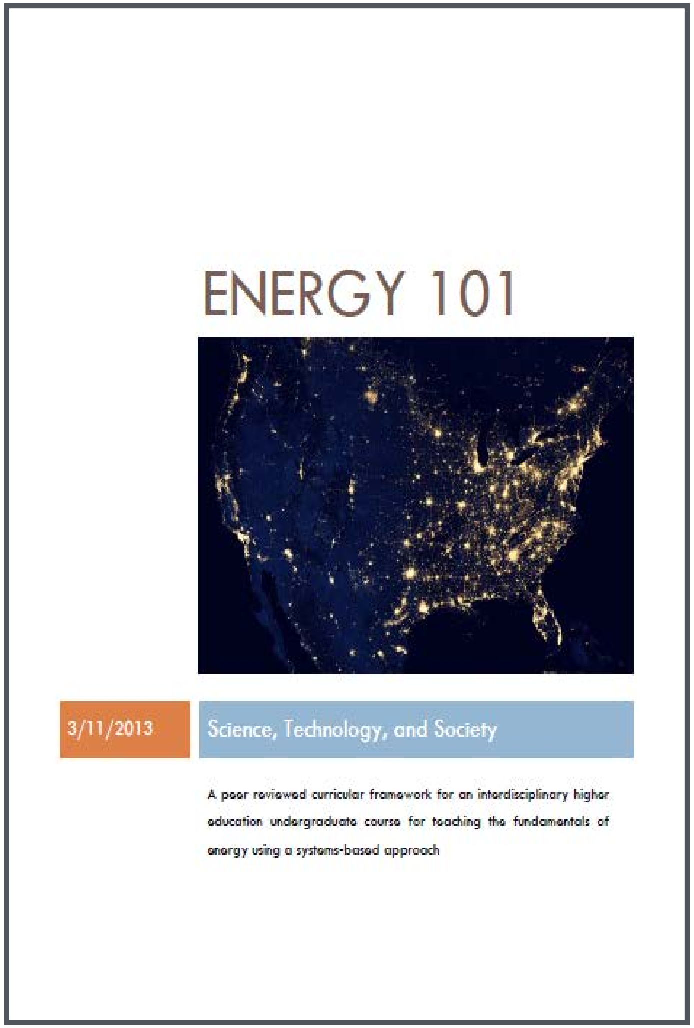
Launch of the Energy 101 Dialogue Series

energy.gov/eere/education/energy-101-dialogue

Background on the Energy 101 Initiative

energy.gov/eere/education/energy101

What is the Energy 101 Initiative?



ENERGY 101

3/11/2013

Science, Technology, and Society

A peer reviewed curricular framework for an interdisciplinary higher education undergraduate course for teaching the fundamentals of energy using a systems-based approach

Promoting Energy Education in the Nation's Colleges and Universities

- A recognition of ongoing post-secondary energy education efforts in the Nation's colleges and universities.
- Effort to further support and amplify those efforts
    - Encouraging the creation of energy courses, by lowering thresholds toward course creation and adoption
    - Facilitate and foster a coordinated national discussion on energy education at the post-secondary level

Overall Goals

- Increasing the pathways available to students towards training, degrees and careers in energy and related fields (Energy STEM)
- Increase the Nation's Energy Literacy

The Energy Literacy Principles and the Energy 101 Framework

Energy Literacy

Essential Principles and

1 Energy is a physical quantity that follows precise natural laws.

2 Physical processes on Earth are the result of energy flow through the Earth system.

3 Biological processes depend on energy flow through the Earth system.

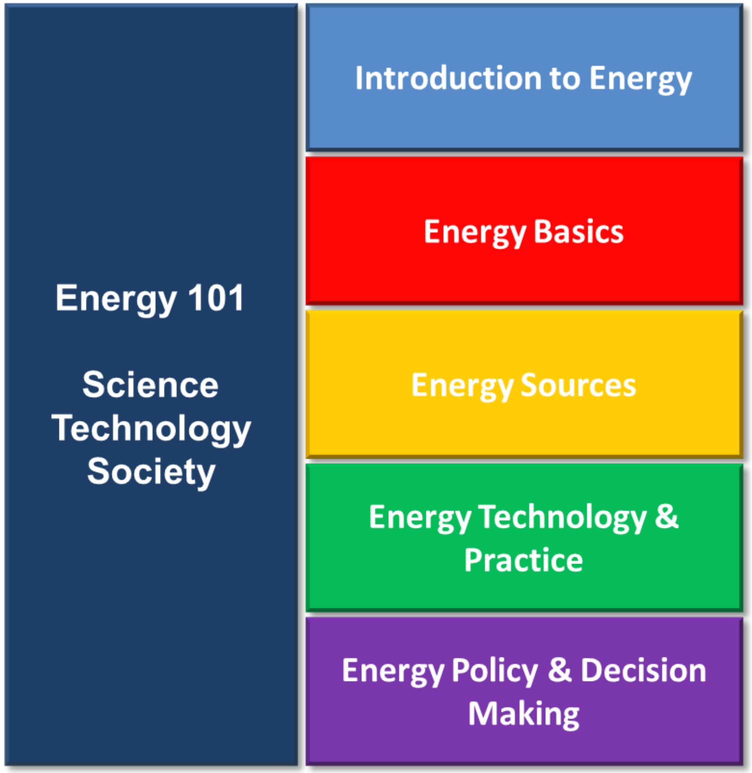
4 Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.

5 Energy decisions are influenced by economic, political, environmental, and social factors.

6 The amount of energy used by human society depends on many factors.

7 The quality of life of individuals and societies is affected by energy choices.

1. Intro to Energy Course models
2. Public comment
3. Expert review



Energy 101

Science Technology Society

Introduction to Energy

Energy Basics

Energy Sources

Energy Technology & Practice

Energy Policy & Decision Making

A peer reviewed and agreed upon set of principles and concepts that define energy literacy

Course outline consisting of 5 Units of fundamentals and 36 core concepts in the format of a semester long course

The 5 Units of the Energy 101 Course Framework- 36 core concepts

Units

U1. Introduction to Energy

1. Energy is a physical quality that follows precise natural laws (Core 1.1)
2. Physical processes on Earth are the result of energy flow through the Earth system. (Core 2.6)
3. Biological processes depend on energy flow through the Earth system. (Core 3.6)

U2. Energy Basics

1. Energy is a physical quantity that follows precise natural laws (Cores 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8)

U3. Energy Sources

2. Physical processes on Earth are the result of energy flow through the Earth system. (Core 2.2)
4. Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination. (Core 4.1, 4.3, 4.5 , 4.7)
6. The amount of energy used by human society depends on many factors. (Core 6.1)
7. The quality of life of individuals and societies is affected by energy choices.(Core 7.3)

U4. Energy Technology & Practice

4. Various sources of energy can be used to power human activities, often this energy must be transferred from source to destination. (Cores 4.2, 4.3, 4.4, 4.5, 4.6, 4.7)

U5. Energy Policy & Decision Making

5. Energy decisions are influenced by economic, political, environmental, and social factors. (Cores 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7)
6. The amount of energy used by human society depends on many factors. (Cores 6.3, 6.4, 6.5, 6.6, 6.8)
7. The amount of energy used by human society depends on many factors. (Core 7.1)

Sections

(Cores)

- **5 Units**
- **1-3 sections**
- **36 supporting core concepts**

Energy 101 Course Framework Unpacked Example

U1. Introduction to Energy UNIT

Sections

1. Energy is a physical quality that follows precise natural laws (Core 1.1)
2. Physical processes on Earth are the result of energy flow through the Earth system. (Core 2.6)
3. Biological processes depend on energy flow through the Earth system. (Core 3.6)

U2. Energy Basics

U3. Energy Sources

U4. Energy Technology & Practice

U5. Energy Policy & Decision Making

Cores

1.1 - Energy is a quantity that is transferred from system to system.

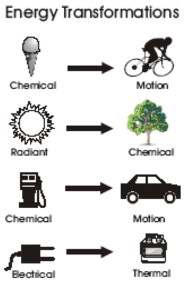
2.6- Greenhouse gases affect energy flow through the Earth system.

3.6 Humans are part of Earth’s ecosystems and influence energy flow through these systems.

Cores Unpacked

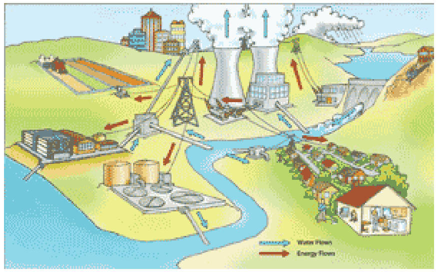
1. Energy is a physical quality that follows precise natural laws (Core 1.1)

1.1 Energy is a quantity that is transferred from system to system. Energy is the ability of a system to do work. A system has done work if it has exerted a force on another system over some distance. When this happens, energy is transferred from one system to another. At least some of the energy is also transformed from one type into another during this process. One can keep track of how much energy transfers into or out of a system.



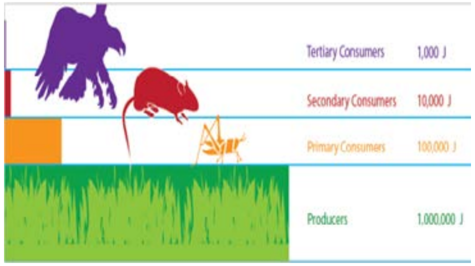
2. Physical processes on Earth are the result of energy flow through the Earth system. (Core 2.6)

2.6 Greenhouse gases affect energy flow through the Earth system. Greenhouse gases in the atmosphere, such as carbon dioxide and water vapor, are transparent to much of the incoming sunlight but not to the infrared light from the warmed surface of Earth. These gases play a major role in determining average global surface temperatures. When Earth emits the same amount of energy as it absorbs, its average temperature remains stable.



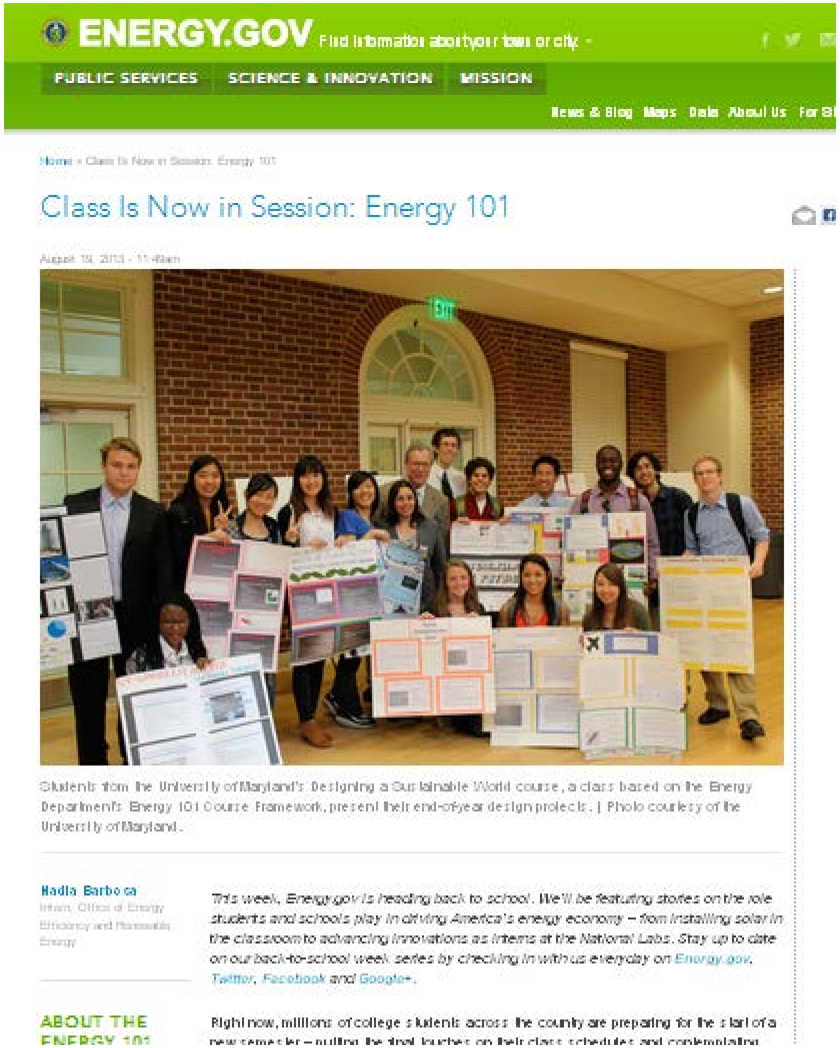
3. Biological processes depend on energy flow through the Earth system. (Core 3.6)

3.6 Humans are part of Earth's ecosystems and influence energy flow through these systems. Humans are modifying the energy balance of Earth's ecosystems at an increasing rate. The changes happen, for example, as a result of changes in agricultural and food processing technology, consumer habits, and human population size.



Framework Summary Document

Energy 101 Framework Use



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Home » Class Is Now in Session: Energy 101

Class Is Now in Session: Energy 101

August 19, 2013 - 11:49am

Students from the University of Maryland's Designing a Sustainable World course, a class based on the Energy Department's Energy 101 Course Framework, present their end-of-year design projects. | Photo courtesy of the University of Maryland.

Nadia Barbosa
Intern, Office of Energy Efficiency and Renewable Energy

This week, Energy.gov is heading back to school. We'll be featuring stories on the role students and schools play in driving America's energy economy – from installing solar in the classroom to advancing innovations as interns at the National Labs. Stay up to date on our back-to-school week series by checking in with us everyday on Energy.gov, Twitter, Facebook *and* Google+.

ABOUT THE

Right now, millions of college students across the country are preparing for the start of a

http://energy.gov/articles/class-now-session-energy-101

Spring 2013, Pilot course at University of Maryland was offered

- Resulted in a general Education Course Credit
- More than 90 percent of the students who took the pilot indicated it helped them think about the complex issues or problems surrounding energy

February 2013, Harford Community College in Bel Air, Maryland, received approval to teach a course based on the Framework, *Introduction to Energy & Sustainability* (SCI 109)

- General Science Course
- Transferrable to All State Higher Education Institutions in Maryland

In May of 2013, Cecil Community College received approval for Introduction to Energy & Sustainability

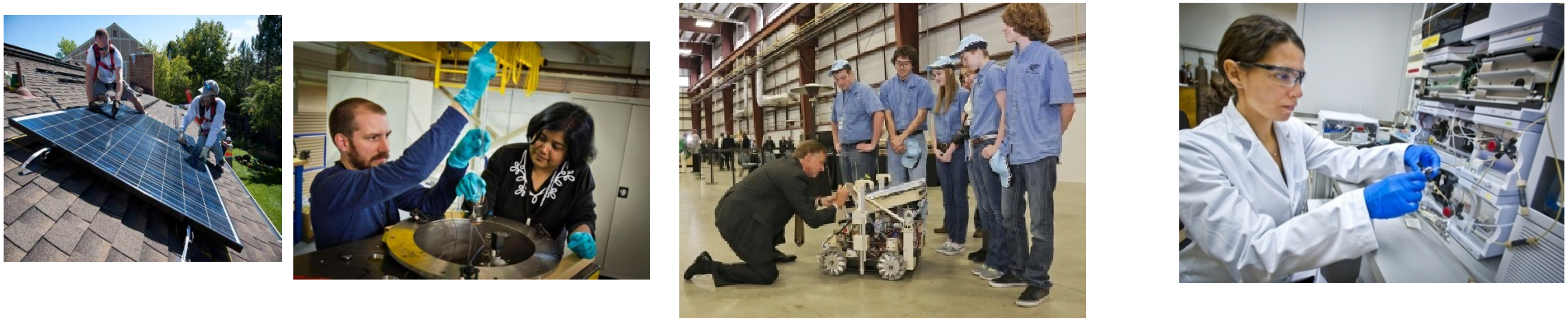
- 4 hour credit courses: ENV 150

Why are Energy Education and Energy literacy important topics to the Department of Energy?

#Energy101

DOE Mission Goals: Energy Workforce

Sustain a World-Leading Technical Workforce



http://www.pinterest.com/energy/

#Energy101

Increase Energy Literacy in the U.S.

National Environmental Education and Training Foundation "Energy Literacy in America[1]" 2002

12% passed a basic quiz on awareness of energy topics

75% believe they have a lot or fair amount of knowledge of energy

Similar studies done since 2002 have shown little energy literacy improvement (2012)

http://www.clarkson.edu/cses/research/energylitproj.html

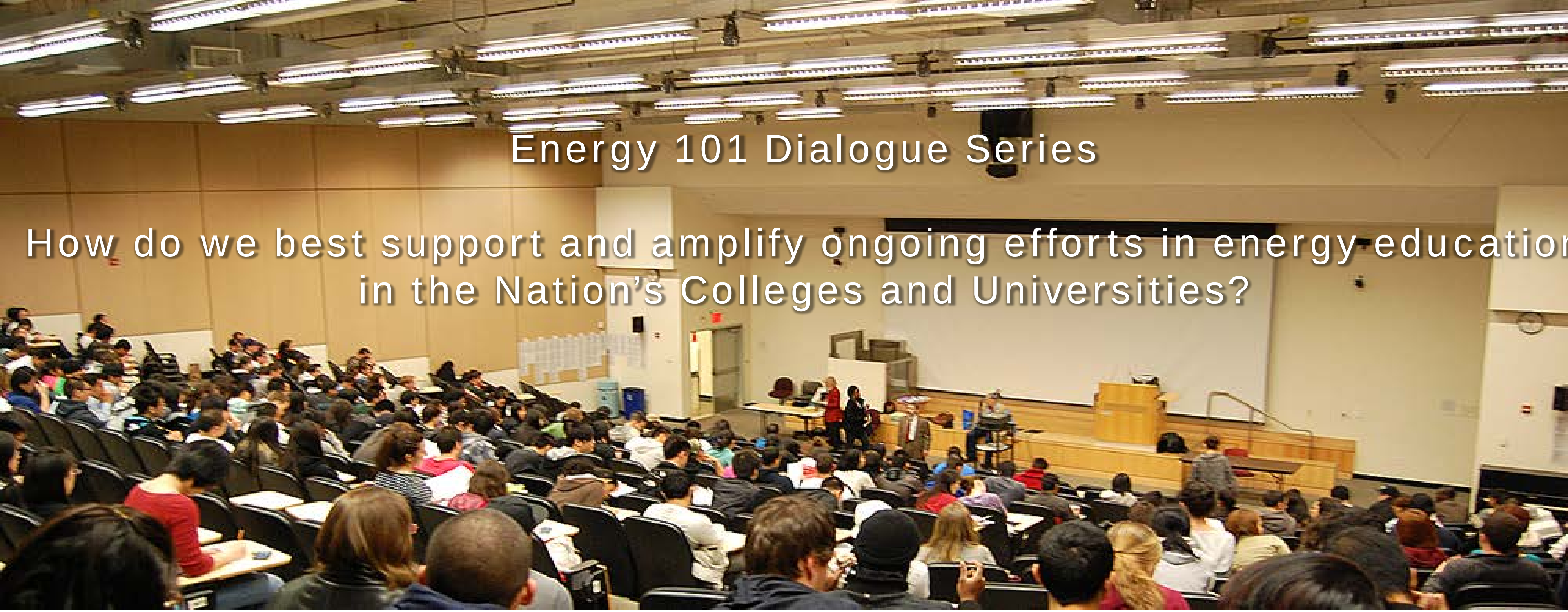
#Energy101

Results of increased Energy Literacy

- A better understanding of energy can:
  - Lead to more informed decision
  - Promote economic development
  - Lead to efficient energy use
  - Reduce environmental risks and negative impacts
  - Help individual and organizations save money

Energy 101 Dialogue Series

- In the process of creating the energy 101 initiative and creation of the framework, we uncovered a growing ecosystem of energy education in the post secondary setting



Energy 101 Dialogue Series

How do we best support and amplify ongoing efforts in energy educatio
in the Nation’s Colleges and Universities?

Energy Dialogue Series Activies / Goals

- Identify issues surrounding increasing energy education opportunities and courses
- Identify and share components of DOE and the federal training & workforce infrastructure to leverage
- Report out best practices and Energy 101/Energy literacy efforts
- Communities of practice around post secondary energy education

Dialogue #1: Energy in the Classroom

- Sharing best practices in the teaching of fundamentals of energy and energy related courses
- Sharing of resources for educators in energy education

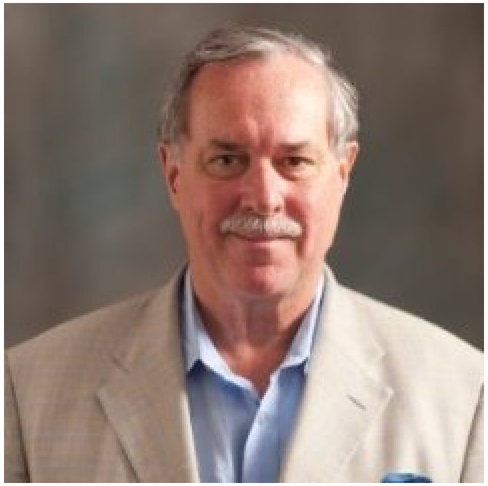
2. Instructors in Energy Education Panel

#Energy101

Energy Educators Panel Speakers

Professor Leigh Abts - Research Associate Professor, University of Maryland
Professor Daniel Kammen - Professor, Energy and Resources Group, University of California, Berkley; Director, Renewable and Appropriate Energy Laboratory
Professor Andy Bunn - Associate Professor, Western Washington University; Director, Institute for Energy Studies
Professor Douglas J. Reinemann - Professor, University of Wisconsin-Madison; Department Chair, Biological Systems Engineering
Professor Kenneth Klemow - Professor, Wilkes University; Associate Director, Institute for Energy and Environmental Research

All panelists views are their own



Professor Leigh Abts - Research Associate Professor, University of Maryland

Energy 101 by Design:

Designing a Sustainable World

Designing Quantitative Solutions for Energy

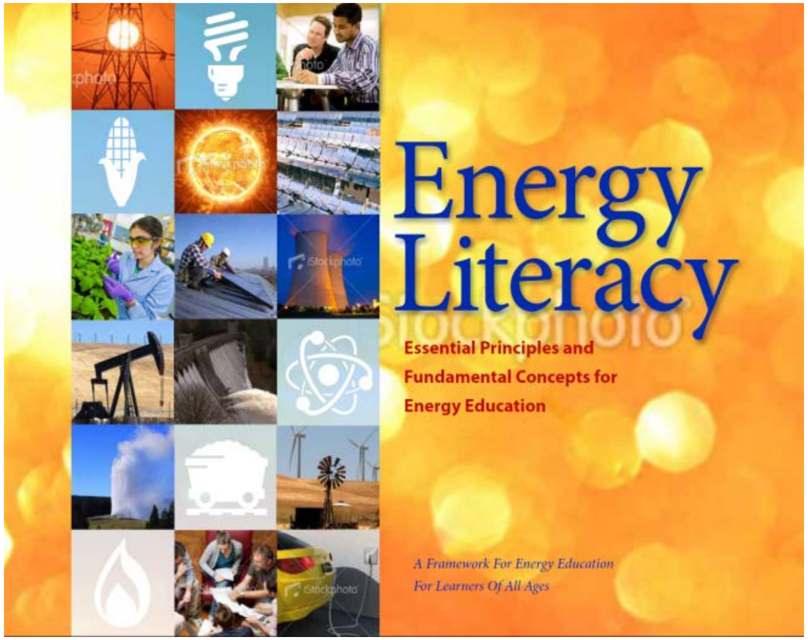
Leigh Abts, Ph.D.
Research Associate Professor
A. James Clark School of Engineering
&
College of Education
University of Maryland, College Park

June 26, 2014

Creating the Framework to Align the Energy Literacy Principles to 21St Century Skills through Design

Initial Project Funded by DOE to APLU with James Turner as PI

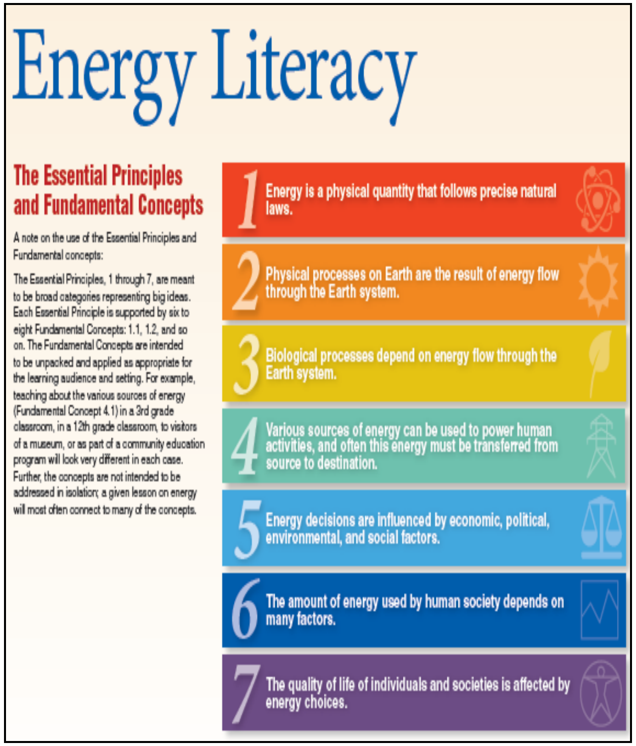
Energy Literacy Principles form the Foundation



Energy Literacy

Essential Principles and Fundamental Concepts for Energy Education

A Framework For Energy Education For Learners Of All Ages



Energy Literacy

The Essential Principles and Fundamental Concepts

A note on the use of the Essential Principles and Fundamental concepts:

The Essential Principles, 1 through 7, are meant to be broad categories representing big ideas. Each Essential Principle is supported by six to eight Fundamental Concepts: 1.1, 1.2, and so on. The Fundamental Concepts are intended to be unpacked and applied as appropriate for the learning audience and setting. For example, teaching about the various sources of energy (Fundamental Concept 4.1) in a 3rd grade classroom, in a 12th grade classroom, to visitors of a museum, or as part of a community education program will look very different in each case. Further, the concepts are not intended to be addressed in isolation; a given lesson on energy will most often connect to many of the concepts.

1 Energy is a physical quantity that follows precise natural laws.

2 Physical processes on Earth are the result of energy flow through the Earth system.

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4 Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.

5 Energy decisions are influenced by economic, political, environmental, and social factors.

6 The amount of energy used by human society depends on many factors.

7 The quality of life of individuals and societies is affected by energy choices.

Courtesy Department of Energy (DOE)

The 21St Century Academic and Workforce Skills Frame the Competencies[1]

Problem solving

Modeling

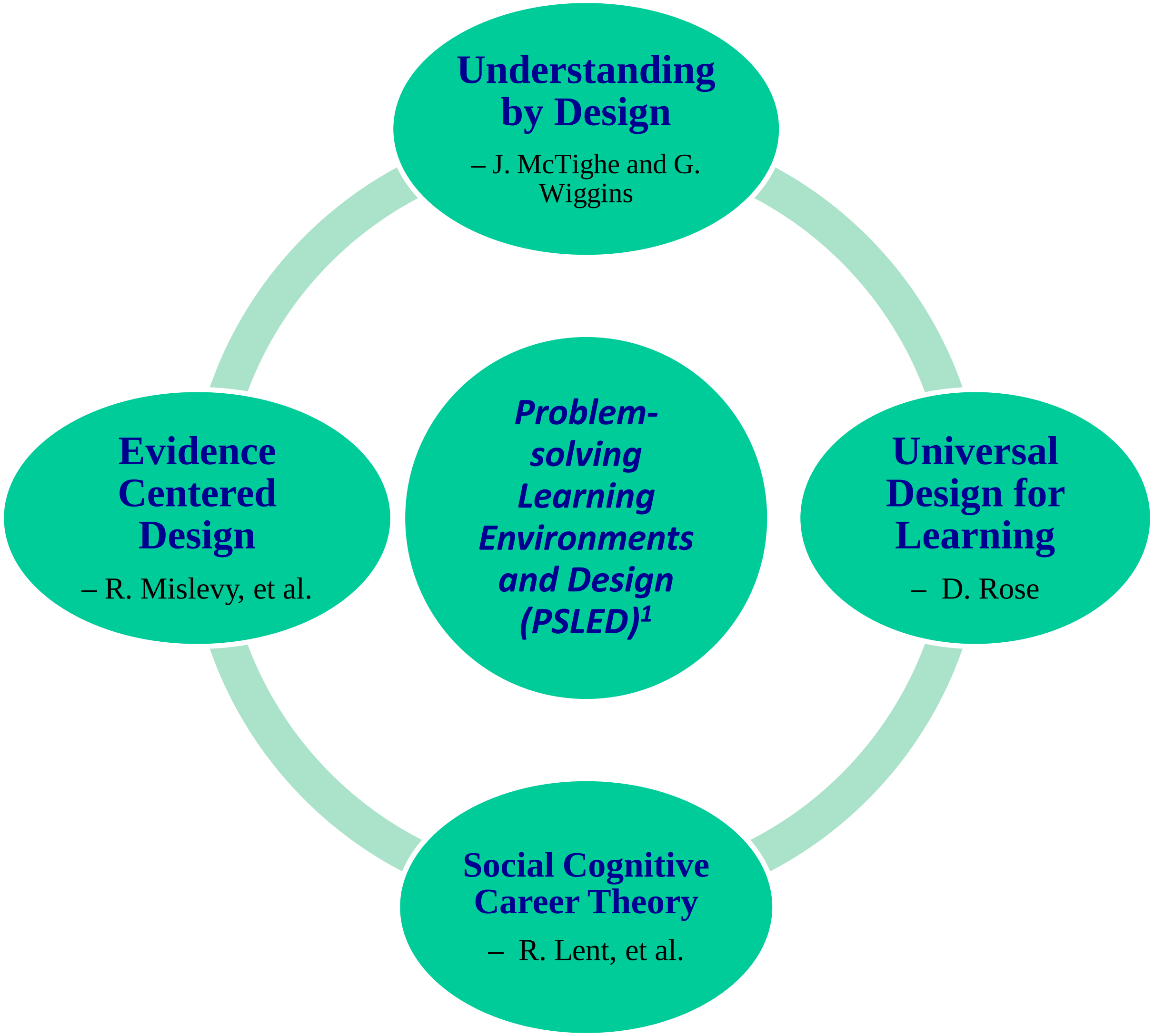
Collaboration

Creative thinking

Communications

1. NSF RET, PRIME and Inspire Awards

Align the Educational Design Theories Establish the Model[1,2,3]



Understanding by Design

– J. McTighe and G. Wiggins

Evidence Centered Design

– R. Mislevy, et al.

Problem-solving Learning Environments and Design (PSLED)[1]

Universal Design for Learning

– D. Rose

Social Cognitive Career Theory

– R. Lent, et al.

1. NSF RET and Inspire Awards
2. Building and expanding upon the concepts outlined by D. H. Johansen and others
3. Graphic developed by Dr. Laura Adolfie

The Pilot Courses

A general curriculum classroom course for UMD Students:
BioE 289A: Designing a Sustainable World

An online course for Active Duty and Veterans:
BioE 110: Designing Quantitative Solutions for Energy

Designing a Sustainable World[3]

Dr. Leigh Abts (Spring 2013 and 2014) and Dr. Idalis Villanueva (2013)

- **Philosophy of Energy 101[1]** - "Solid understanding of basic energy principles … develop critical thinking skills … making informed decisions about energy production, energy use, sustainable development and other issues."

- **Philosophy of a UMD I-course[2]** - "Spark the imagination, demand intellect, and inspire innovation … challenge students to wrestle with big questions … examine the ways that different disciplines address them."

Courtesy of Ms. Angela Kang, FR LTSC

1. http://www.eesi.org/energy101
2. http://www.gened.umd.edu/i-series/iseries.php
3. Course developed through funding provided by DOE and NSF SITE RET

Utilize the PLTW Innovation Portal™

InnovationPortal Beta

Identify a Problem. Go after a solution. Document your work. Connect with Opportunities.

Home | About | FAQ | Resources & Examples | News | Opportunities | Contact Us

The Innovation Portal enables

...students to create, maintain and share digital portfolios. The portfolios can be used to meet a class requirement or they can be used to submit the portfolio to a scholarship or open contest. The contest owners - or anyone else invited by the student - can evaluate a student's portfolio.

Register Now! or Sign In!

Portfolio Elements

Portfolio Home

- A Presentation and justification of the problem — Resources | EDPPSR
- B Documentation and analysis of prior solution attempts — Resources | EDPPSR
- C Presentation and justification of solution design requirements — Resources | EDPPSR
- D Design concept generation, analysis, and selection — Resources | EDPPSR
- E Application of STEM principles and practices — Resources | EDPPSR
- F Consideration of design viability — Resources | EDPPSR
- G Construction of a testable prototype — Resources | EDPPSR
- H Prototype testing and data collection plan

Steps to the Design Process

Courtesy Project Lead the Way

Online, Asynchronous Course for Active Duty and Veterans[1,2]

Designing Quantitative Solutions for Energy

UMD Faculty – Dr. Leigh Abts and Dr. Ian White

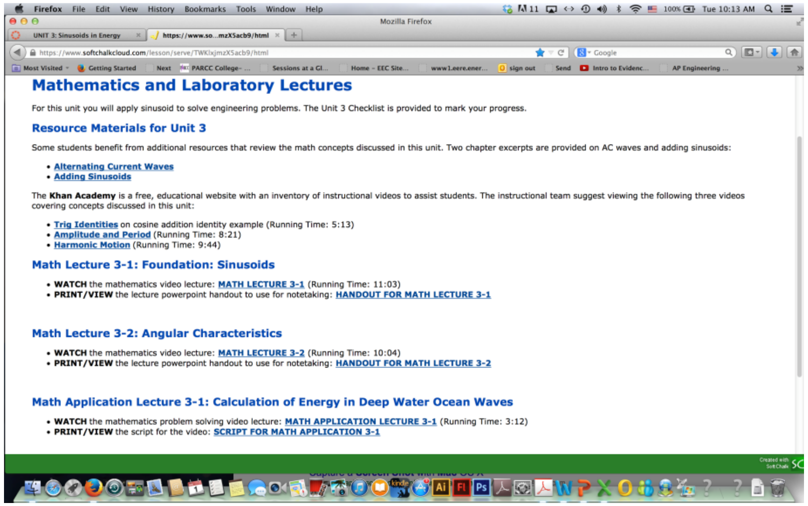
- **24 mathematics videos** (Dr. Danny Barnes)[3] based on the Wright State Engineering Math
- **4 virtual laboratory videos** (Ms. Emily Hauser and Ms. Gail Wyant)[4] filmed at Cecil Community College
- **12 energy-based application videos** (Ms. Toby Ratcliffe)[4] studio filmed
- **7 design videos** to guide student projects submitted to Innovation Portal (Dr. Leigh Abts)[4] studio filmed aligned to the PLTW Innovation Portal™
- **11 Career mentoring videos** (Center for Energy Workforce Development)[5]
- **4-credits from UMD[6]**

Authored:

SoftChalk™

Delivered:

CANVAS™ LMS



Mathematics and Laboratory Lectures

For this unit you will apply sinusoid to solve engineering problems. The Unit 3 Checklist is provided to mark your progress.

Resource Materials for Unit 3

Some students benefit from additional resources that review the math concepts discussed in this unit. Two chapter excerpts are provided on AC waves and adding sinusoids:

- Alternating Current Waves
- Adding Sinusoids

The **Khan Academy** is a free, educational website with an inventory of instructional videos to assist students. The instructional team suggest viewing the following three videos covering concepts discussed in this unit:

- Trig Identities on cosine addition identity example (Running Time: 5:13)
- Amplitude and Period (Running Time: 8:21)
- Harmonic Motion (Running Time: 9:44)

Math Lecture 3-1: Foundation: Sinusoids

- **WATCH** the mathematics video lecture: MATH LECTURE 3-1 (Running Time: 11:03)
- **PRINT/VIEW** the lecture powerpoint handout to use for notetaking: HANDOUT FOR MATH LECTURE 3-1

Math Lecture 3-2: Angular Characteristics

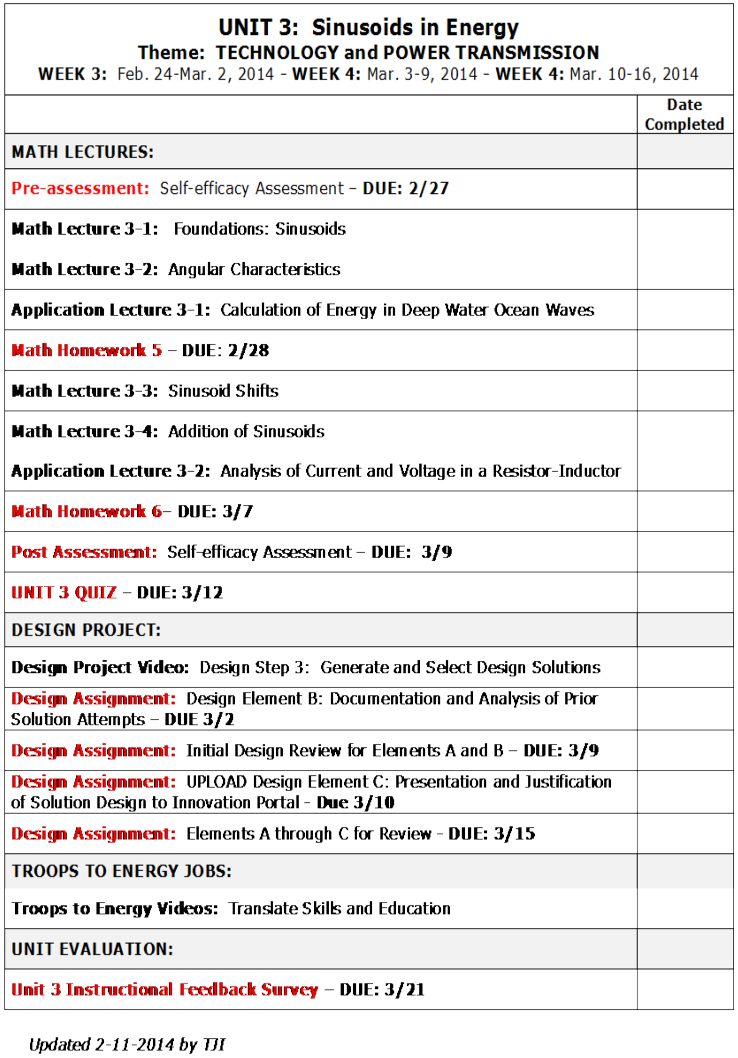
- **WATCH** the mathematics video lecture: MATH LECTURE 3-2 (Running Time: 10:04)
- **PRINT/VIEW** the lecture powerpoint handout to use for notetaking: HANDOUT FOR MATH LECTURE 3-2

Math Application Lecture 3-1: Calculation of Energy in Deep Water Ocean Waves

- **WATCH** the mathematics problem solving video lecture: MATH APPLICATION LECTURE 3-1 (Running Time: 3:12)
- **PRINT/VIEW** the script for the video: SCRIPT FOR MATH APPLICATION 3-1

1. Funded by Advanced Distributed Learning Initiative and National Science Foundation.
2. Building upon concepts originally proposed by Dr. Ian White and Dr. Jennifer Wolk derived from Dr. Nathan Klingbeil's Wright State Course.
3. Videos production by the UMD Seigel Learning Center.
4. Video production by Vanderpool Films.
5. Videos by the Center for Workforce Development.
6. Credits offered through the UMD Office of Extended Studies.

A Unit-level PSLED



UNIT 3: Sinusoids in Energy

Theme: TECHNOLOGY and POWER TRANSMISSION

WEEK 3: Feb. 24-Mar. 2, 2014 - **WEEK 4:** Mar. 3-9, 2014 - **WEEK 4:** Mar. 10-16, 2014

	Date Completed
MATH LECTURES:	
Pre-assessment: Self-efficacy Assessment – **DUE: 2/27**	
Math Lecture 3-1: Foundations: Sinusoids **Math Lecture 3-2:** Angular Characteristics	
Application Lecture 3-1: Calculation of Energy in Deep Water Ocean Waves	
Math Homework 5 – **DUE: 2/28**	
Math Lecture 3-3: Sinusoid Shifts	
Math Lecture 3-4: Addition of Sinusoids **Application Lecture 3-2:** Analysis of Current and Voltage in a Resistor-Inductor	
Math Homework 6– **DUE: 3/7**	
Post Assessment: Self-efficacy Assessment – **DUE: 3/9**	
UNIT 3 QUIZ – **DUE: 3/12**	
DESIGN PROJECT:	
Design Project Video: Design Step 3: Generate and Select Design Solutions	
Design Assignment: Design Element B: Documentation and Analysis of Prior Solution Attempts – **DUE 3/2**	
Design Assignment: Initial Design Review for Elements A and B – **DUE: 3/9**	
Design Assignment: UPLOAD Design Element C: Presentation and Justification of Solution Design to Innovation Portal - **Due 3/10**	
Design Assignment: Elements A through C for Review - **DUE: 3/15**	
TROOPS TO ENERGY JOBS:	
Troops to Energy Videos: Translate Skills and Education	
UNIT EVALUATION:	
Unit 3 Instructional Feedback Survey – **DUE: 3/21**	

Updated 2-11-2014 by TJI

Template developed by Ms. Tami Imbierowicz

UbD – UDL – ECD – SSCT Template Sample

Draft Unit 4: Stage 1 – Desired Results	
	d reasonable solutions to the problem.

Template Design and Content: Dr. Stephanie Moore, Dr. Rosemary Reshetar, Ms. Toby Ratcliffe, Ms. Emily Hauser, Ms. Gail Wyant, Dr. Laura Adolfie and Dr. Leigh Abts

?

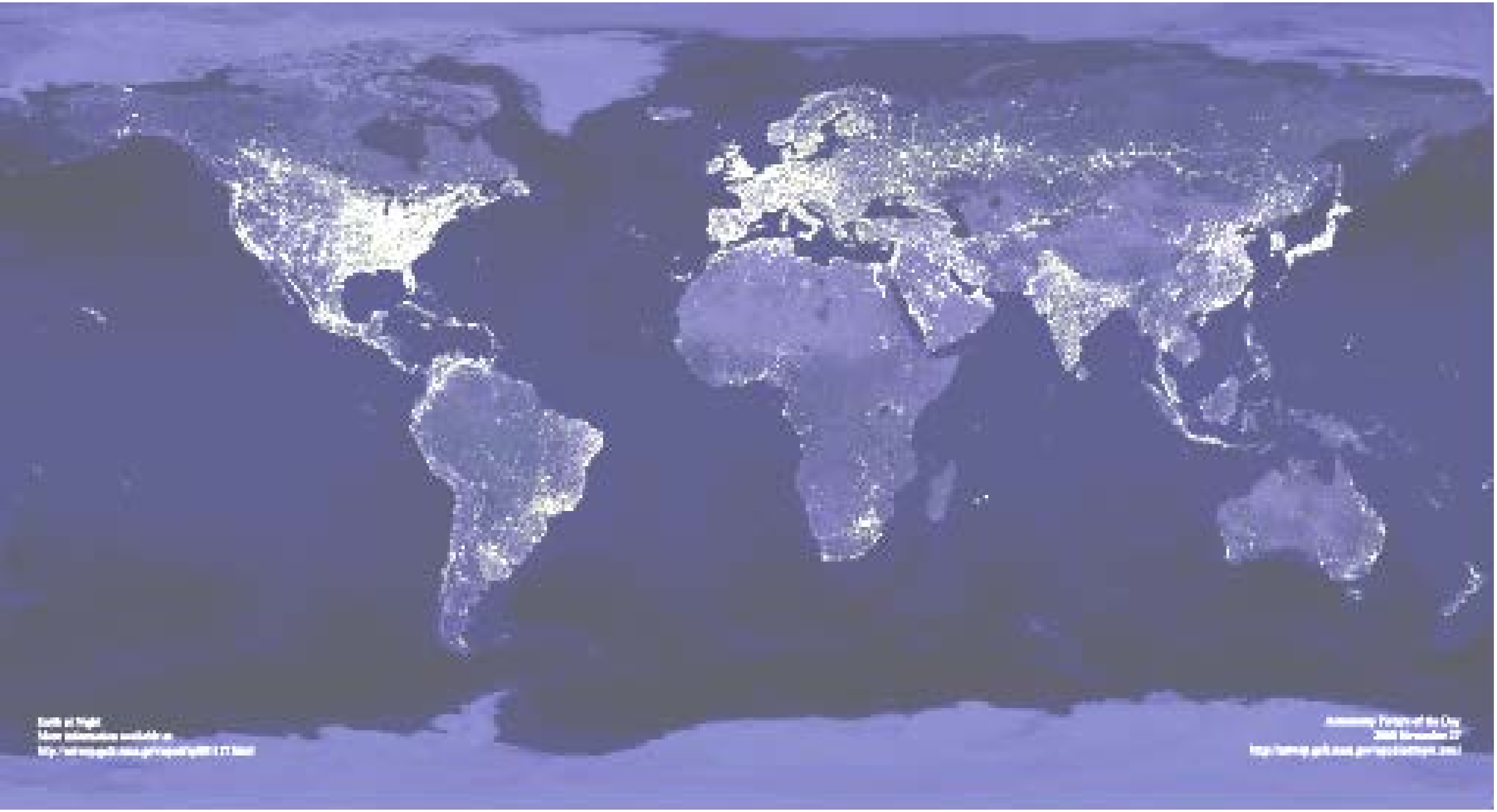
Course: http://ter.ps/bioe110
Contact: labts@umd.edu

Professor Daniel M. Kammen
Energy and Resources Group, University of California, Berkley

Director, Renewable and Appropriate Energy Laboratory

Prof. Kammen has taught Energy and Society for 15 years; the course is the combined undergraduate and graduate gateway course to interdisciplinary energy science, engineering, financial and policy studies at UC Berkeley. It has been a mOOC for over a decade at http://er100200.berkeley.edu

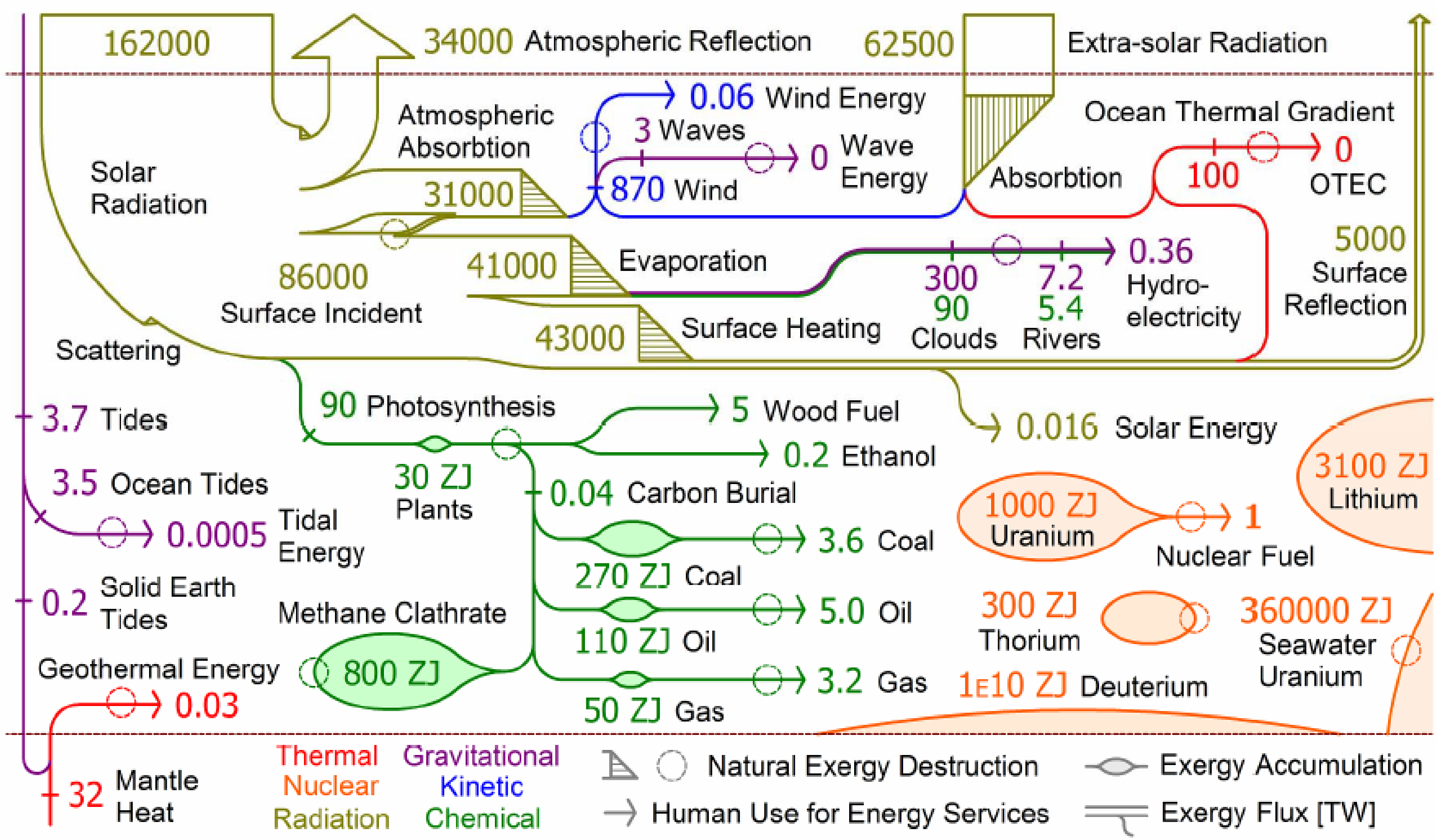
Energy and Society in two slides: *slide 1*



Scales of analysis

Energy Stocks & Flows for the Earth

Energy and Society in two slides: *slide 2*

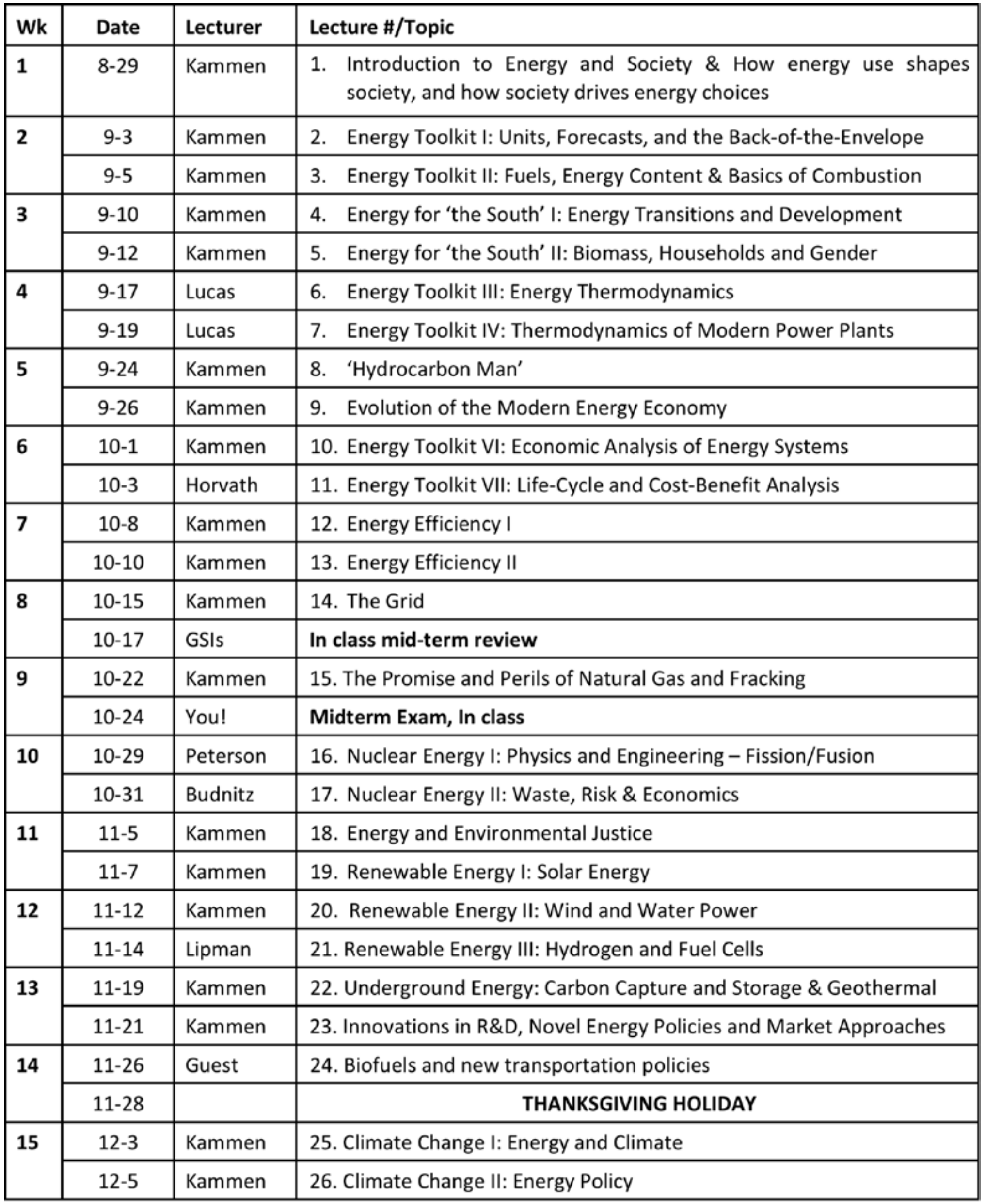


Current Global Exergy Usage Rate ~ 15 TW (0.5 ZJ per year)

86000/15 = 5733

(1 ZJ = 10^{21}J)

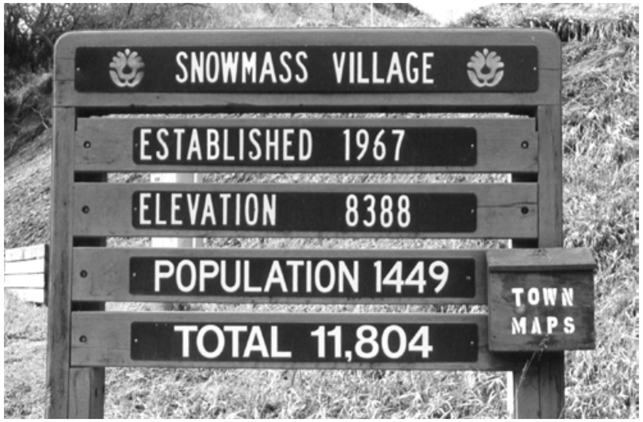
A mOOC (managed Online Open Course - http://er100200.berkeley.edu)



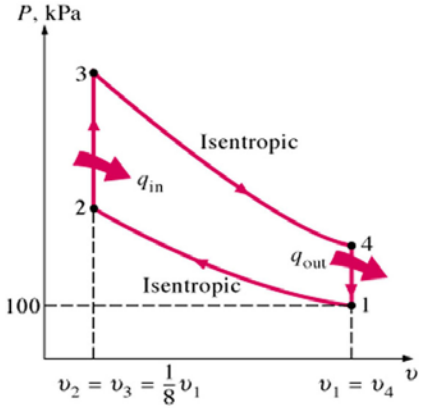
Wk	Date	Lecturer	Lecture #/Topic
1	8-29	Kammen	1. Introduction to Energy and Society & How energy use shapes society, and how society drives energy choices
2	9-3	Kammen	2. Energy Toolkit I: Units, Forecasts, and the Back-of-the-Envelope
	9-5	Kammen	3. Energy Toolkit II: Fuels, Energy Content & Basics of Combustion
3	9-10	Kammen	4. Energy for 'the South' I: Energy Transitions and Development
	9-12	Kammen	5. Energy for 'the South' II: Biomass, Households and Gender
4	9-17	Lucas	6. Energy Toolkit III: Energy Thermodynamics
	9-19	Lucas	7. Energy Toolkit IV: Thermodynamics of Modern Power Plants
5	9-24	Kammen	8. 'Hydrocarbon Man'
	9-26	Kammen	9. Evolution of the Modern Energy Economy
6	10-1	Kammen	10. Energy Toolkit VI: Economic Analysis of Energy Systems
	10-3	Horvath	11. Energy Toolkit VII: Life-Cycle and Cost-Benefit Analysis
7	10-8	Kammen	12. Energy Efficiency I
	10-10	Kammen	13. Energy Efficiency II
8	10-15	Kammen	14. The Grid
	10-17	GSIs	**In class mid-term review**
9	10-22	Kammen	15. The Promise and Perils of Natural Gas and Fracking
	10-24	You!	**Midterm Exam, In class**
10	10-29	Peterson	16. Nuclear Energy I: Physics and Engineering – Fission/Fusion
	10-31	Budnitz	17. Nuclear Energy II: Waste, Risk & Economics
11	11-5	Kammen	18. Energy and Environmental Justice
	11-7	Kammen	19. Renewable Energy I: Solar Energy
12	11-12	Kammen	20. Renewable Energy II: Wind and Water Power
	11-14	Lipman	21. Renewable Energy III: Hydrogen and Fuel Cells
13	11-19	Kammen	22. Underground Energy: Carbon Capture and Storage & Geothermal
	11-21	Kammen	23. Innovations in R&D, Novel Energy Policies and Market Approaches
14	11-26	Guest	24. Biofuels and new transportation policies
	11-28		**THANKSGIVING HOLIDAY**
15	12-3	Kammen	25. Climate Change I: Energy and Climate
	12-5	Kammen	26. Climate Change II: Energy Policy

Goal: build and use toolkits for energy studies

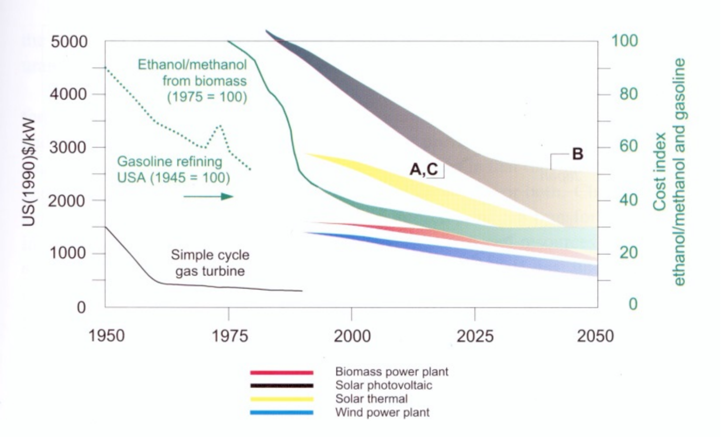
Analytic methods



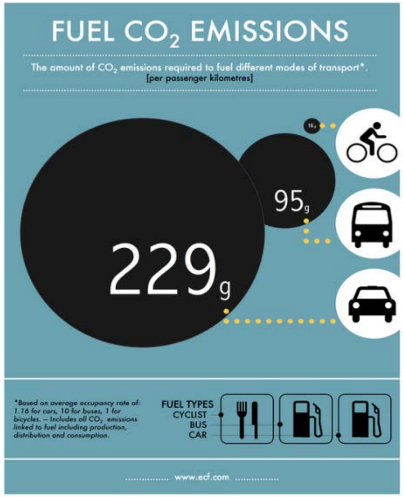
Systems methods



Forecasting methods



Life-cycle methods

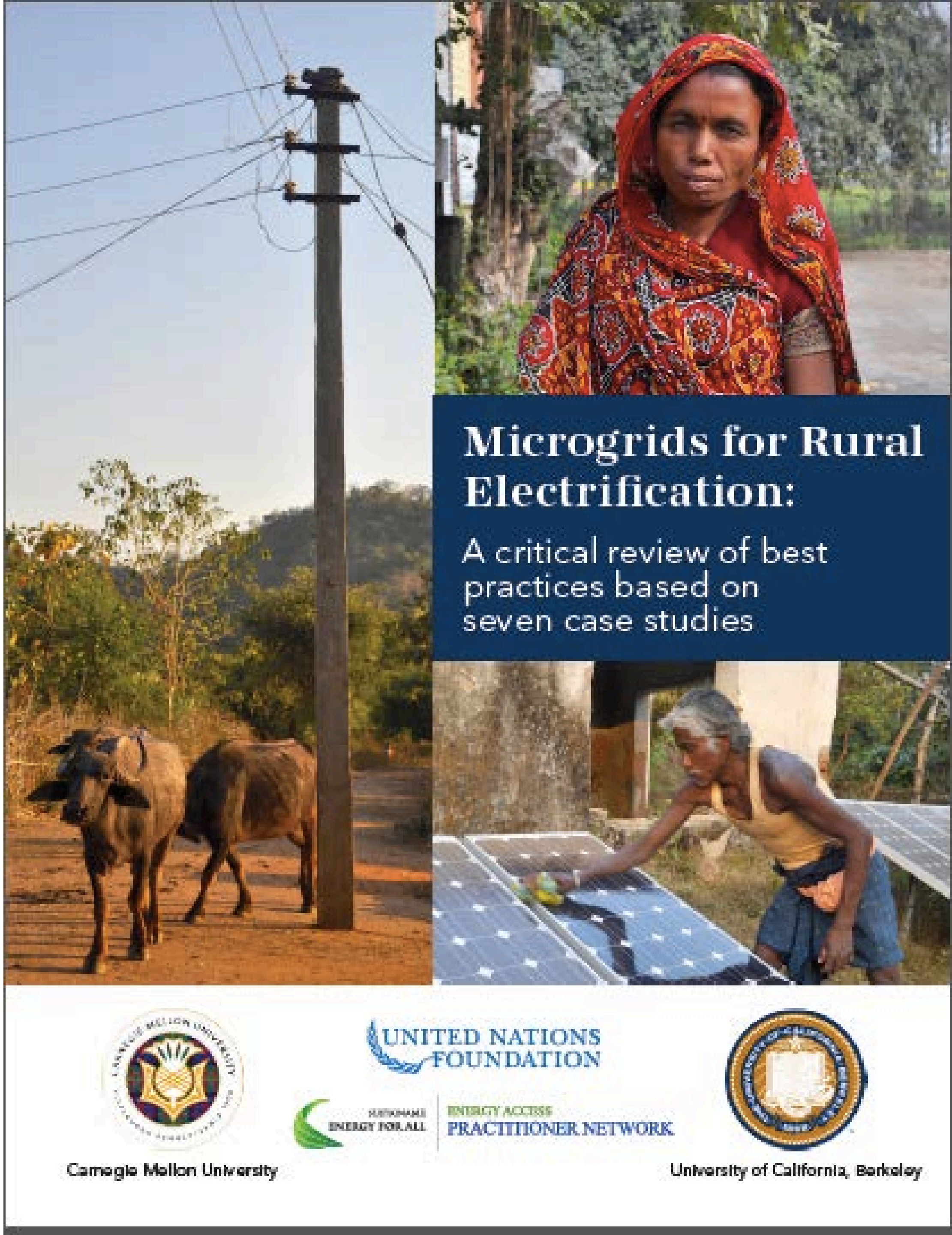


The amount of CO_2 emissions required to fuel different modes of transport*. [per passenger kilometres]

*Based on average occupancy rate of: 1.16 for cars, 10 for buses, 1 for bicycles. – Includes all CO_2 emissions linked to fuel including production, distribution and consumption.

Policy analysis and action methods

Access narratives of energy



Microgrids for Rural Electrification:

A critical review of best practices based on seven case studies

UNITED NATIONS FOUNDATION

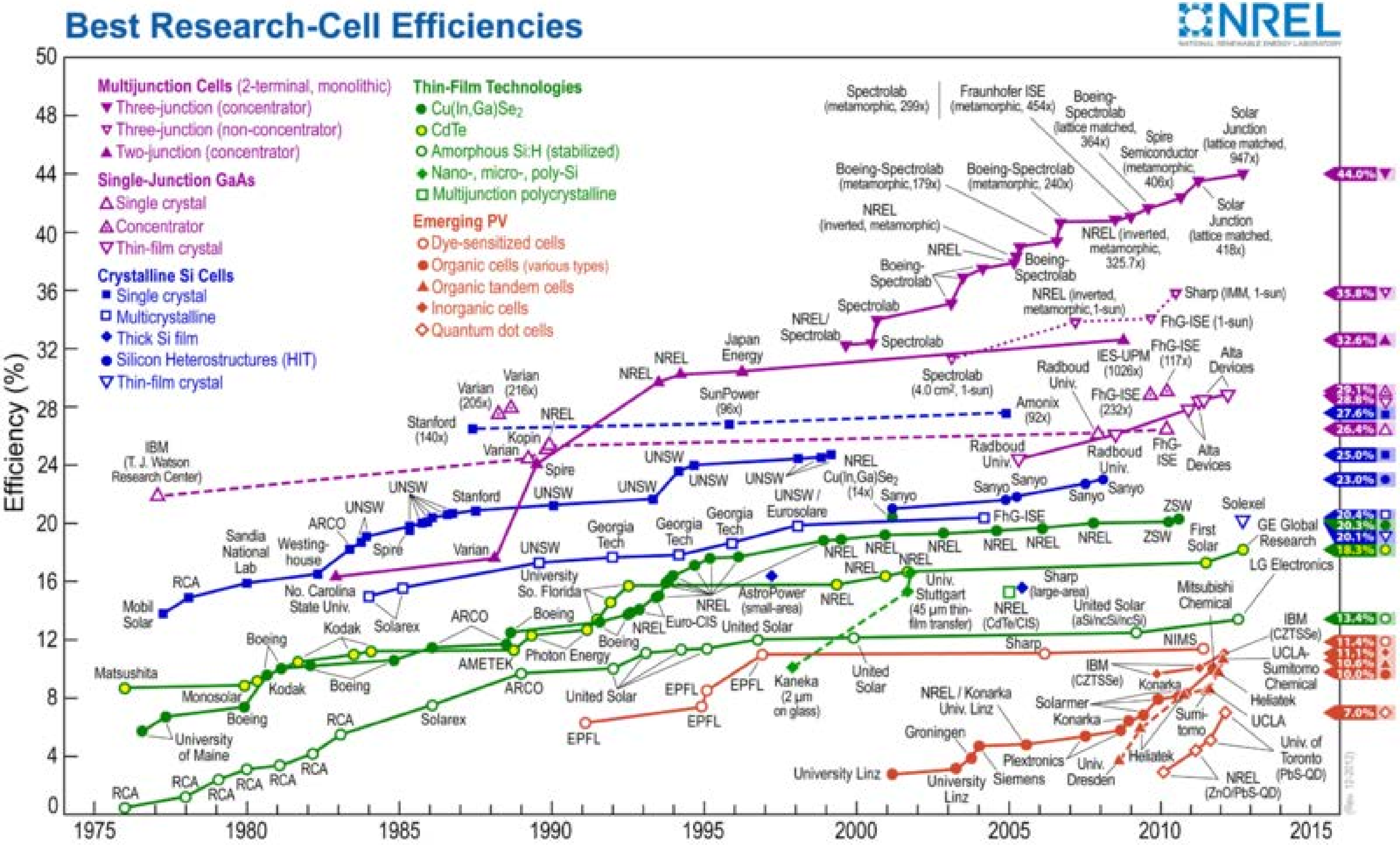
SUSTAINABLE ENERGY FOR ALL

ENERGY ACCESS PRACTITIONER NETWORK

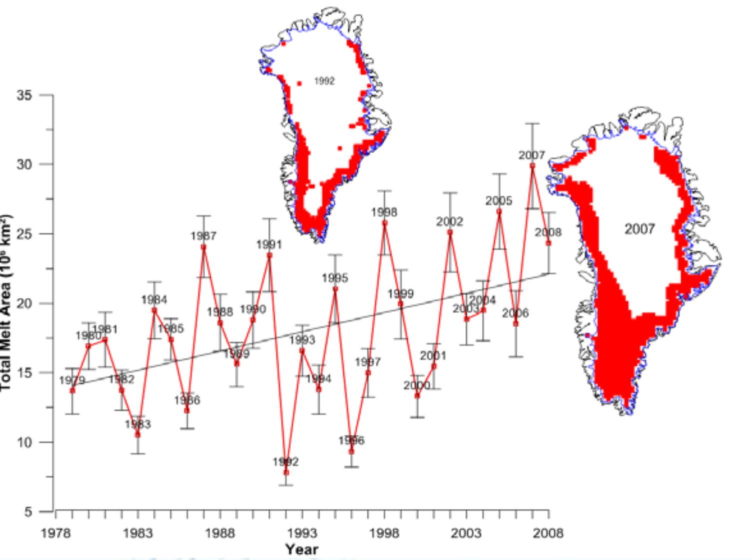
Carnegie Mellon University

University of California, Berkeley

Science and engineering narratives of energy

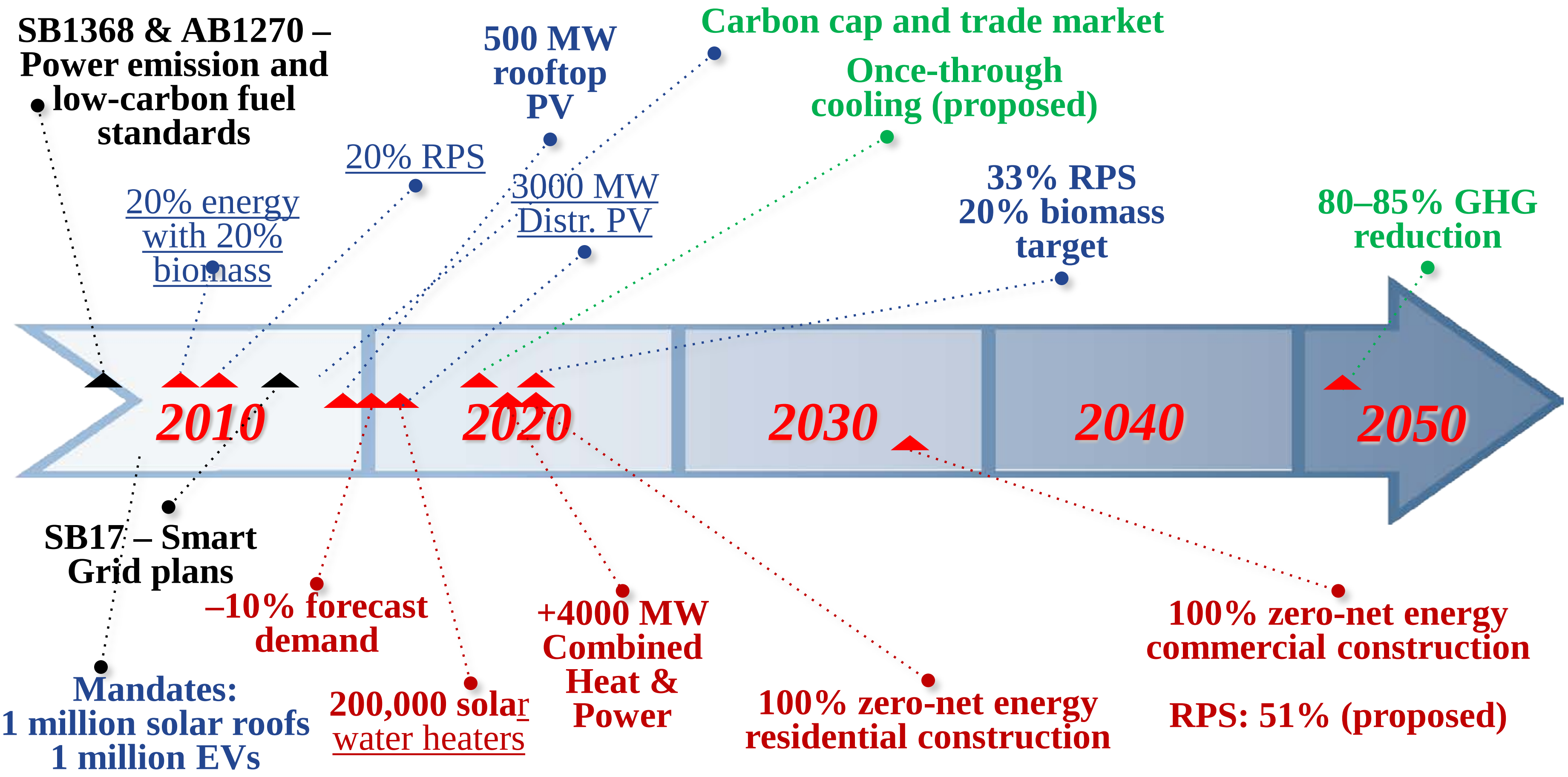


Climate narratives of energy



D Kammen: Svalbard, Norway

Policy narratives of energy



SB1368 & AB1270 – Power emission and low-carbon fuel standards

20% energy with 20% biomass

20% RPS

500 MW rooftop PV

3000 MW Distr. PV

Carbon cap and trade market

Once-through cooling (proposed)

33% RPS 20% biomass target

80–85% GHG reduction

SB17 – Smart Grid plans

Mandates:
1 million solar roofs
1 million EVs

–10% forecast demand

200,000 solar water heaters

+4000 MW Combined Heat & Power

100% zero-net energy residential construction

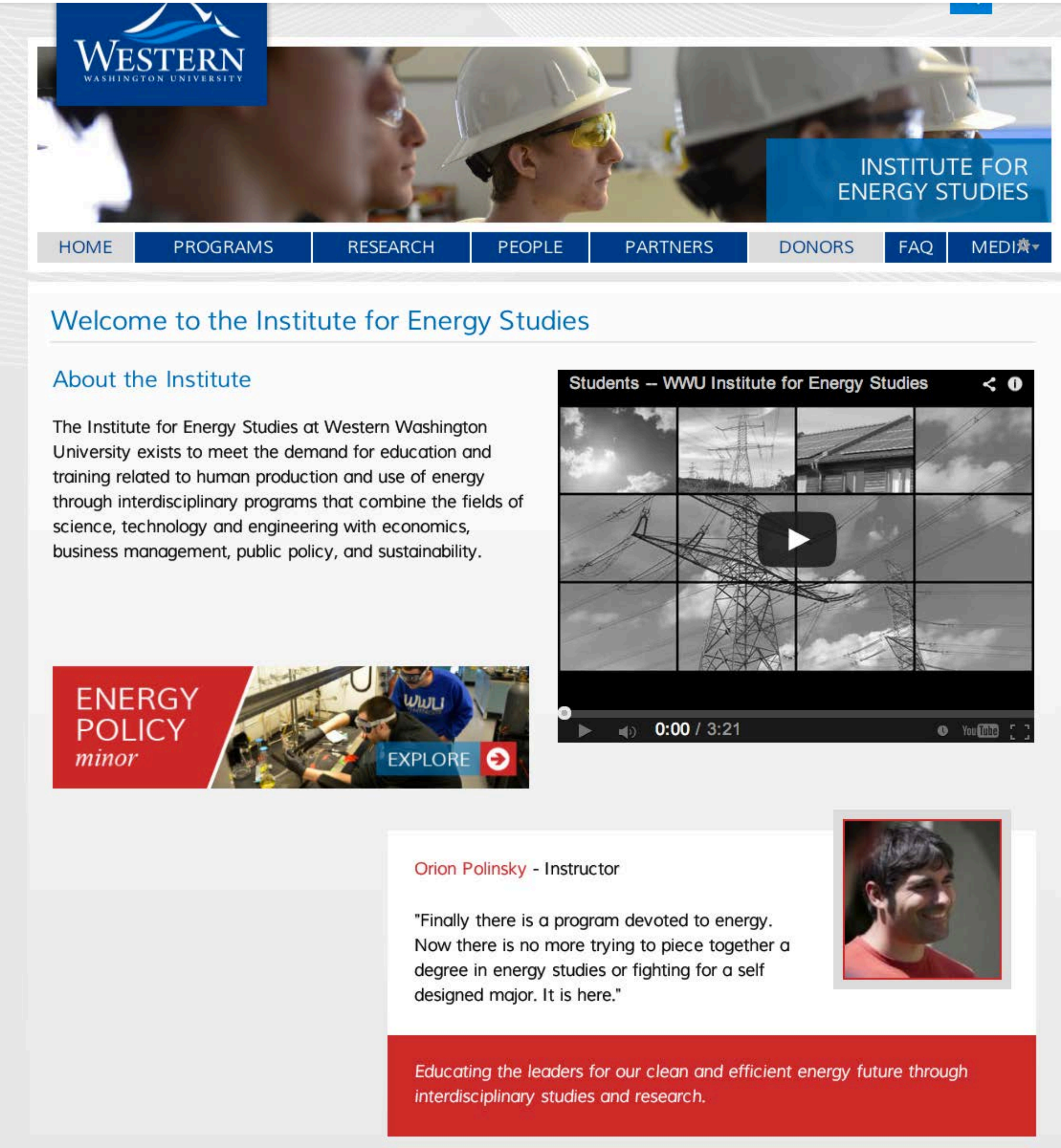
100% zero-net energy commercial construction

RPS: 51% (proposed)

Pipeline of innovations: scientific, technical, market, managerial and environmental

Professor Andy Bunn
Associate Professor, Western Washington University
Director, Institute for Energy Studies, Western Washington University

Andy Bunn is the director of the institute for energy studies at Western Washington University. The institute is a cross-college venture designed to meet the demand for education and training related to human production and use of energy through interdisciplinary programs that combine science, technology and engineering with economics, business management, public policy, and sustainability



Welcome to the Institute for Energy Studies

About the Institute

The Institute for Energy Studies at Western Washington University exists to meet the demand for education and training related to human production and use of energy through interdisciplinary programs that combine the fields of science, technology and engineering with economics, business management, public policy, and sustainability.

Orion Polinsky - Instructor

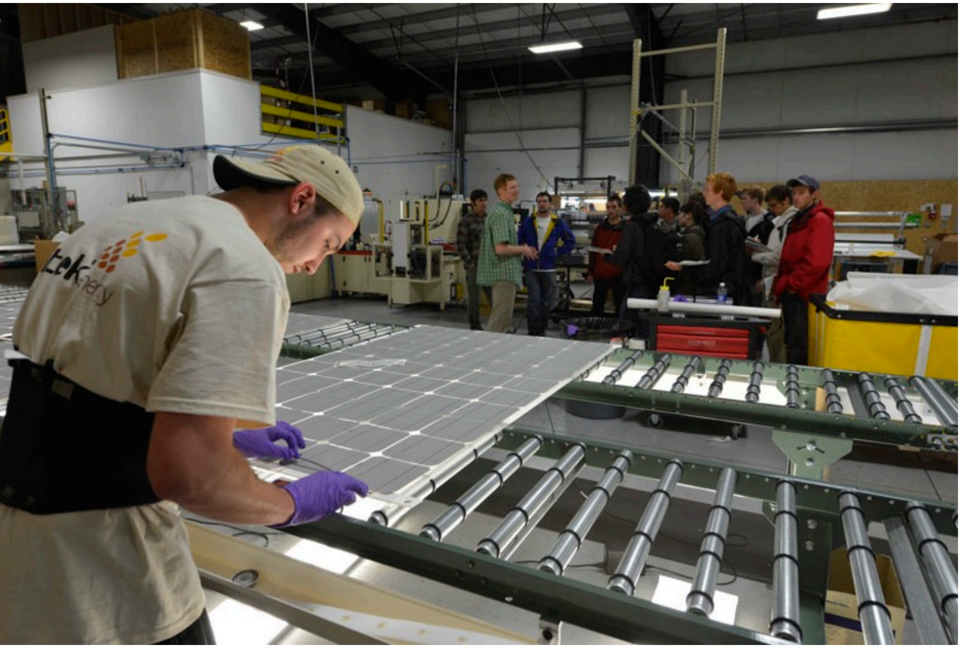
"Finally there is a program devoted to energy. Now there is no more trying to piece together a degree in energy studies or fighting for a self designed major. It is here."

Educating the leaders for our clean and efficient energy future through interdisciplinary studies and research.

https://energy.wwu.edu/

Lessons learned while teaching energy without a license

- Getting into the field
- Local issues
- History
- Units
- Thermodynamics
- Working with data



Property of Museum of History & Industry, Seattle

Locomotive hauling coal from Lake Union, Seattle, ca. 1871

Units

- Units are like language
- The beauty of units are hard to describe to nonscientists

$$\frac{3.25in}{hr}\times\frac{ft}{12in}\times\frac{m}{3.28ft}\times\frac{10^3mm}{m}\times\frac{hr}{60\min}=\frac{1.37mm}{\min}$$

Units

- The units are ugly – just the way it is
  - Tons of oil equivalent, terawatt-hours, Quads
  - Horsepower?!?! (550 foot pounds per second)
- We typically use kilowatt hours (kWh)
  - Unit on our electric bill, costs less than dime
  - A 40 W bulb left on all day, or the work a servant can do
  - US: ~239kWh per person per day

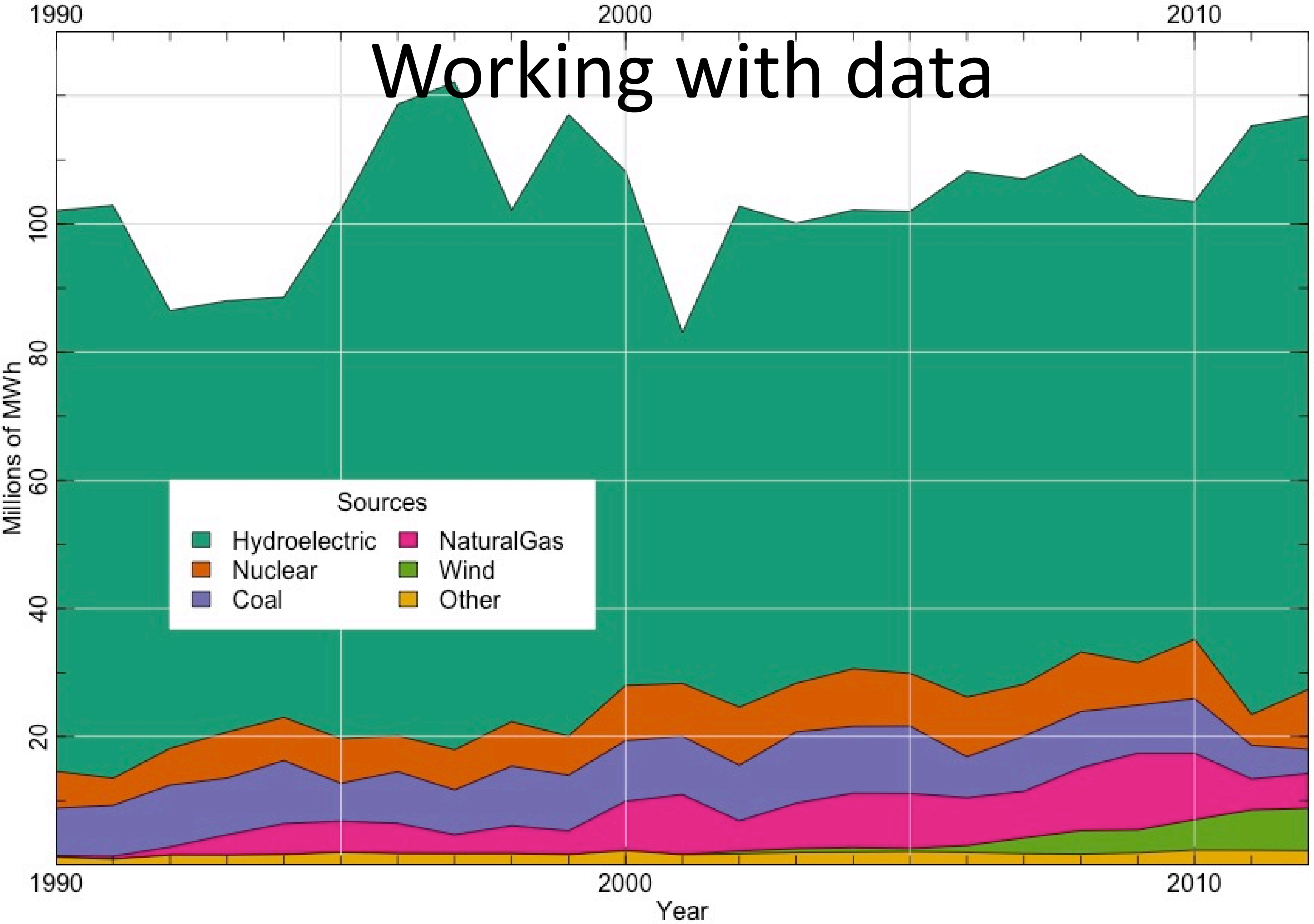
$$\frac{97.3\ Quad}{year} \times \frac{10^{15} Btu}{Quad} \times \frac{10^{3} J}{Btu} \times \frac{kWh}{3.6 \times 10^{6} J} \times \frac{year}{365\ day} \times \frac{1}{3.1 \times 10^{8} ppl} = \frac{239\ kWh}{person\ day}$$

Thermodynamics

- Class discussion about first and second laws
  - Where did the energy go when I biked up the hill to campus today?
  - What's the difference between energy conservation in physics and in policy?

  - Give an example of the second law in your every day life
  - Does evolution disprove the second law?

Working with data



Electric Power Industry Generation by Primary Energy Source, 1990-2012, Washington
http://www.eia.gov/electricity/state/washington/

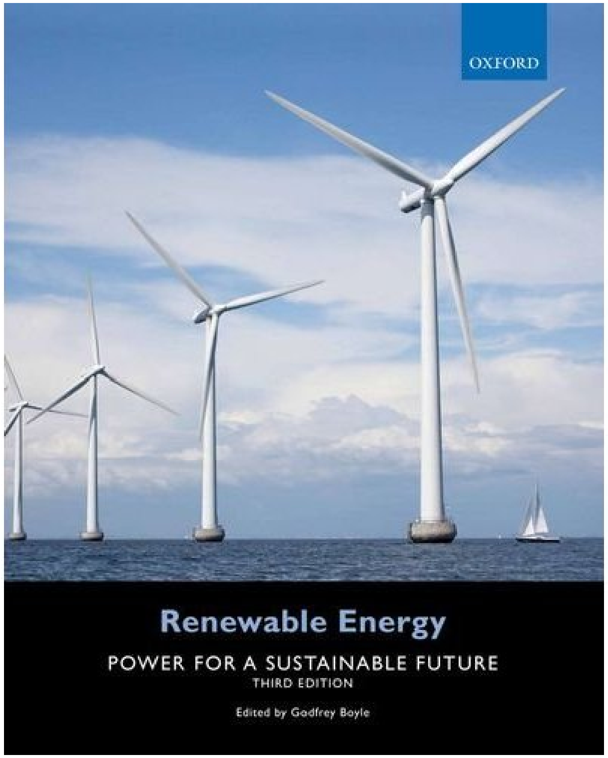
Professor Douglas J. Reinemann, University of Wisconsin-Madison; Department Chair, Biological Systems Engineering

Renewable Energy Systems

University of Wisconsin – Madison
Biological Systems Engineering 367
Cross Listed with the
Nelson Institute for Environmental Studies

Texts and Web Resources

- RETScreen International
  - – Design Software
  - – E-textbook
- Required text
  - Renewable Energy for a Sustainabl Future 3rd Edition
  - Godfrey Boyle
  - Pre-order for 1 Nov release



Design Projects

- Renewable Energy System (RES) design projects
- We recommend you use RETscreen to do the analysis
- Making a pitch to ‘sell’ this RES project to:
  - A Company or group of Investors
  - A Homeowner (Your Uncle Vince)
  - A Governmental or Non-Profit organization

Each technology module

- Overview of the state of the art and application
- Review of collection, processing and conversion systems
- Engineering calculations of energy and power
- Special issues relating to limitations, scale, economics and policy
- Overview of environmental impact/implications

Professor Ken Klemow, Wilkes University; Associate Director, Institute for Energy and Environmental Research

Ken Klemow has served on the Wilkes University faculty for over thirty years, where he teaches courses in botany, ecology, and energy. His research focuses on restoration of lands and waters damaged by anthracite coal mining in northeastern Pennsylvania. For the past four years, Ken has led Wilkes's Energy Institute, where he is a PI for a DOE contract involving assessing Marcellus Shale impacts on surface waters. Ken has also been active with the Ecological Society of America's education initiatives for over 20 years, and will lead several sessions exploring the interface between ecology, energy, and education at their annual meeting later this summer.

Wilkes University “Energy in Our World” BIO / EES 105

Kenneth M. Klemow, Ph.D.
Professor of Biology and Environmental Science
Associate Director, Institute for Energy and Environmental Research

WILKES UNIVERSITY

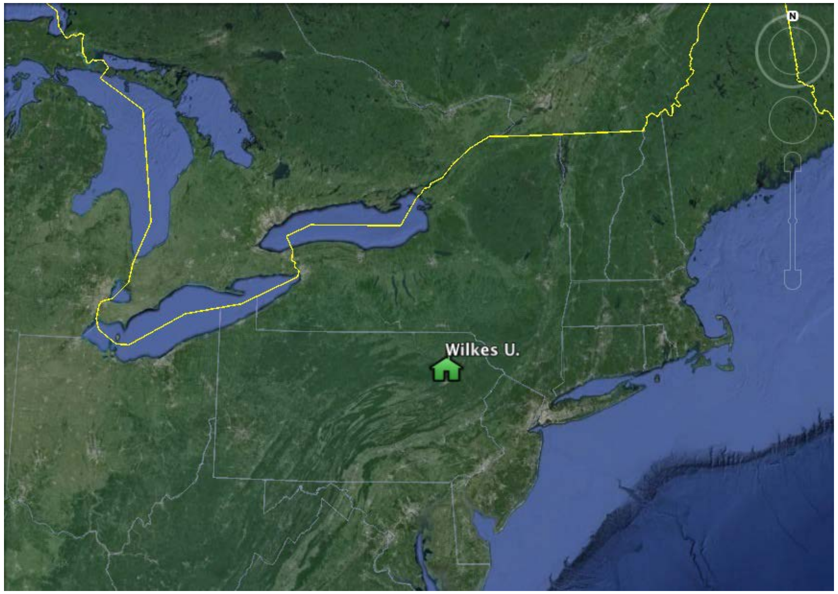
THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

Purposes of Course

- Provide a broad overview of energy topics for Wilkes students
    - Energy-related concepts discussed within >20 courses at Wilkes, but no single course focuses on energy
- Gateway to interdisciplinary energy minor under development

About Wilkes

- “Small”, private, non-sectarian, comprehensive university in northeastern PA.
    - Liberal arts tradition
    - 2,100 undergrads
    - Popular majors include biology, engineering, business, psychology, education, communications
    - Most students from PA, NY, NJ



WILKES UNIVERSITY

THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

Local energy issues

http://www.marcellus-shale.us

http://www.communitywalk.com

http://pashto.wunderground.com

Course information

- Fall 2013
- 40 enrolled, 34 finished
- Mostly non-majors
  - Students took class as “Science” Elective
- Class level:
  - Mostly sophomores and juniors
- Course website:
  - http://klemow.wilkes.edu/BIO-EES-105.html
- Meetings: Weekly, 3-hour lectures

WILKES UNIVERSITY

THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

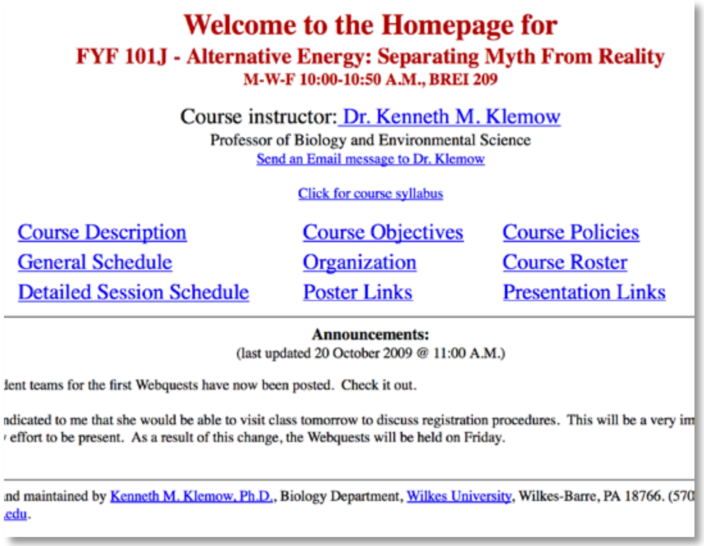
Course instructor

- Kenneth M. Klemow, Ph.D.
  - Plant ecologist
    - Policy, communicating science
  - Wilkes faculty since 1982
  - Energy credentials
    - Restoration of ecosystems damaged by anthracite mining
    - Consults on windfarm projects
    - Twice taught courses on Alternative Energy
    - Leads Wilkes Energy Institute
      - PI of $880K contract with DOE

WILKES UNIVERSITY

THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

Course influences



Welcome to the Homepage for

FYF 101J - Alternative Energy: Separating Myth From Reality

M-W-F 10:00-10:50 A.M., BREI 209

Course instructor: Dr. Kenneth M. Klemow

Professor of Biology and Environmental Science

Send an Email message to Dr. Klemow

Click for course syllabus

Course Description	Course Objectives	Course Policies
General Schedule	Organization	Course Roster
Detailed Session Schedule	Poster Links	Presentation Links

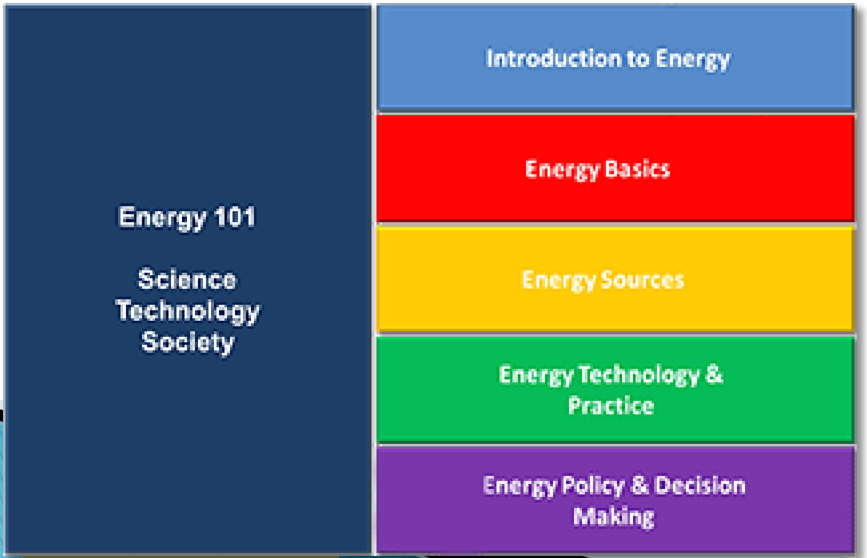
Announcements:

(last updated 20 October 2009 @ 11:00 A.M.)

ent teams for the first Webquests have now been posted. Check it out.

ndicated to me that she would be able to visit class tomorrow to discuss registration procedures. This will be a very i
effort to be present. As a result of this change, the Webquests will be held on Friday.

nd maintained by Kenneth M. Klemow, Ph.D., Biology Department, Wilkes University, Wilkes-Barre, PA 18766. (57
edu.



Energy 101

Science
Technology
Society

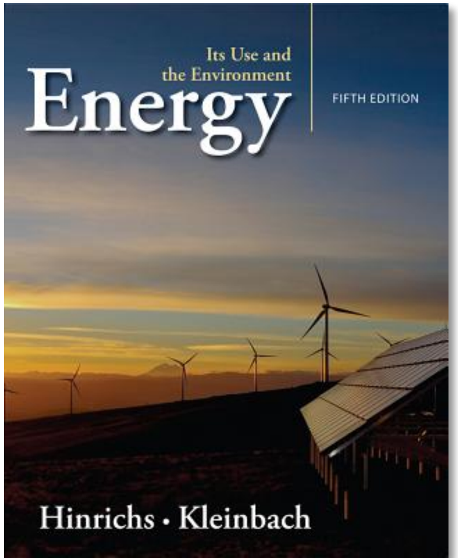
Introduction to Energy

Energy Basics

Energy Sources

Energy Technology & Practice

Energy Policy & Decision Making



WILKES
UNIVERSITY

Main features of course

- Sessions 1 – 4: Intro, physical and biological basis for energy
- Session 5: Webquests
- Sessions 6-13: Presentations on energy types:
  - Cluster 1: coal, petroleum, Hubbert curve, natural gas, nuclear,
  - Cluster 2: hydropower, solar, geothermal, wind, hydrogen, biomass/biodiesel, ethanol
  - Faculty overview, then student teams
- Session 14: Guest lecture on Smart Grid

Philosophy

- Consider holistically
  - All energy types
  - Supply, demand, technological, environmental, social, economic
- Try to not advocate one option over another
- Climate change as a scientific consensus

Student presentations

- Students organized into teams of 3–4, ensuring diversity of majors and academic achievement
- Each team focused on one energy type
  - Based on WebQuest
    - Prompting questions
    - Posted websites
  - Each presentation lasted 20 minutes

Other student assessments

- Exams (students permitted "cheat sheet")
  - Gave one retest on problem set
- Beginning and ending surveys
- Website-evaluation rubric

WILKES UNIVERSITY

THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

Findings:

- Students diverse in aptitude, attitude
- Math phobia was a big issue, especially at beginning.
  - 1/3 class struggled but mastered expected concepts
  - 1/3 of class struggled and largely gave up.
  - 1/3 of class had no problem; often resented students with math issues
- Weekly meeting time prevented continuity.
- Students desired more hands-on experience.
- Evaluations positive, but diverse (ranged from “I want to take energy minor” to “worst course ever”).
- Many found textbook overwhelming.

Lessons learned…

- Will retain
    - Webquests / student presentations
    - Diverse perspective (all energy forms, multiple aspects)
- Will change
    - Adopt three one-hour meetings per week for continuity
    - More guest speakers
    - More hands on / demonstrations
    - Try even harder to explain quantitative concepts
    - Perhaps adopt another text

Contact information:

Ken Klemow

Biology Department, Wilkes University

Wilkes-Barre, PA 18766

Kenneth.klemow@wilkes.edu

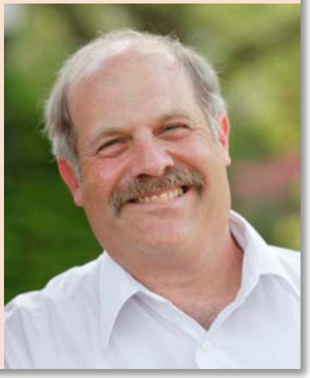
570-408-4758

Facebook: DrKlemow

Websites:

Klemow.wilkes.edu

Energy.wilkes.edu



WILKES UNIVERSITY

THE INSTITUTE FOR ENERGY & ENVIRONMENTAL RESEARCH FOR NORTHEASTERN PENNSYLVANIA

3. Online Discussion Forum

#Energy101

Topics for Discussion

How do we promote Energy Education in
the Nation's Colleges and Universities?

- Recommended Course Content (textbooks, multimedia, simulations)
- Best practices in communicating complicated energy concepts
- Useful interdisciplinary examples
- Digital resources and Digital tagging of resources

4. Energy Education Resources

#Energy101

Resources- Speakers

Professor Justin Hougham – **Northwest Advanced Renewables Alliance** - Assistant Professor, University of Wisconsin-Extension; Director, Upham Woods Outdoor Learning Centers

Todd Cohen **SEED Center** - American Association of Community Colleges; Director, Sustainability Education and Economic Development Centers

Dr. David Blockstein **National Energy Education Summit** - National Council for Science and the Environment; Senior Scientist and Director of Education

Professor Justin Hougham
Assistant Professor, University of Wisconsin-Extension; Director, Upham Woods Outdoor Learning Centers

NARA

Education at the Speed of Research: Integrating Research and Education

R. Justin Hougham
NARA Education and Outreach
Assistant Professor, University of Wisconsin-Extension
justin@nararenewables

Sustainable BioJet
Valuable Lignin Co-Products
Rural Economic Development
Supply Chain Coalitions
Energy Literacy

NATIONAL MODEL

NARA

Northwest Advanced Renewables Alliance

SUPPLY CHAIN

FRP

FOREST RESIDUES PREPARATION

Primary feedstock targets include forest residues from logging and thinning operations. We are also considering mill residues and discarded woody material from construction and demolition, in regions where these materials are under utilized.

T

TRANSPORTATION

Feedstocks are transported from the collection site to a conversion facility. Chipping can take place at the loading or in a preprocessing facility.

PT

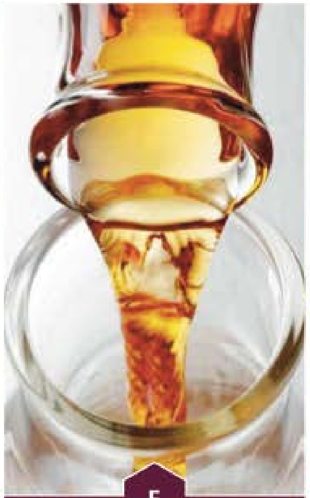
PRE-TREATMENT

Wood chips are treated to make the sugar polymers (polysaccharides) accessible to degrading enzymes. These processes allow the lignin to be available for separation.

EH

ENZYMATIC HYDROLYSIS

Specific enzymes are added to hydrolyze (cleave) the polysaccharides and generate simple sugars (monosaccharides).



F

FERMENTATION

Specialized yeast convert the monosaccharides into isobutanol.

BCP

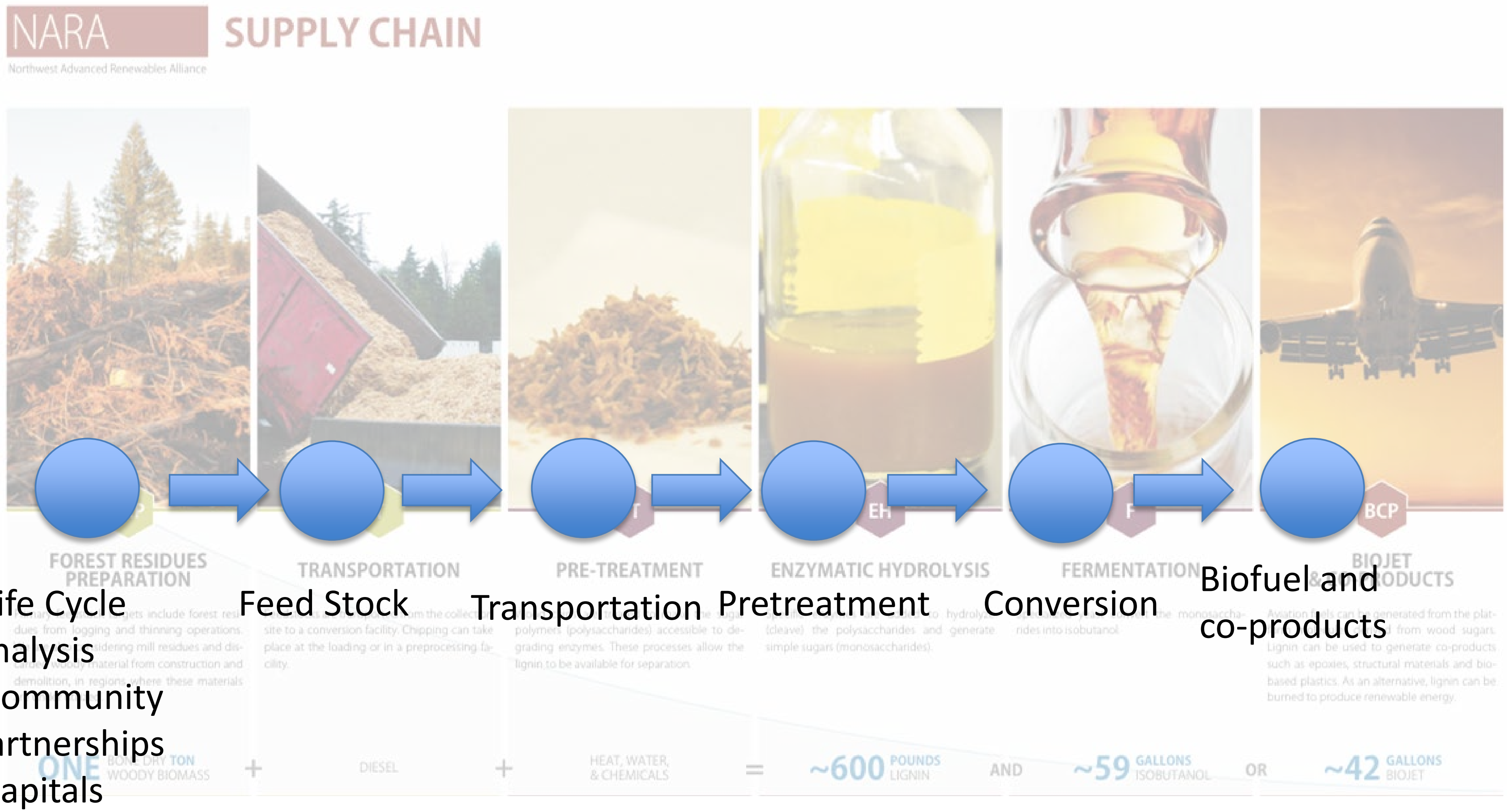
BIOJET & CO-PRODUCTS

Aviation fuels can be generated from the platform molecules derived from wood sugars. Lignin can be used to generate co-products such as epoxies, structural materials and bio-based plastics. As an alternative, lignin can be burned to produce renewable energy.

ONE BONE DRY **TON** WOODY BIOMASS + DIESEL + HEAT, WATER, & CHEMICALS = **~600** **POUNDS** LIGNIN **AND** **~59** **GALLONS** ISOBUTANOL **OR** **~42** **GALLONS** BIOJET

NARA

Flow for Education and Outreach of NARA research



-Life Cycle Analysis
-Community Partnerships
-Capitals Framework

Feed Stock

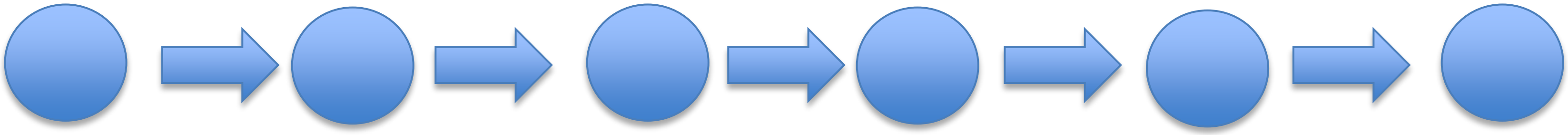
Transportation

Pretreatment

Conversion

Biofuel and co-products

Flow for Education and Outreach of NARA research



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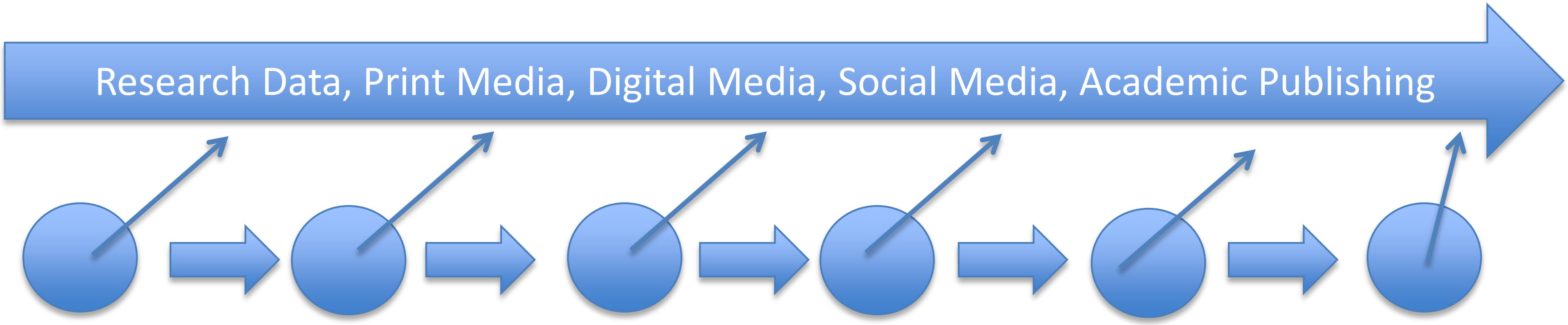

Research Data, Print Media, Digital Media, Social Media, Academic Publishing

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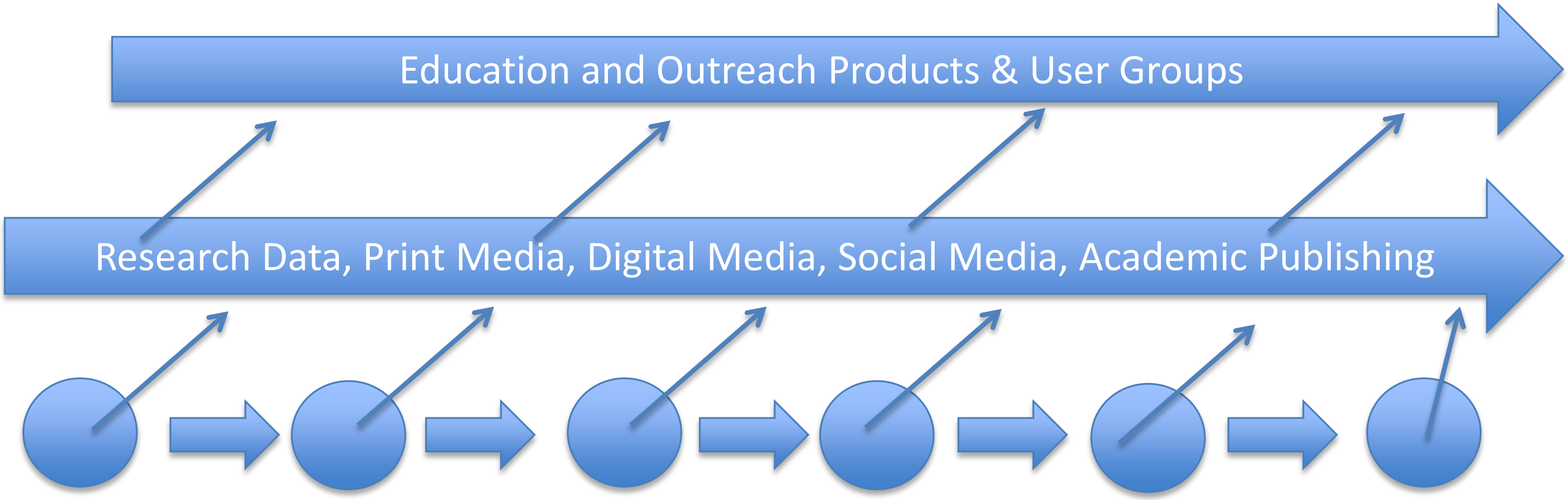

Education and Outreach Products & User Groups

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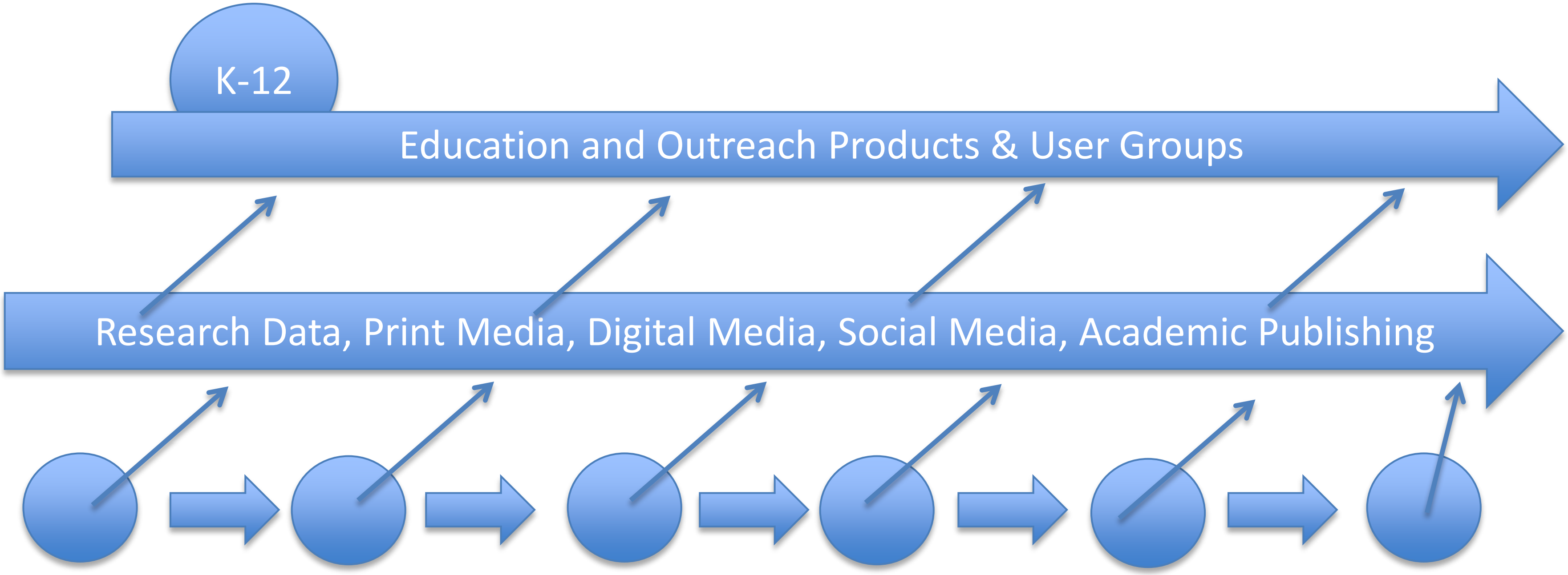

K-12

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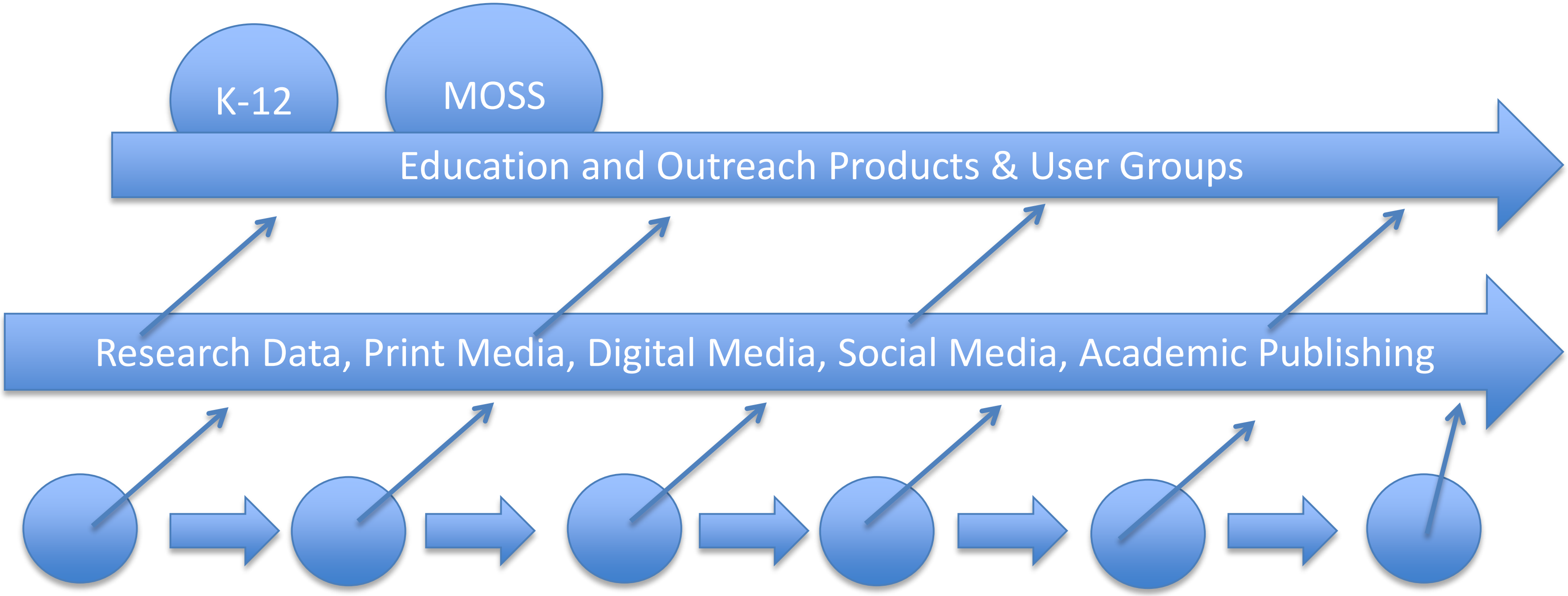

K-12

MOSS

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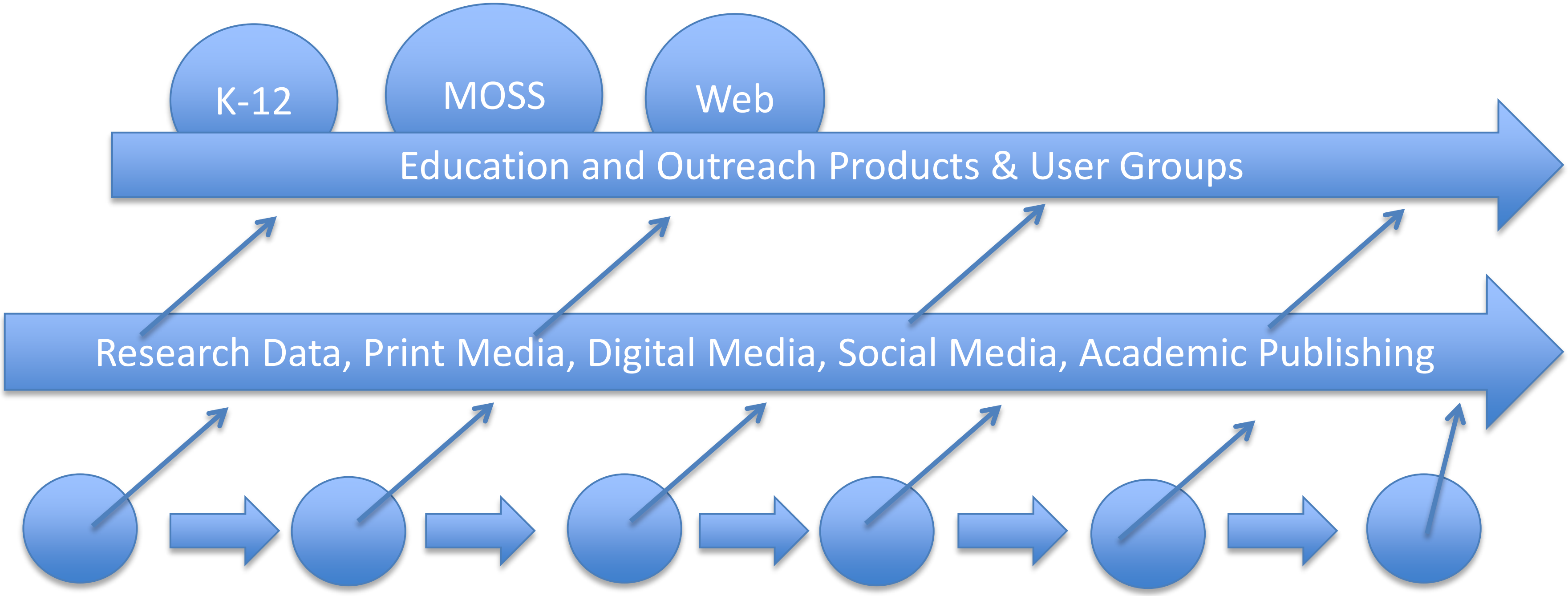

K-12

MOSS

Web

Education and Outreach Products & User Groups

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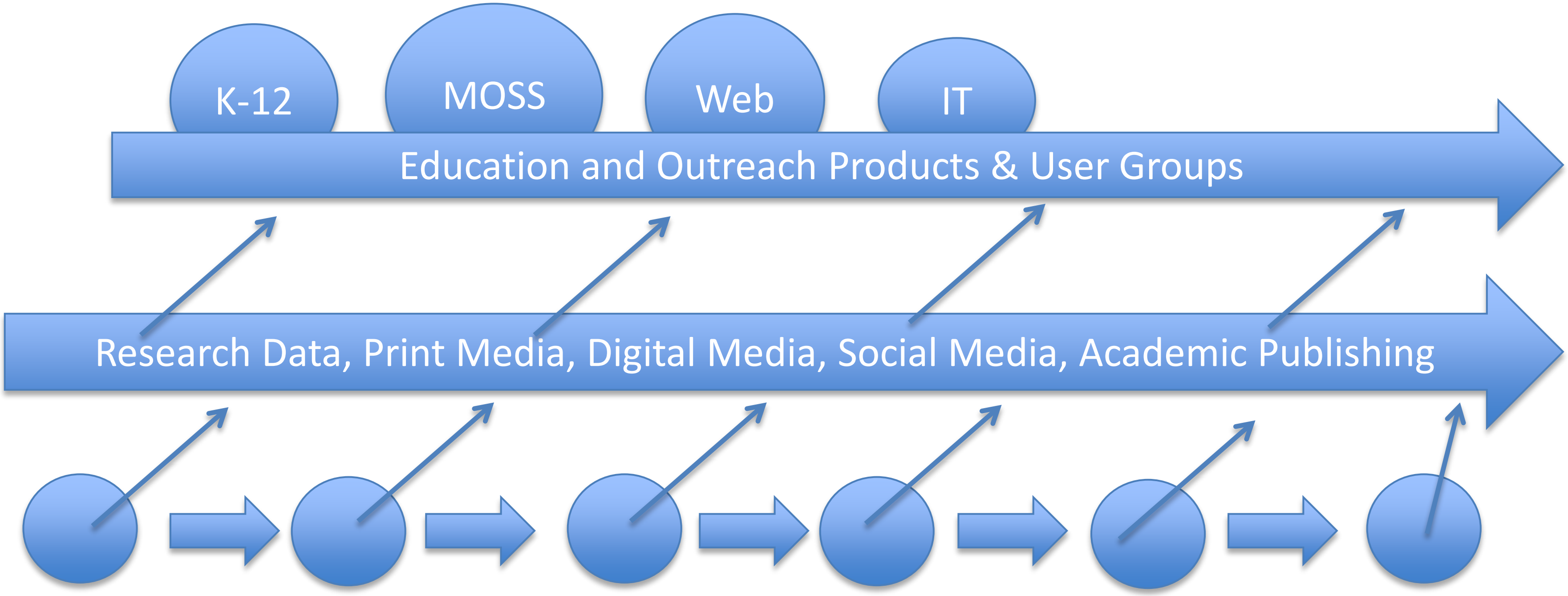

K-12

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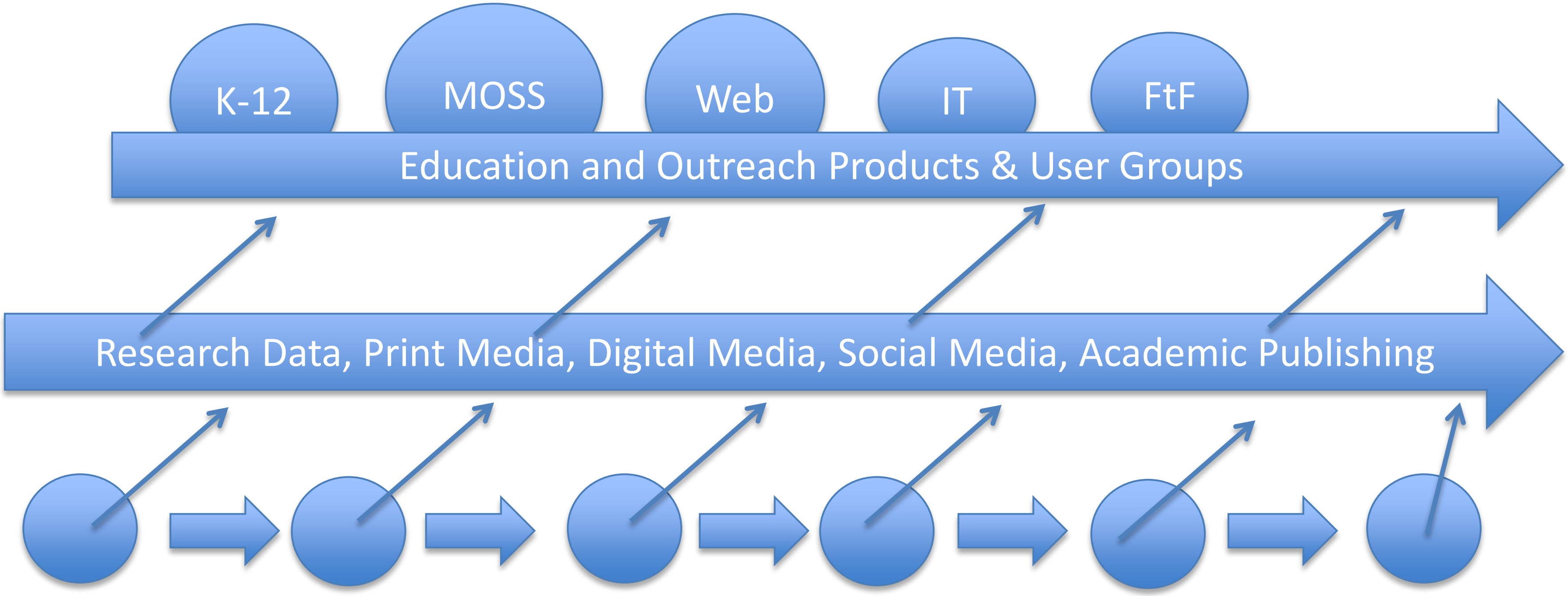

K-12

MOSS

Web

IT

FtF

Education and Outreach Products & User Groups

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Transportation

Pretreatment

Conversion

Biofuel and co-products

NARA

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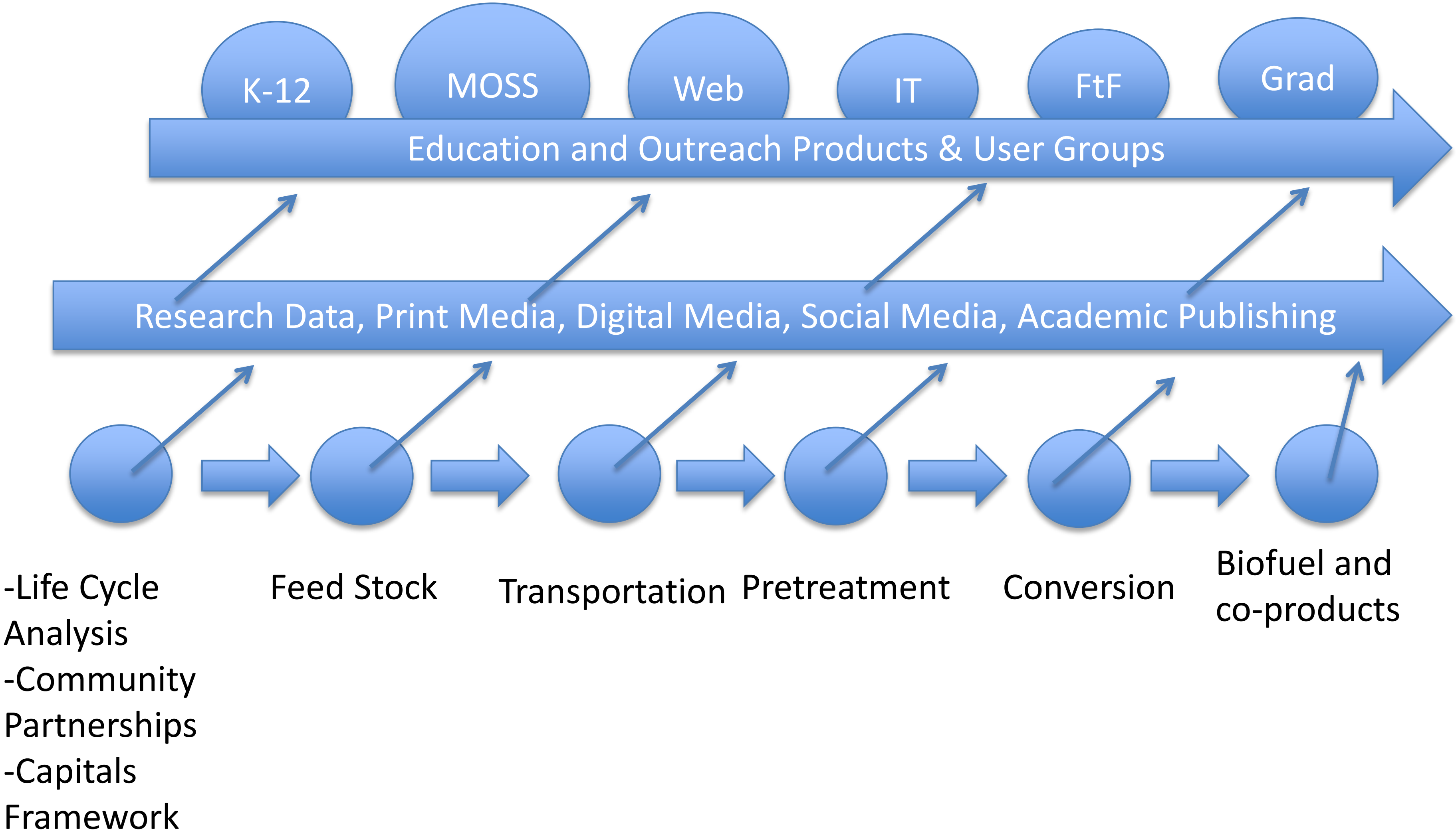


K-12

MOSS

Web

IT

FtF

Grad

Education and Outreach Products & User Groups

Research Data, Print Media, Digital Media, Social Media, Academic Publishing

-Life Cycle Analysis
-Community Partnerships
-Capitals Framework

Feed Stock

Transportation

Pretreatment

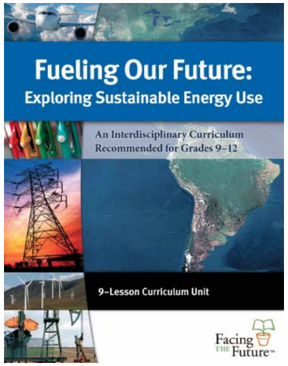
Conversion

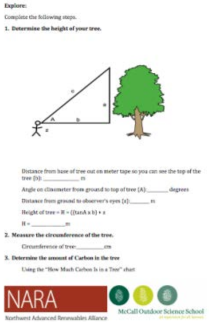
Biofuel and co-products

Impact

Energy Literacy

- Curriculum
- Media
- Assessment





Explore:

Complete the following steps.

1. **Determine the height of your tree.**

Distance from base of tree out on meter tape so you can see the top of the tree (b): __________ m

Angle on clinometer from ground to top of tree (A):______ degrees

Distance from ground to observer's eyes (z):______ m

Height of tree = H = ((tanA x b) + z

H = __________m

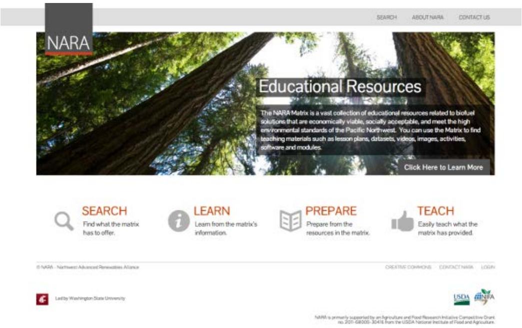
2. **Measure the circumference of the tree.**

Circumference of tree:________cm

3. **Determine the amount of Carbon in the tree**

Using the "How Much Carbon Is in a Tree" chart

- 2500 k-12 students/yr through direct instruction
- 60 teachers/yr through direct instruction
    - 2600 K-12 students through these teachers
- 16 graduate students/yr through year-long coursework
- 1000's of contacts through web-based resources
    - Blog
    - Matrix



Educational Resources

The NARA Matrix is a vast collection of educational resources related to biofuel solutions that are economically viable, socially acceptable, and meet the high environmental standards of the Pacific Northwest. You can use the Matrix to find teaching materials such as lesson plans, datasets, videos, images, activities, software and modules.

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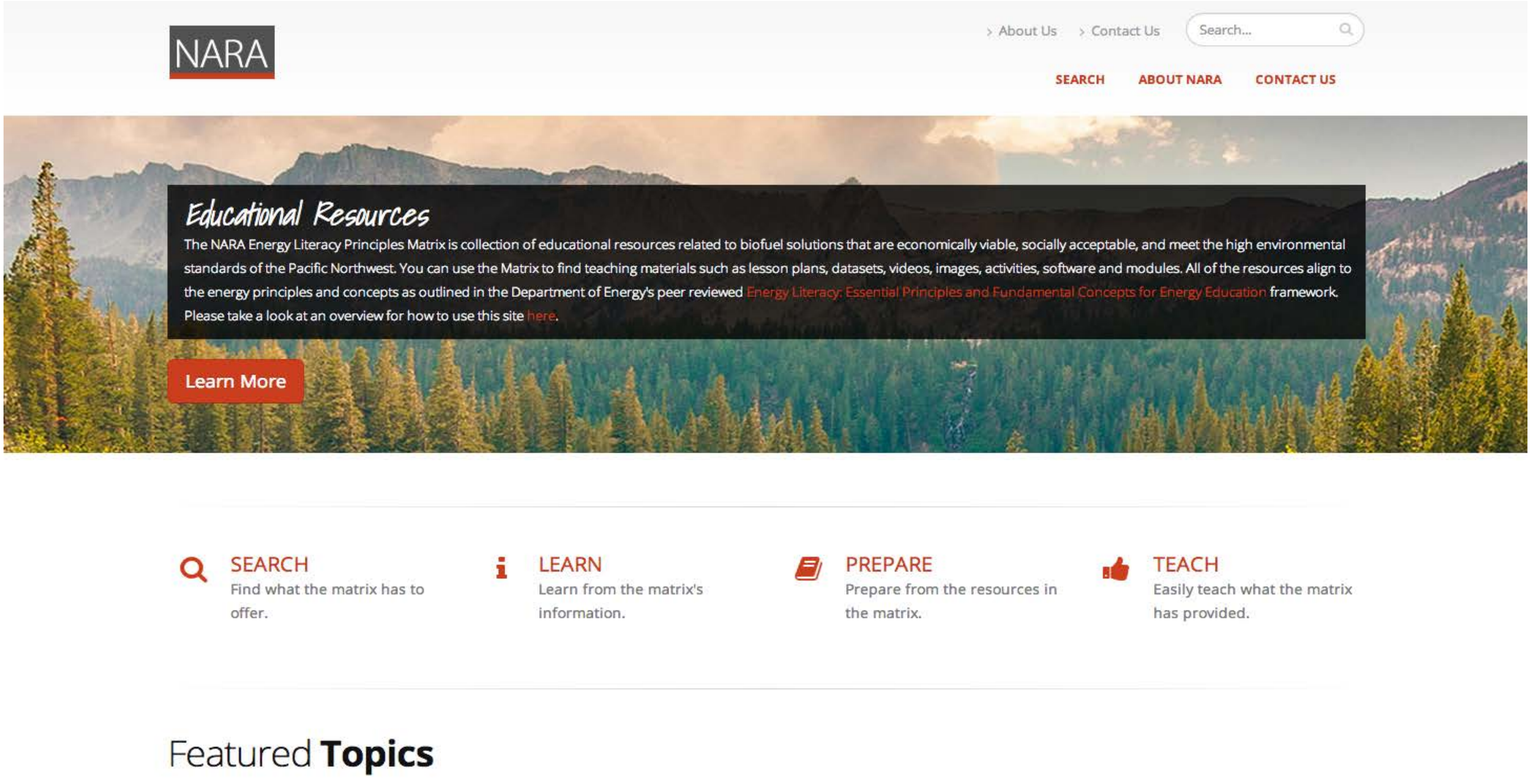
Led by Washington State University

NARA is primarily supported by an Agriculture and Food Research Initiative Competitive Grant no. 201-68005-30416 from the USDA National Institute of Food and Agriculture.

EnergyLiteracyPrinciples.org



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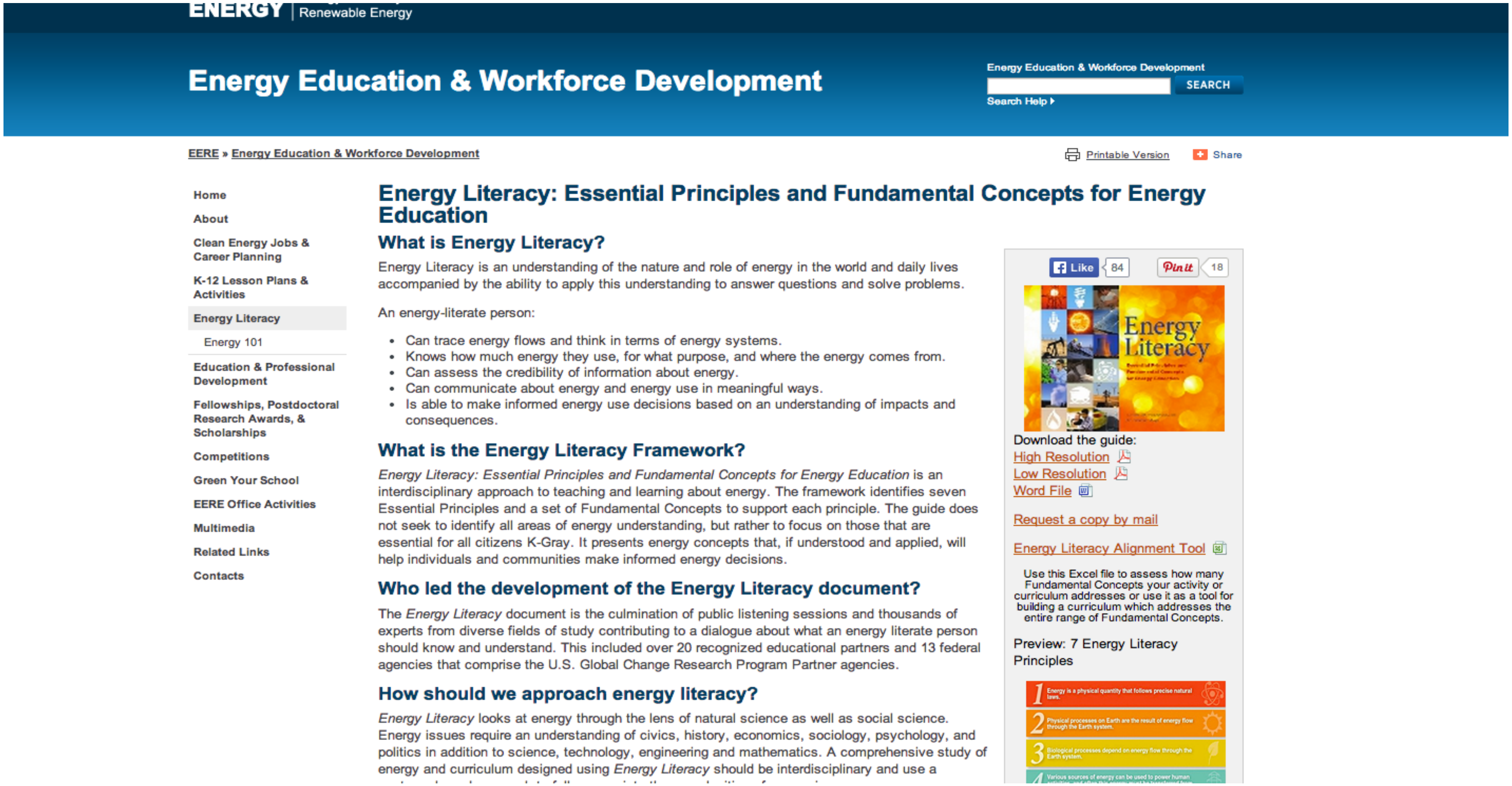
Featured **Topics**

Energy Literacy Framework



Energy Education & Workforce Development

EERE » Energy Education & Workforce Development

Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education

What is Energy Literacy?

Energy Literacy is an understanding of the nature and role of energy in the world and daily lives accompanied by the ability to apply this understanding to answer questions and solve problems.

An energy-literate person:

- Can trace energy flows and think in terms of energy systems.
- Knows how much energy they use, for what purpose, and where the energy comes from.
- Can assess the credibility of information about energy.
- Can communicate about energy and energy use in meaningful ways.
- Is able to make informed energy use decisions based on an understanding of impacts and consequences.

What is the Energy Literacy Framework?

Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education is an interdisciplinary approach to teaching and learning about energy. The framework identifies seven Essential Principles and a set of Fundamental Concepts to support each principle. The guide does not seek to identify all areas of energy understanding, but rather to focus on those that are essential for all citizens K-Gray. It presents energy concepts that, if understood and applied, will help individuals and communities make informed energy decisions.

Who led the development of the Energy Literacy document?

The *Energy Literacy* document is the culmination of public listening sessions and thousands of experts from diverse fields of study contributing to a dialogue about what an energy literate person should know and understand. This included over 20 recognized educational partners and 13 federal agencies that comprise the U.S. Global Change Research Program Partner agencies.

How should we approach energy literacy?

Energy Literacy looks at energy through the lens of natural science as well as social science. Energy issues require an understanding of civics, history, economics, sociology, psychology, and politics in addition to science, technology, engineering and mathematics. A comprehensive study of energy and curriculum designed using *Energy Literacy* should be interdisciplinary and use a

Download the guide:
High Resolution
Low Resolution
Word File

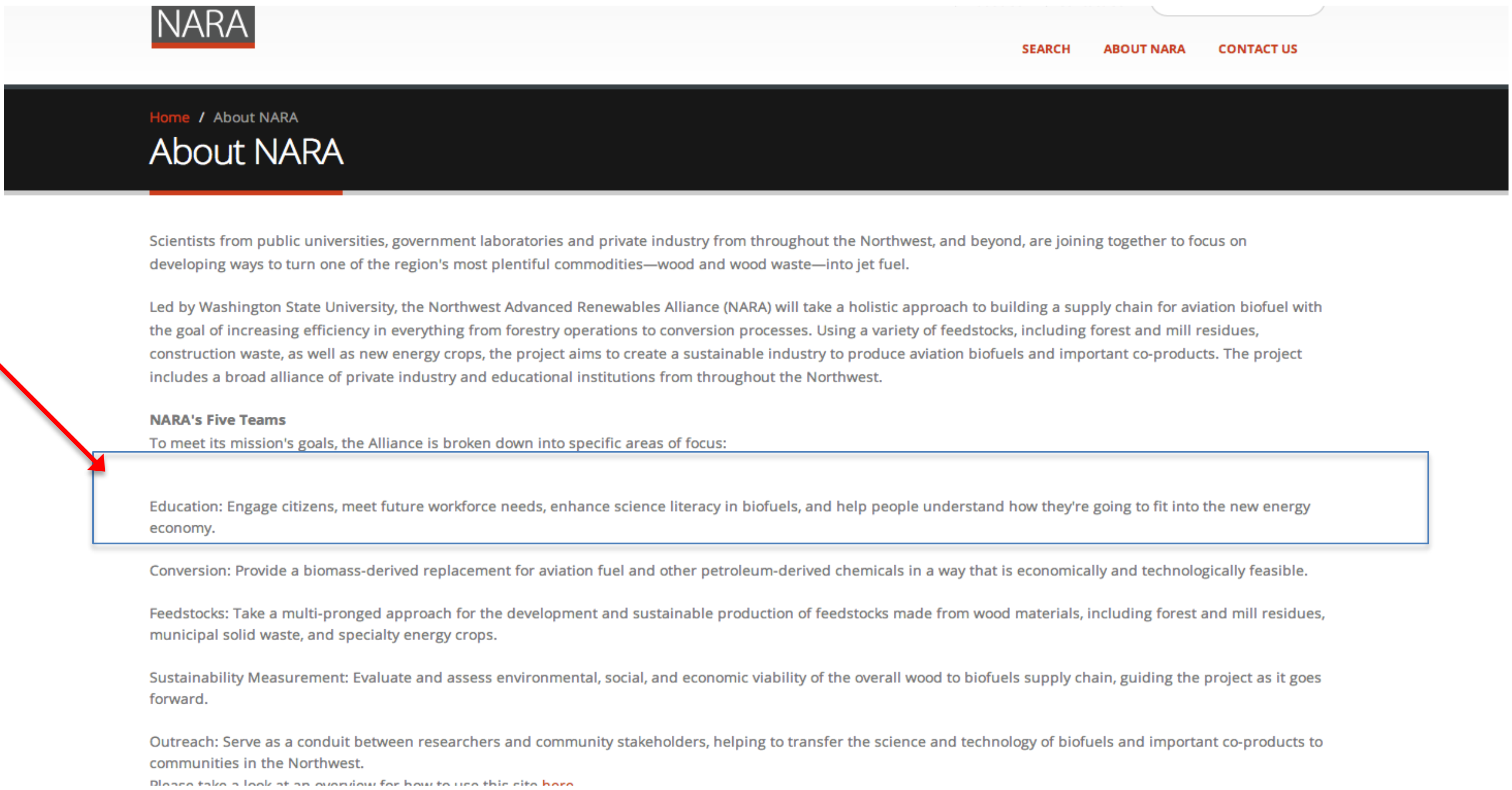
Request a copy by mail

Energy Literacy Alignment Tool

Use this Excel file to assess how many Fundamental Concepts your activity or curriculum addresses or use it as a tool for building a curriculum which addresses the entire range of Fundamental Concepts.

Preview: 7 Energy Literacy Principles

Connection to NARA



NARA

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Home / About NARA

About NARA

Scientists from public universities, government laboratories and private industry from throughout the Northwest, and beyond, are joining together to focus on developing ways to turn one of the region's most plentiful commodities—wood and wood waste—into jet fuel.

Led by Washington State University, the Northwest Advanced Renewables Alliance (NARA) will take a holistic approach to building a supply chain for aviation biofuel with the goal of increasing efficiency in everything from forestry operations to conversion processes. Using a variety of feedstocks, including forest and mill residues, construction waste, as well as new energy crops, the project aims to create a sustainable industry to produce aviation biofuels and important co-products. The project includes a broad alliance of private industry and educational institutions from throughout the Northwest.

NARA's Five Teams
To meet its mission's goals, the Alliance is broken down into specific areas of focus:

Education: Engage citizens, meet future workforce needs, enhance science literacy in biofuels, and help people understand how they're going to fit into the new energy economy.

Conversion: Provide a biomass-derived replacement for aviation fuel and other petroleum-derived chemicals in a way that is economically and technologically feasible.

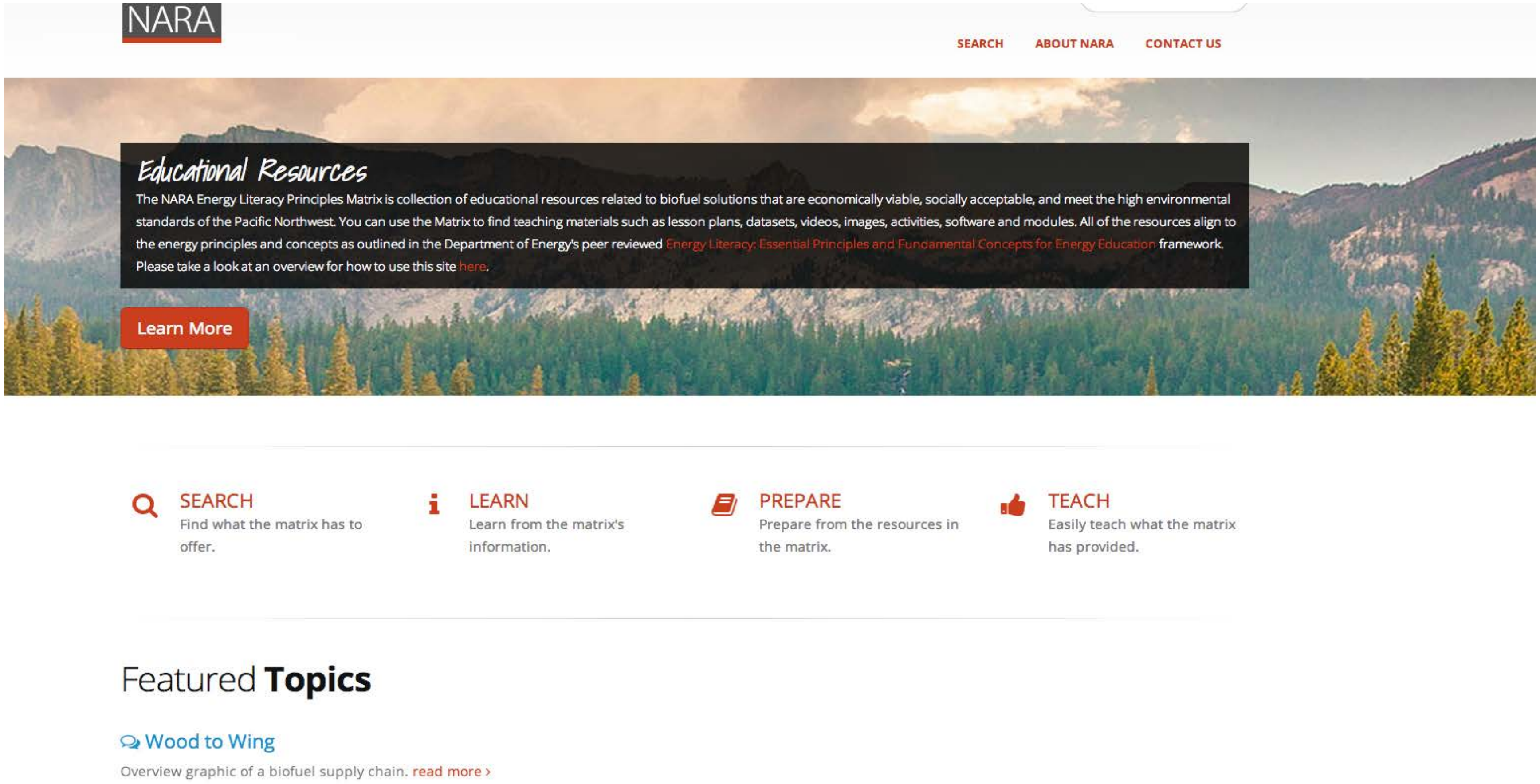
Feedstocks: Take a multi-pronged approach for the development and sustainable production of feedstocks made from wood materials, including forest and mill residues, municipal solid waste, and specialty energy crops.

Sustainability Measurement: Evaluate and assess environmental, social, and economic viability of the overall wood to biofuels supply chain, guiding the project as it goes forward.

Outreach: Serve as a conduit between researchers and community stakeholders, helping to transfer the science and technology of biofuels and important co-products to communities in the Northwest.

Please take a look at an overview for how to use this site here.

Site functions and uses



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Wood to Wing

Overview graphic of a biofuel supply chain. read more ›

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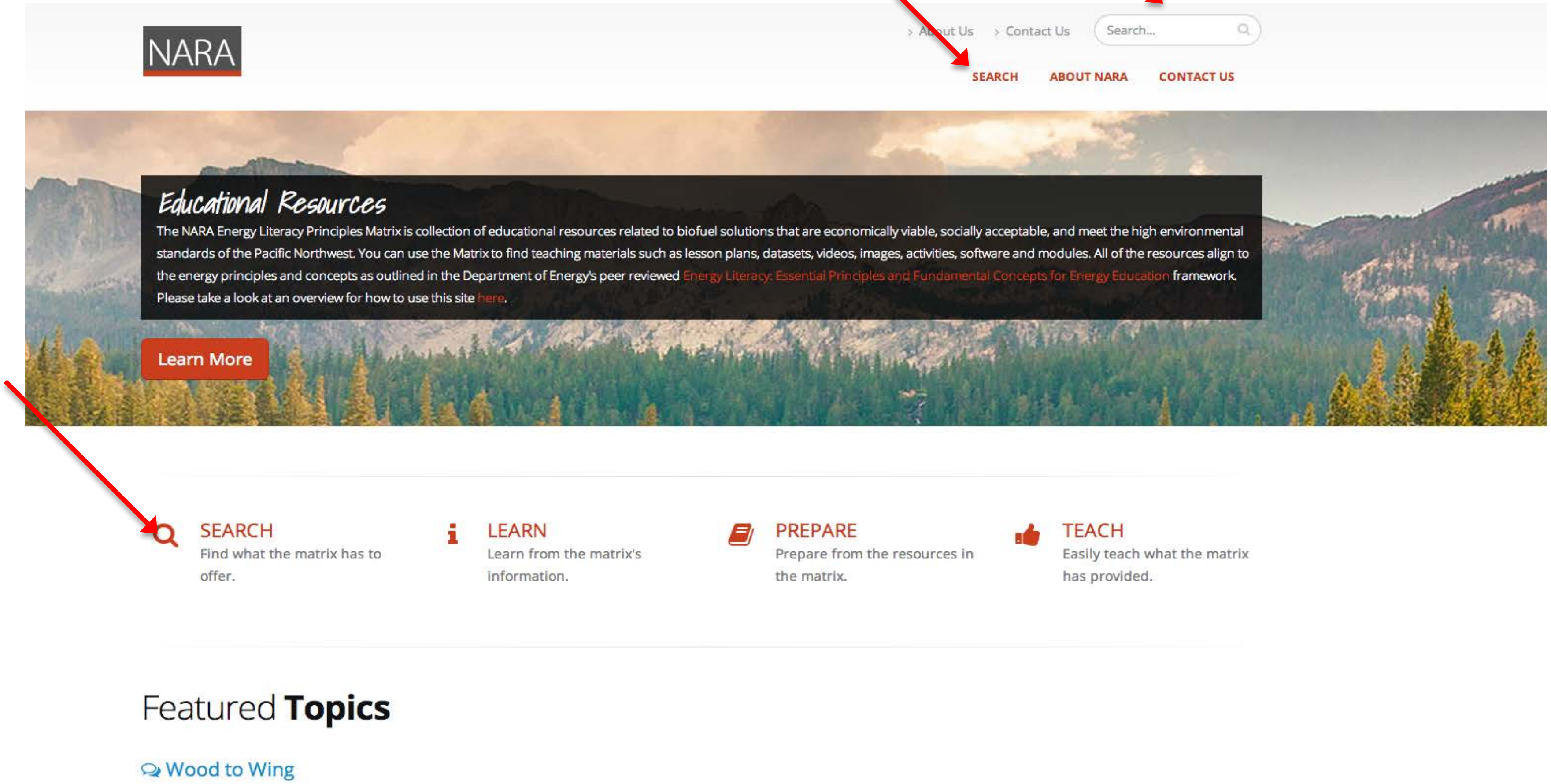

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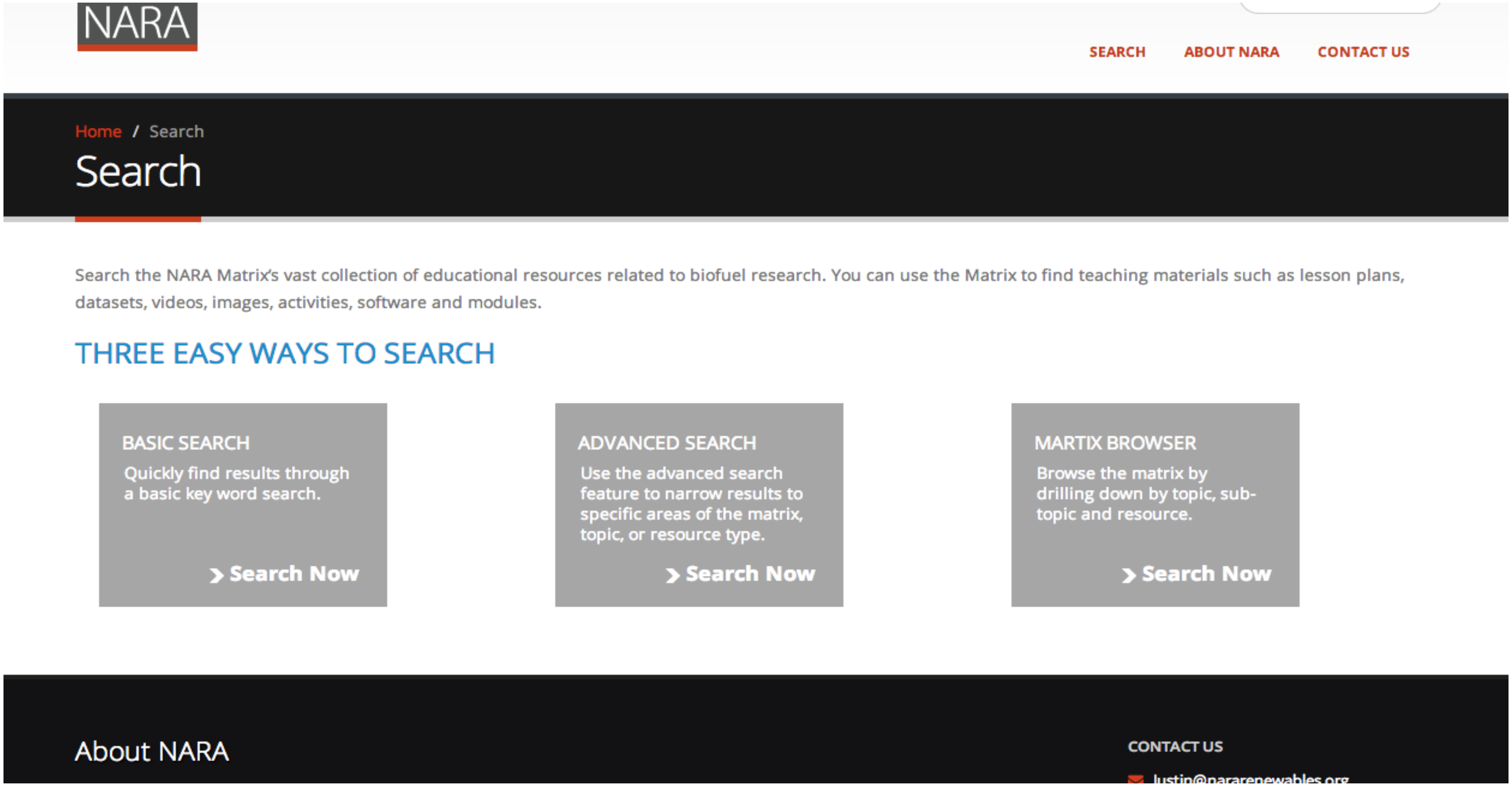

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Search the NARA Matrix's vast collection of educational resources related to biofuel research. You can use the Matrix to find teaching materials such as lesson plans, datasets, videos, images, activities, software and modules.

THREE EASY WAYS TO SEARCH

BASIC SEARCH

Quickly find results through a basic key word search.

› Search Now

ADVANCED SEARCH

Use the advanced search feature to narrow results to specific areas of the matrix, topic, or resource type.

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MARTIX BROWSER

Browse the matrix by drilling down by topic, sub-topic and resource.

› Search Now

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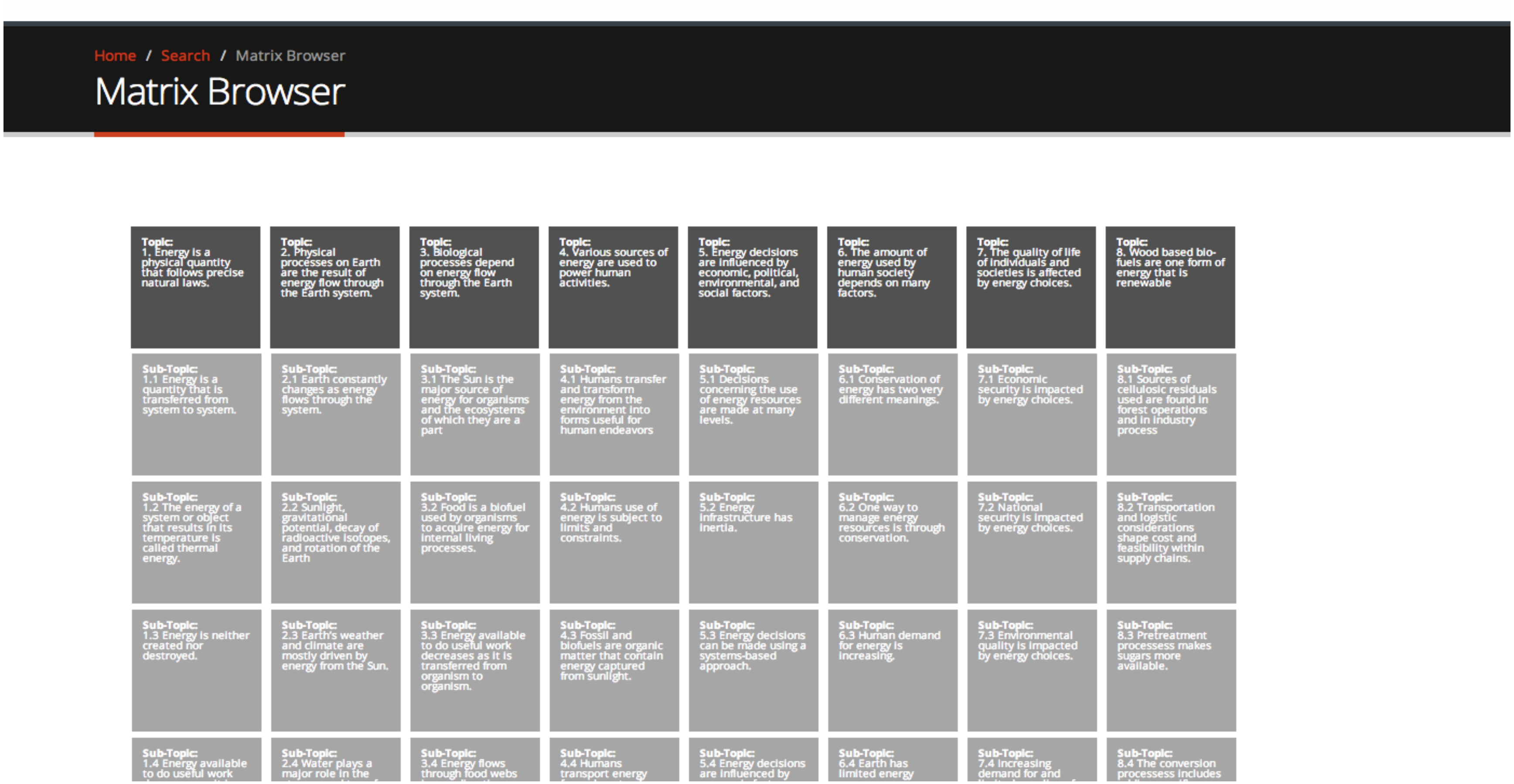
Justin@nararenewables.org

Browse

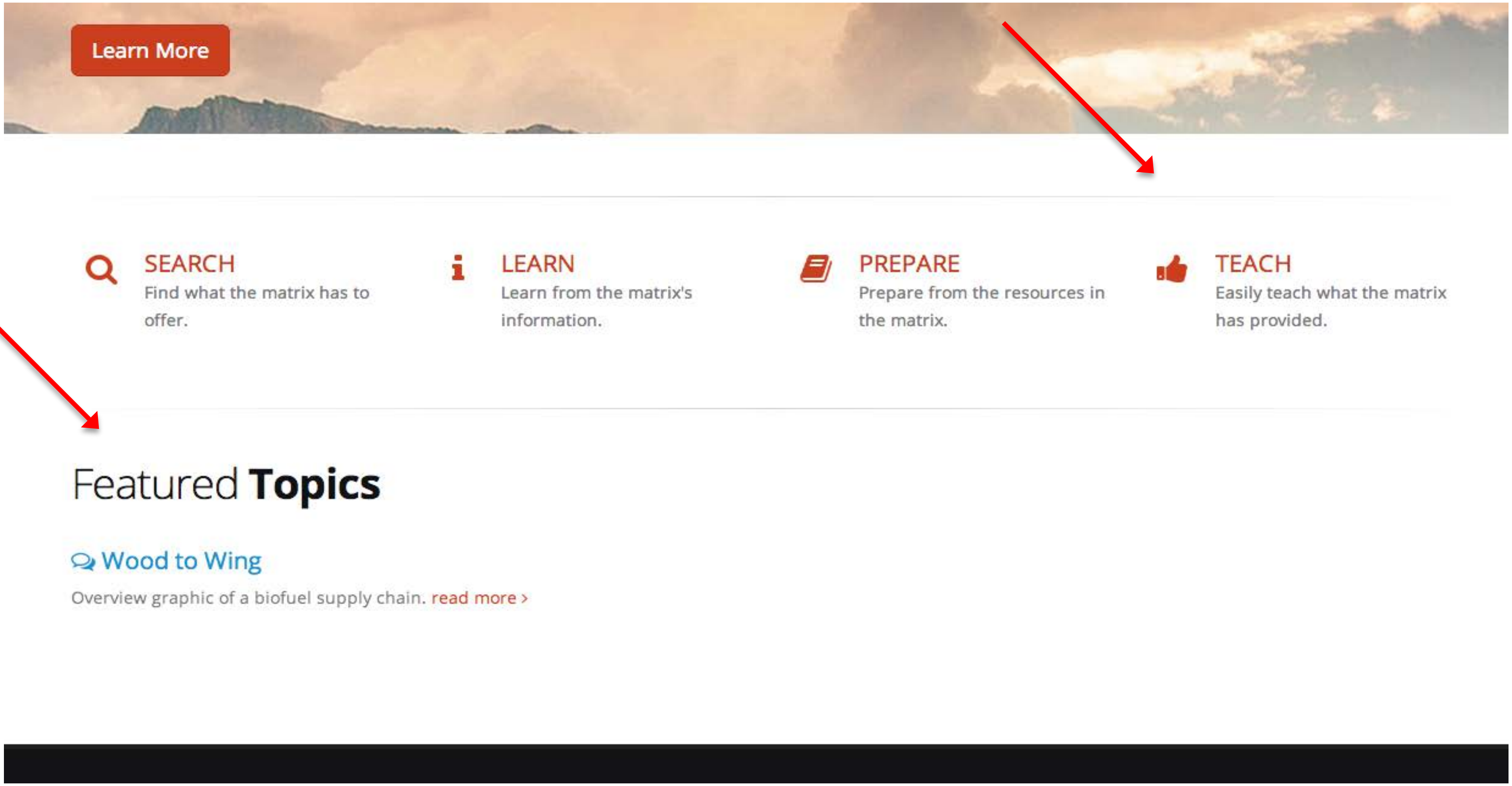


Home / Search / Matrix Browser

Matrix Browser

Topic: 1. Energy is a physical quantity that follows precise natural laws.	**Topic:** 2. Physical processes on Earth are the result of energy flow through the Earth system.	**Topic:** 3. Biological processes depend on energy flow through the Earth system.	**Topic:** 4. Various sources of energy are used to power human activities.	**Topic:** 5. Energy decisions are influenced by economic, political, environmental, and social factors.	**Topic:** 6. The amount of energy used by human society depends on many factors.	**Topic:** 7. The quality of life of individuals and societies is affected by energy choices.	**Topic:** 8. Wood based bio-fuels are one form of energy that is renewable
Sub-Topic: 1.1 Energy is a quantity that is transferred from system to system.	**Sub-Topic:** 2.1 Earth constantly changes as energy flows through the system.	**Sub-Topic:** 3.1 The Sun is the major source of energy for organisms and the ecosystems of which they are a part	**Sub-Topic:** 4.1 Humans transfer and transform energy from the environment into forms useful for human endeavors	**Sub-Topic:** 5.1 Decisions concerning the use of energy resources are made at many levels.	**Sub-Topic:** 6.1 Conservation of energy has two very different meanings.	**Sub-Topic:** 7.1 Economic security is impacted by energy choices.	**Sub-Topic:** 8.1 Sources of cellulosic residuals used are found in forest operations and in industry process
Sub-Topic: 1.2 The energy of a system or object that results in its temperature is called thermal energy.	**Sub-Topic:** 2.2 Sunlight, gravitational potential, decay of radioactive isotopes, and rotation of the Earth	**Sub-Topic:** 3.2 Food is a biofuel used by organisms to acquire energy for internal living processes.	**Sub-Topic:** 4.2 Humans use of energy is subject to limits and constraints.	**Sub-Topic:** 5.2 Energy infrastructure has inertia.	**Sub-Topic:** 6.2 One way to manage energy resources is through conservation.	**Sub-Topic:** 7.2 National security is impacted by energy choices.	**Sub-Topic:** 8.2 Transportation and logistic considerations shape cost and feasibility within supply chains.
Sub-Topic: 1.3 Energy is neither created nor destroyed.	**Sub-Topic:** 2.3 Earth's weather and climate are mostly driven by energy from the Sun.	**Sub-Topic:** 3.3 Energy available to do useful work decreases as it is transferred from organism to organism.	**Sub-Topic:** 4.3 Fossil and biofuels are organic matter that contain energy captured from sunlight.	**Sub-Topic:** 5.3 Energy decisions can be made using a systems-based approach.	**Sub-Topic:** 6.3 Human demand for energy is increasing.	**Sub-Topic:** 7.3 Environmental quality is impacted by energy choices.	**Sub-Topic:** 8.3 Pretreatment processes makes sugars more available.
Sub-Topic: 1.4 Energy available to do useful work	**Sub-Topic:** 2.4 Water plays a major role in the	**Sub-Topic:** 3.4 Energy flows through food webs	**Sub-Topic:** 4.4 Humans transport energy	**Sub-Topic:** 5.4 Energy decisions are influenced by	**Sub-Topic:** 6.4 Earth has limited energy	**Sub-Topic:** 7.4 Increasing demand for and	**Sub-Topic:** 8.4 The conversion processess includes

Organization of featured content



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Wood to Wing

Overview graphic of a biofuel supply chain. read more ›

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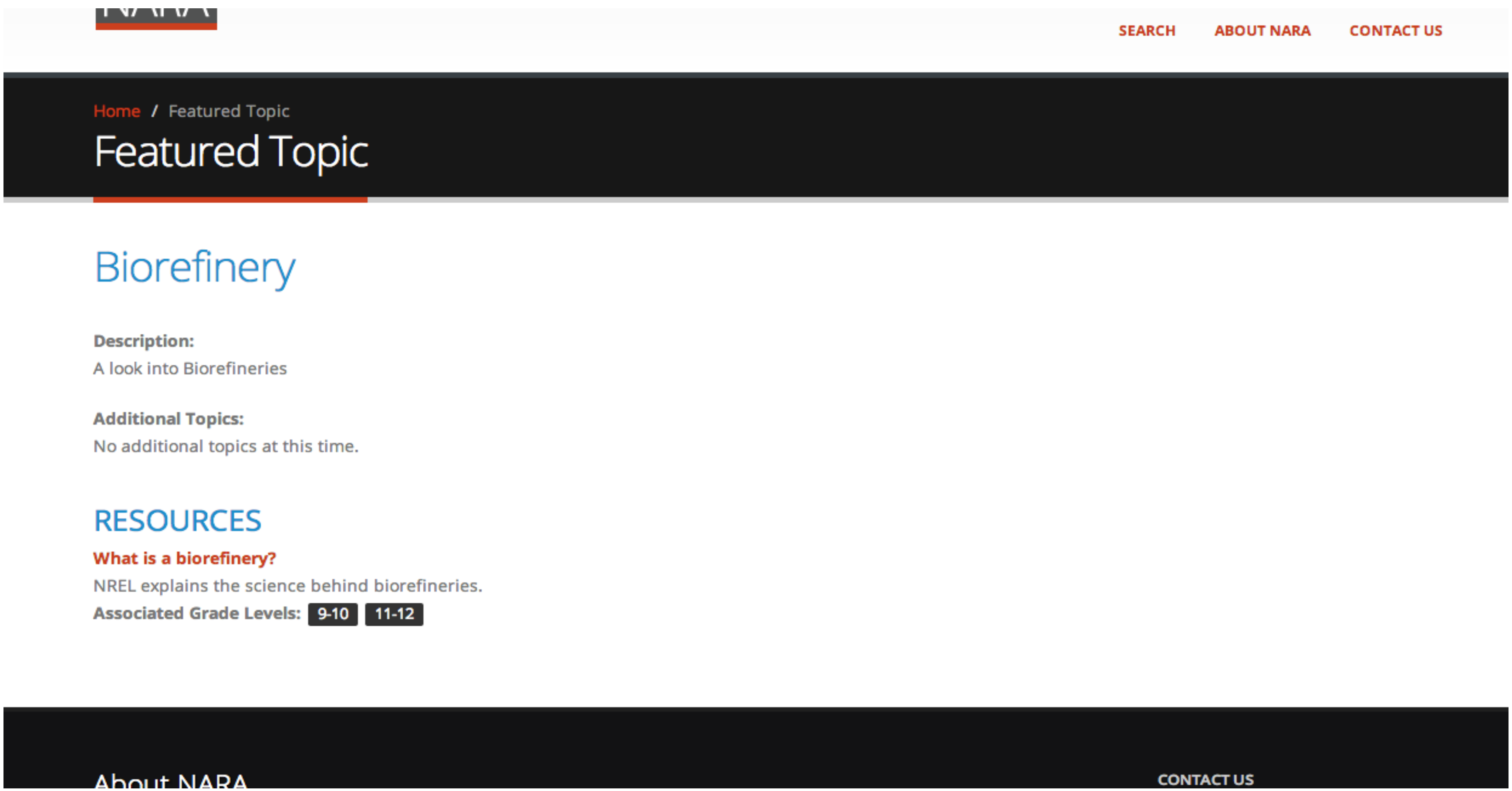
Featured Content



Featured Topic

Biorefinery

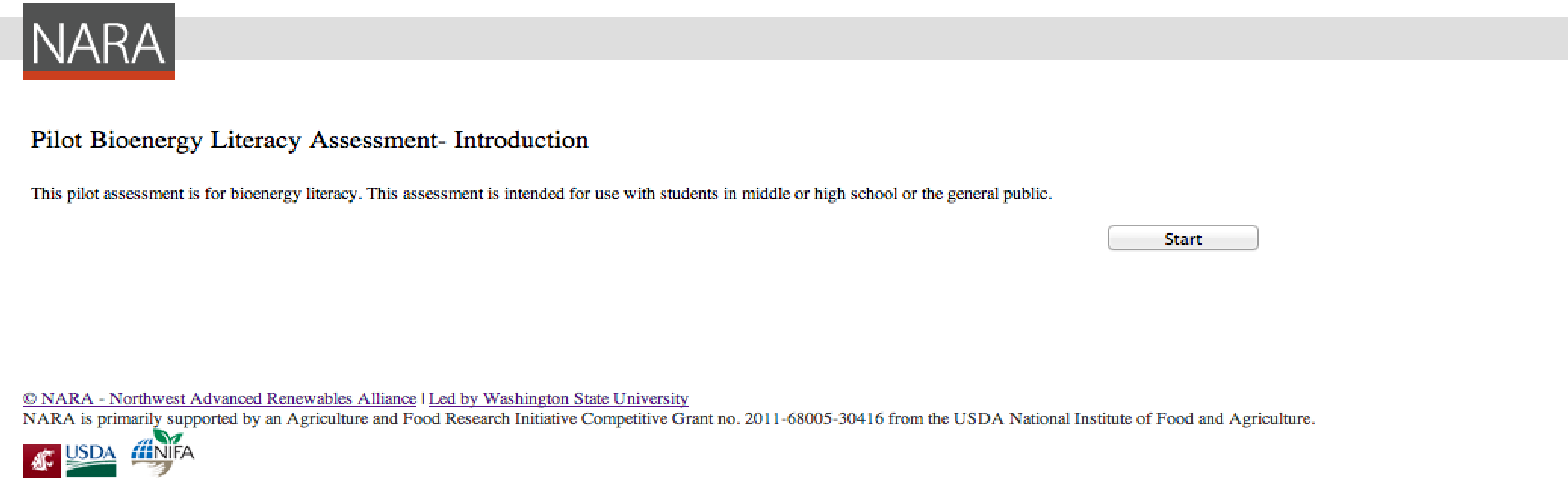
Description:
A look into Biorefineries

Additional Topics:
No additional topics at this time.

RESOURCES

What is a biorefinery?
NREL explains the science behind biorefineries.
Associated Grade Levels: 9-10 11-12

Assessment

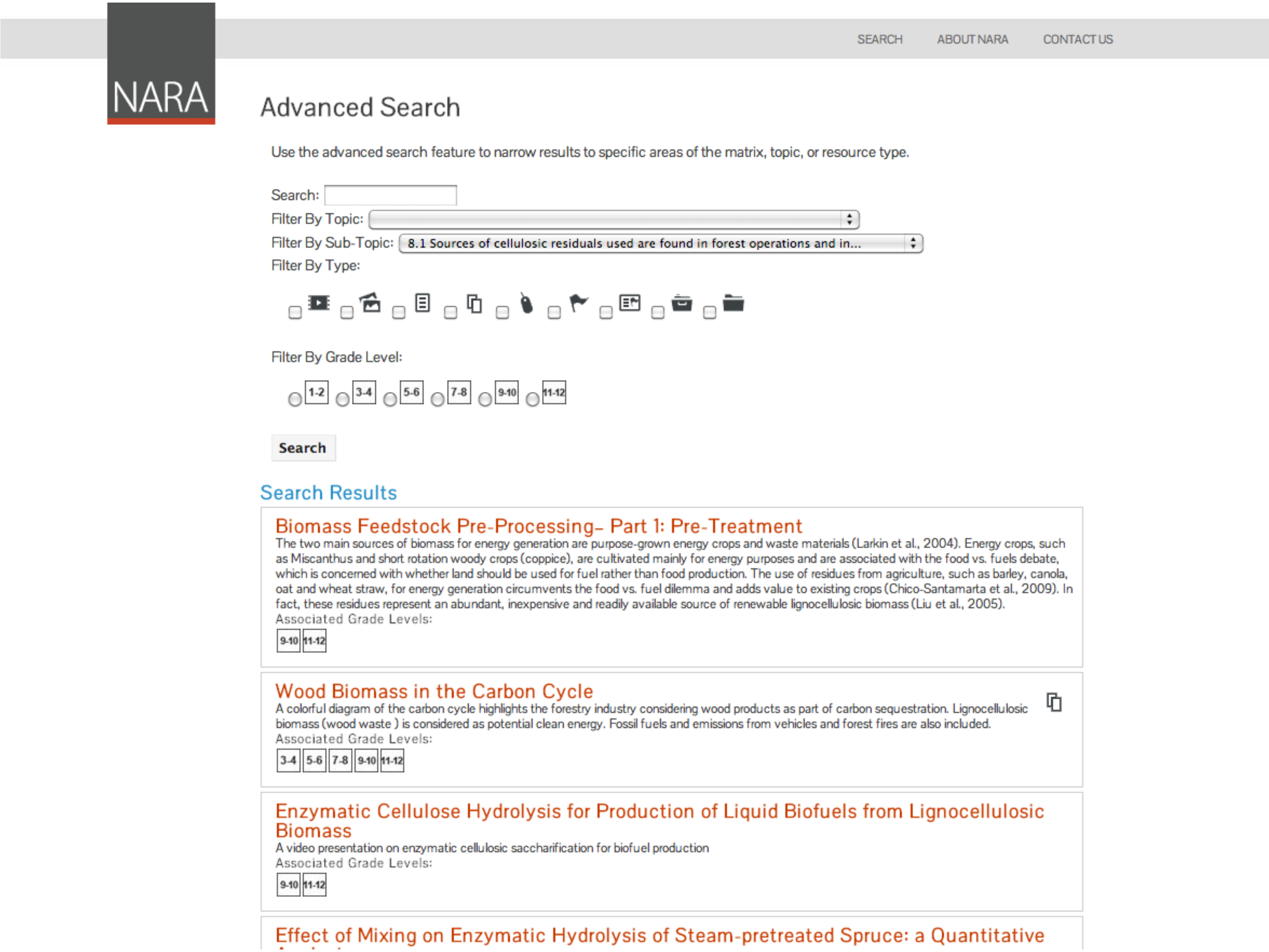


Pilot Bioenergy Literacy Assessment- Introduction

This pilot assessment is for bioenergy literacy. This assessment is intended for use with students in middle or high school or the general public.

NARA is primarily supported by an Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

Cases: Websites and Blogs



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Advanced Search

Use the advanced search feature to narrow results to specific areas of the matrix, topic, or resource type.

Search:
Filter By Topic:
Filter By Sub-Topic: 8.1 Sources of cellulosic residuals used are found in forest operations and in...
Filter By Type:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Filter By Grade Level:

○ 1-2 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11-12

Search

Search Results

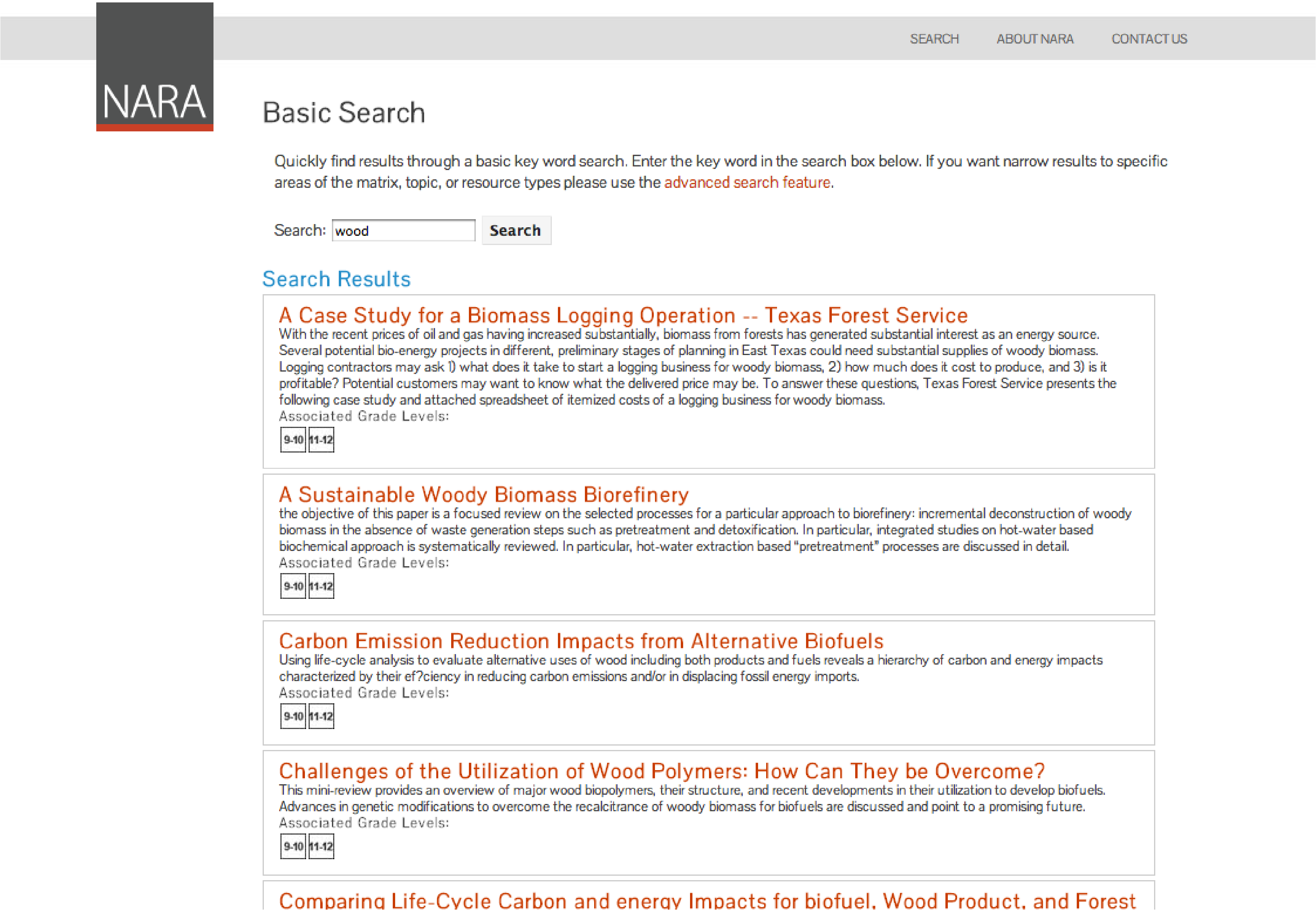
Biomass Feedstock Pre-Processing– Part 1: Pre-Treatment
The two main sources of biomass for energy generation are purpose-grown energy crops and waste materials (Larkin et al., 2004). Energy crops, such as Miscanthus and short rotation woody crops (coppice), are cultivated mainly for energy purposes and are associated with the food vs. fuels debate, which is concerned with whether land should be used for fuel rather than food production. The use of residues from agriculture, such as barley, canola, oat and wheat straw, for energy generation circumvents the food vs. fuel dilemma and adds value to existing crops (Chico-Santamarta et al., 2009). In fact, these residues represent an abundant, inexpensive and readily available source of renewable lignocellulosic biomass (Liu et al., 2005).
Associated Grade Levels:
9-10 11-12

Wood Biomass in the Carbon Cycle
A colorful diagram of the carbon cycle highlights the forestry industry considering wood products as part of carbon sequestration. Lignocellulosic biomass (wood waste) is considered as potential clean energy. Fossil fuels and emissions from vehicles and forest fires are also included.
Associated Grade Levels:
3-4 5-6 7-8 9-10 11-12

Enzymatic Cellulose Hydrolysis for Production of Liquid Biofuels from Lignocellulosic Biomass
A video presentation on enzymatic cellulosic saccharification for biofuel production
Associated Grade Levels:
9-10 11-12

Effect of Mixing on Enzymatic Hydrolysis of Steam-pretreated Spruce: a Quantitative

Cases: Websites and Blogs



Basic Search

Quickly find results through a basic key word search. Enter the key word in the search box below. If you want narrow results to specific areas of the matrix, topic, or resource types please use the advanced search feature.

Search: wood **Search**

Search Results

A Case Study for a Biomass Logging Operation -- Texas Forest Service

With the recent prices of oil and gas having increased substantially, biomass from forests has generated substantial interest as an energy source. Several potential bio-energy projects in different, preliminary stages of planning in East Texas could need substantial supplies of woody biomass. Logging contractors may ask 1) what does it take to start a logging business for woody biomass, 2) how much does it cost to produce, and 3) is it profitable? Potential customers may want to know what the delivered price may be. To answer these questions, Texas Forest Service presents the following case study and attached spreadsheet of itemized costs of a logging business for woody biomass.

Associated Grade Levels:

9-10 11-12

A Sustainable Woody Biomass Biorefinery

the objective of this paper is a focused review on the selected processes for a particular approach to biorefinery: incremental deconstruction of woody biomass in the absence of waste generation steps such as pretreatment and detoxification. In particular, integrated studies on hot-water based biochemical approach is systematically reviewed. In particular, hot-water extraction based "pretreatment" processes are discussed in detail.

Associated Grade Levels:

9-10 11-12

Carbon Emission Reduction Impacts from Alternative Biofuels

Using life-cycle analysis to evaluate alternative uses of wood including both products and fuels reveals a hierarchy of carbon and energy impacts characterized by their ef?ciency in reducing carbon emissions and/or in displacing fossil energy imports.

Associated Grade Levels:

9-10 11-12

Challenges of the Utilization of Wood Polymers: How Can They be Overcome?

This mini-review provides an overview of major wood biopolymers, their structure, and recent developments in their utilization to develop biofuels. Advances in genetic modifications to overcome the recalcitrance of woody biomass for biofuels are discussed and point to a promising future.

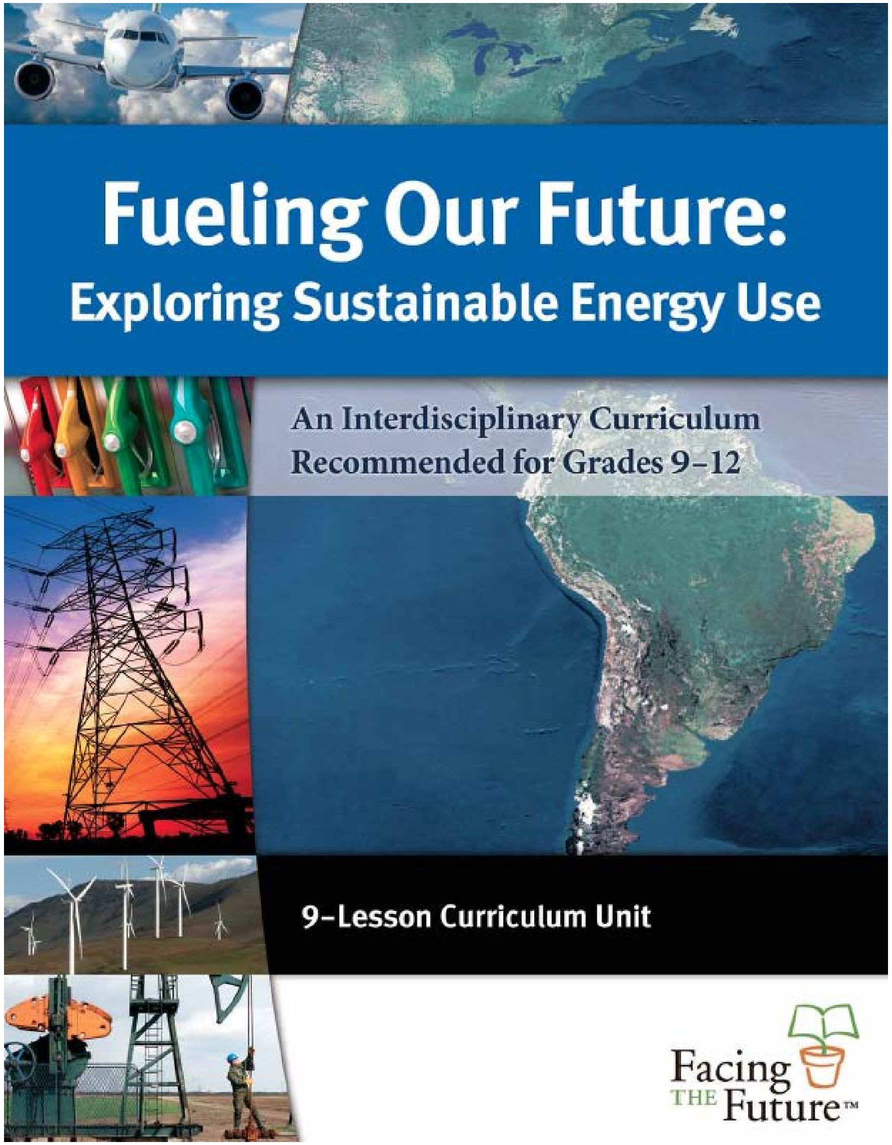
Associated Grade Levels:

9-10 11-12

Comparing Life-Cycle Carbon and energy Impacts for biofuel, Wood Product, and Forest

Cases: Facing the Future

Curriculum created by Facing the Future
2013 Launch
Online and print resource



Fueling Our Future:
Exploring Sustainable Energy Use

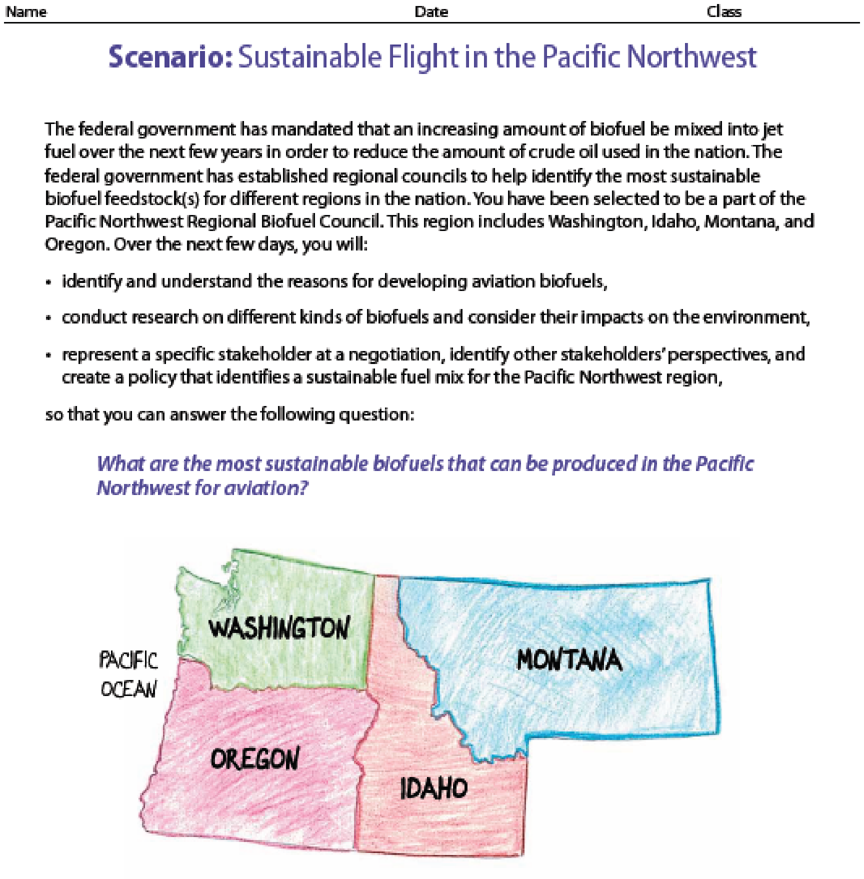
An Interdisciplinary Curriculum
Recommended for Grades 9–12

9-Lesson Curriculum Unit

Facing THE Future™

Cases: Facing the Future

Exploring energy literacy and biofuels
- Activities parallel some NARA functions



Name Date Class

Scenario: Sustainable Flight in the Pacific Northwest

The federal government has mandated that an increasing amount of biofuel be mixed into jet fuel over the next few years in order to reduce the amount of crude oil used in the nation. The federal government has established regional councils to help identify the most sustainable biofuel feedstock(s) for different regions in the nation. You have been selected to be a part of the Pacific Northwest Regional Biofuel Council. This region includes Washington, Idaho, Montana, and Oregon. Over the next few days, you will:

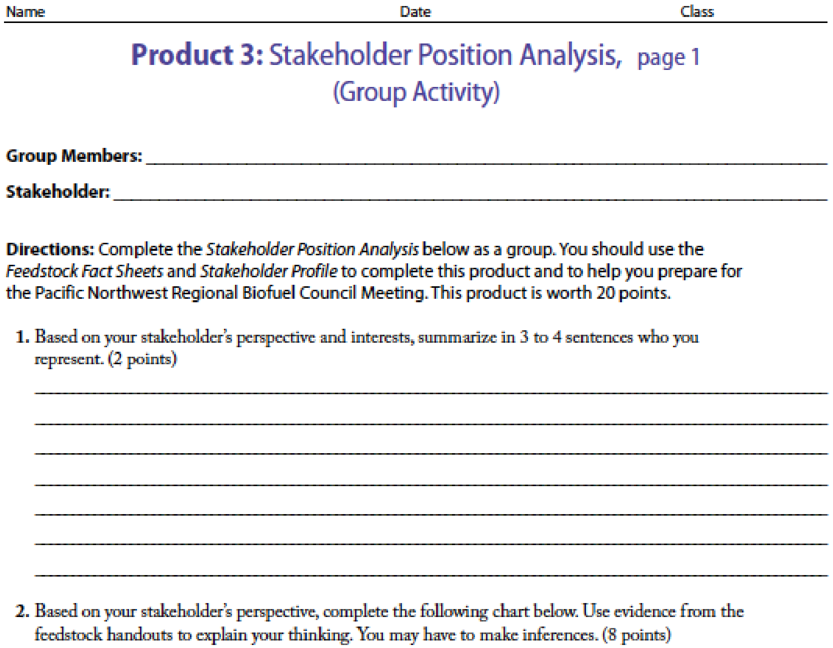
- identify and understand the reasons for developing aviation biofuels,
- conduct research on different kinds of biofuels and consider their impacts on the environment,
- represent a specific stakeholder at a negotiation, identify other stakeholders' perspectives, and create a policy that identifies a sustainable fuel mix for the Pacific Northwest region,

so that you can answer the following question:

What are the most sustainable biofuels that can be produced in the Pacific Northwest for aviation?

Cases: Facing the Future

Stakeholder activity



Name Date Class

Product 3: Stakeholder Position Analysis, page 1
(Group Activity)

Group Members: ______________________________

Stakeholder: ______________________________

Directions: Complete the *Stakeholder Position Analysis* below as a group. You should use the *Feedstock Fact Sheets* and *Stakeholder Profile* to complete this product and to help you prepare for the Pacific Northwest Regional Biofuel Council Meeting. This product is worth 20 points.

1. Based on your stakeholder's perspective and interests, summarize in 3 to 4 sentences who you represent. (2 points)

____

____

____

____

____

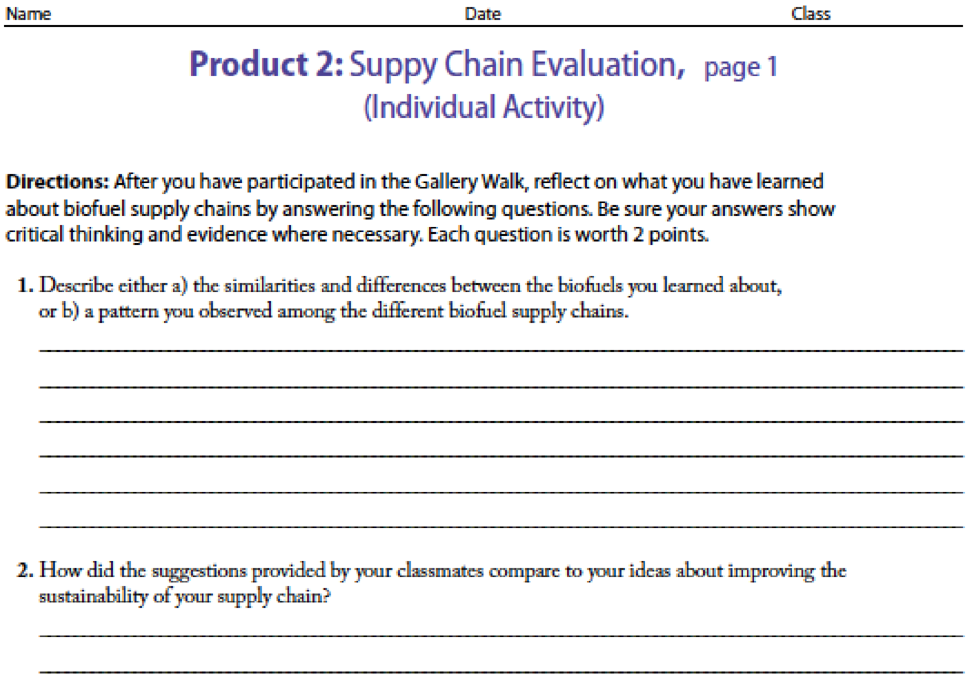
____

____

2. Based on your stakeholder's perspective, complete the following chart below. Use evidence from the feedstock handouts to explain your thinking. You may have to make inferences. (8 points)

Cases: Facing the Future

Supply chain



Name Date Class

Product 2: Suppy Chain Evaluation, page 1
(Individual Activity)

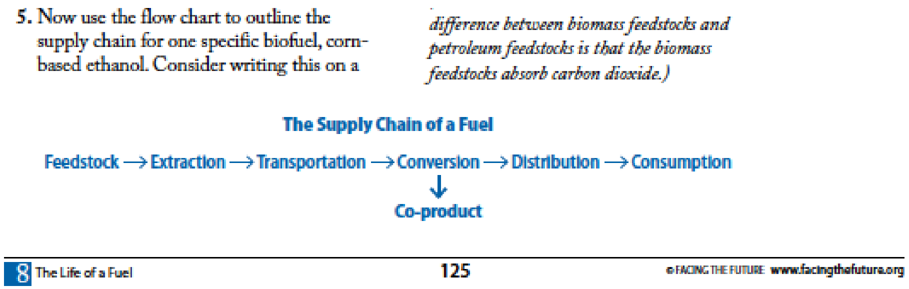
Directions: After you have participated in the Gallery Walk, reflect on what you have learned about biofuel supply chains by answering the following questions. Be sure your answers show critical thinking and evidence where necessary. Each question is worth 2 points.

1. Describe either a) the similarities and differences between the biofuels you learned about, or b) a pattern you observed among the different biofuel supply chains.

2. How did the suggestions provided by your classmates compare to your ideas about improving the sustainability of your supply chain?

Cases: Facing the Future

Use of NARA field data and media



5. Now use the flow chart to outline the supply chain for one specific biofuel, corn-based ethanol. Consider writing this on a

difference between biomass feedstocks and petroleum feedstocks is that the biomass feedstocks absorb carbon dioxide.)

The Supply Chain of a Fuel

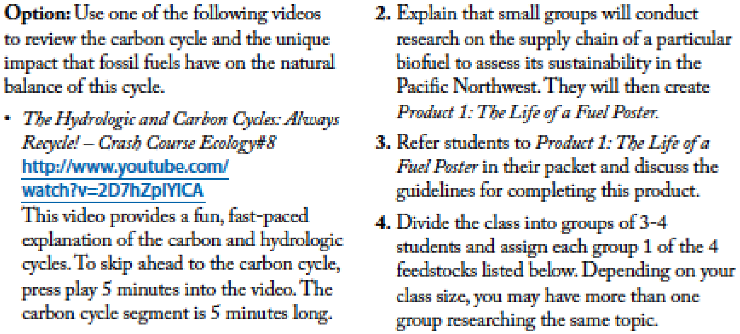
Feedstock → Extraction → Transportation → Conversion → Distribution → Consumption

↓

Co-product

8 The Life of a Fuel 125 © FACING THE FUTURE www.facingthefuture.org

JUSTIN HOUGH AM



Option: Use one of the following videos to review the carbon cycle and the unique impact that fossil fuels have on the natural balance of this cycle.

- *The Hydrologic and Carbon Cycles: Always Recycle! – Crash Course Ecology#8* http://www.youtube.com/watch?v=2D7hZpIYlCA
  This video provides a fun, fast-paced explanation of the carbon and hydrologic cycles. To skip ahead to the carbon cycle, press play 5 minutes into the video. The carbon cycle segment is 5 minutes long.

2. Explain that small groups will conduct research on the supply chain of a particular biofuel to assess its sustainability in the Pacific Northwest. They will then create *Product 1: The Life of a Fuel Poster.*

3. Refer students to *Product 1: The Life of a Fuel Poster* in their packet and discuss the guidelines for completing this product.

4. Divide the class into groups of 3-4 students and assign each group 1 of the 4 feedstocks listed below. Depending on your class size, you may have more than one group researching the same topic.

Cases: McCall Outdoor Science School

Field-based inquiries for
- graduate students
- teachers
- k-12 students

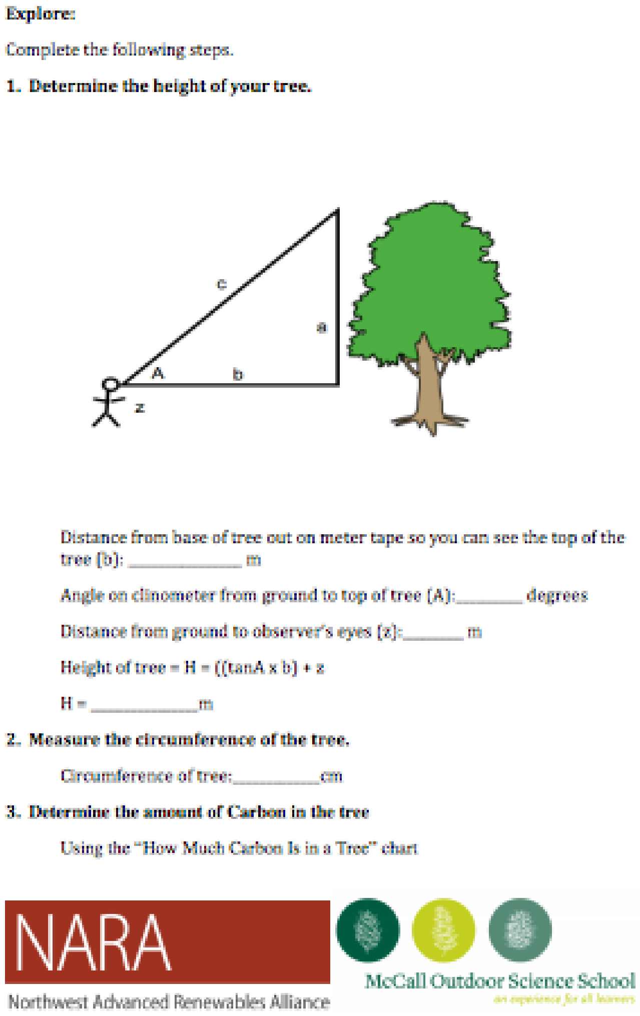
Cases: McCall Outdoor Science School

MOSS Graduates Field testing curriculum

Cases: McCall Outdoor Science School

MOSS k-12 students in the field

Cases: McCall Outdoor Science School



Explore:

Complete the following steps.

1. **Determine the height of your tree.**

Distance from base of tree out on meter tape so you can see the top of the tree (b): ____________ m

Angle on clinometer from ground to top of tree (A):_______ degrees

Distance from ground to observer's eyes (z):______ m

Height of tree = H = ((tanA x b) + z

H = ____________m

2. **Measure the circumference of the tree.**

Circumference of tree:_________cm

3. **Determine the amount of Carbon in the tree**

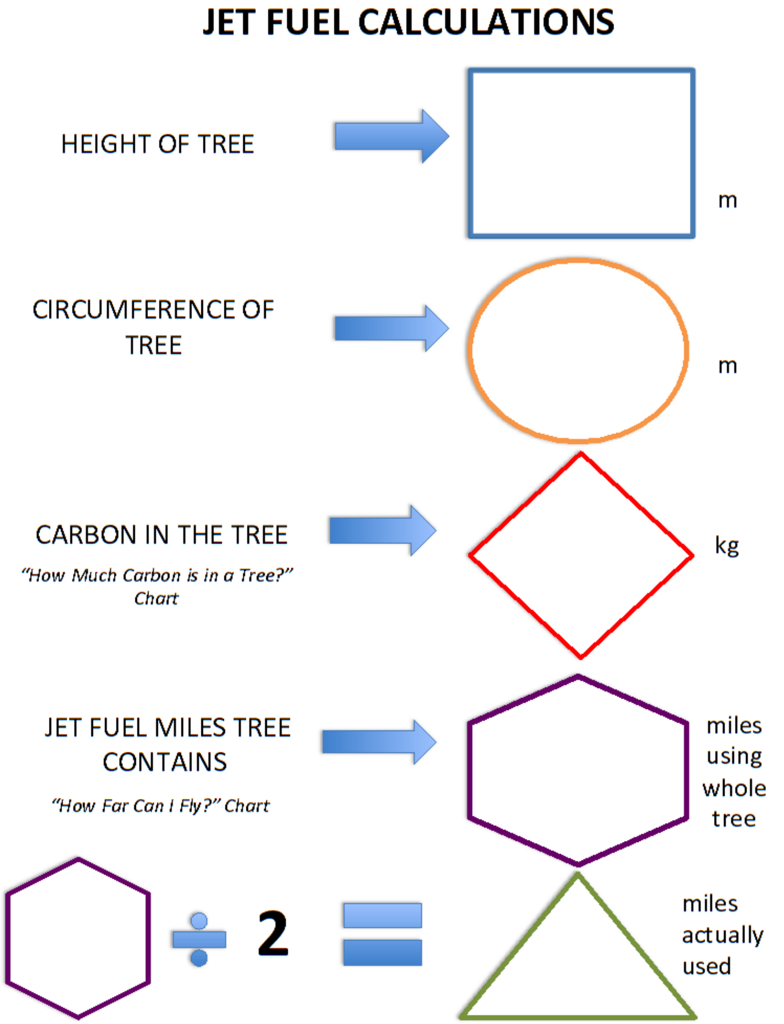
Using the "How Much Carbon Is in a Tree" chart

NARA
Northwest Advanced Renewables Alliance

McCall Outdoor Science School
an experience for all learners

Cases: McCall Outdoor Science School

Testing curriculum development with graduates adds value and usability



JET FUEL CALCULATIONS

HEIGHT OF TREE → m

CIRCUMFERENCE OF TREE → m

CARBON IN THE TREE → kg

"How Much Carbon is in a Tree?" Chart

JET FUEL MILES TREE CONTAINS → miles using whole tree

"How Far Can I Fly?" Chart

÷ 2 = miles actually used

Curriculum published for national teacher audience

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- SciGuides®
- NSTA Learning Center Science Objects
- e-Books
- *Science Store Home*

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- Science Education for Middle Level Students
- Environmental Education
- K–16 Coordination
- Gender Equity in Science Education
- *All NSTA Position Statements*

Competitions

- The DuPont Challenge
- eCYBERMISSION
- Shell Science Lab Challenge
- Siemens We Can Change the World Challenge
- Toshiba ExploraVision

:: ONLINE INTERACTION

Rich opportunities for nuts-and-bolts discussion. Ask questions, talk about issues, make new connections in your professional community.

- NSTA Communities

Middle School Science Classroom

SCIENCE SCOPE

NSTA's peer-reviewed journal for middle level and junior high school science teachers

Science Scope is now available to NSTA members in a digital version. Same great content, but now NSTA members can read it on the computer as well as the Kindle Fire, Android tablet/phone, and iPad/iPhone. For more information, please go to our digital journals page. Questions? e-mail us at digitaljournals@nsta.org.

in this issue:

Aligning your science curriculum with the new *Next Generation Science Standards* can be a difficult and time-consuming task. Before you take on this challenge, check out the articles in this issue of *Science Scope* to learn how other middle school science teachers have made the transition from the *National Science Education Standards* to *NGSS*.

Featured Articles:

Free - Cross-Disciplinary Writing: Scientific Argumentation, the Common Core, and the ADI Model

Developing and Using Models to Align With NGSS

Free - Editor's Roundtable: Start Your Engines—Time to Take the NGSS out for a Test Drive

September 2013

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Upham Woods Outdoor Learning Center

THE VALUE OF A TREE

COMPARING CARBON SEQUESTRATION TO FOREST PRODUCTS

by Jennifer Schon,
R. Justin Hougham,
Karla Eitel, and
Steve Hollenhorst

What is the value of a tree? Of a forest? How do we manage our forests to ensure that we minimize our impact on the environment while creating the products we use and fuel we need to power our energy-rich lives? As Earth Day approaches, wise and efficient use of energy is on our minds—it is an important and timely topic for students, consumers, policy makers, scientists, and educators. With an increasing world population and decreasing supply of fossil fuels, finding a reliable, abundant, and sustainable source of energy is a high priority. One current research effort is being led by the U.S. Department of Agriculture–funded Northwest Advanced Renewables Alliance (NARA), which combines research efforts from industry and education institutions to build a renewable supply chain for aviation biofuel.

The best-known examples of renewable (liquid) biofuels for transportation applications are biodiesel and ethanol blends—in both cases, they are used for automobiles (see Biofuels sidebar for more information). Standards that increase efficiency and decrease emissions are being rolled out in all energy sectors and will affect cars, municipal power, electronics, and mass transportation. Recently there is an increasing focus on aviation fuel, as well. The United States Department of Agriculture and many other governmental and private industry groups are working to create biofuels from forest, mill, and construction waste to be refined into

March 2014 3

Cases: Imagine Tomorrow

Annual high school problem-solving competition

Imagine Tomorrow

REDESIGN. REFORM. REFUEL.

May 30–June 1, 2014

Washington State University, Pullman

$100,000+ in cash prizes, thanks to our sponsors

Cases: Imagine Tomorrow

Teacher professional development model

- Support and workshops for teachers
- Direct support from NARA researchers
  - Natalie Martinkus
  - Indroneil Ganguly

MOSS

McCALL OUTDOOR SCIENCE SCHOOL

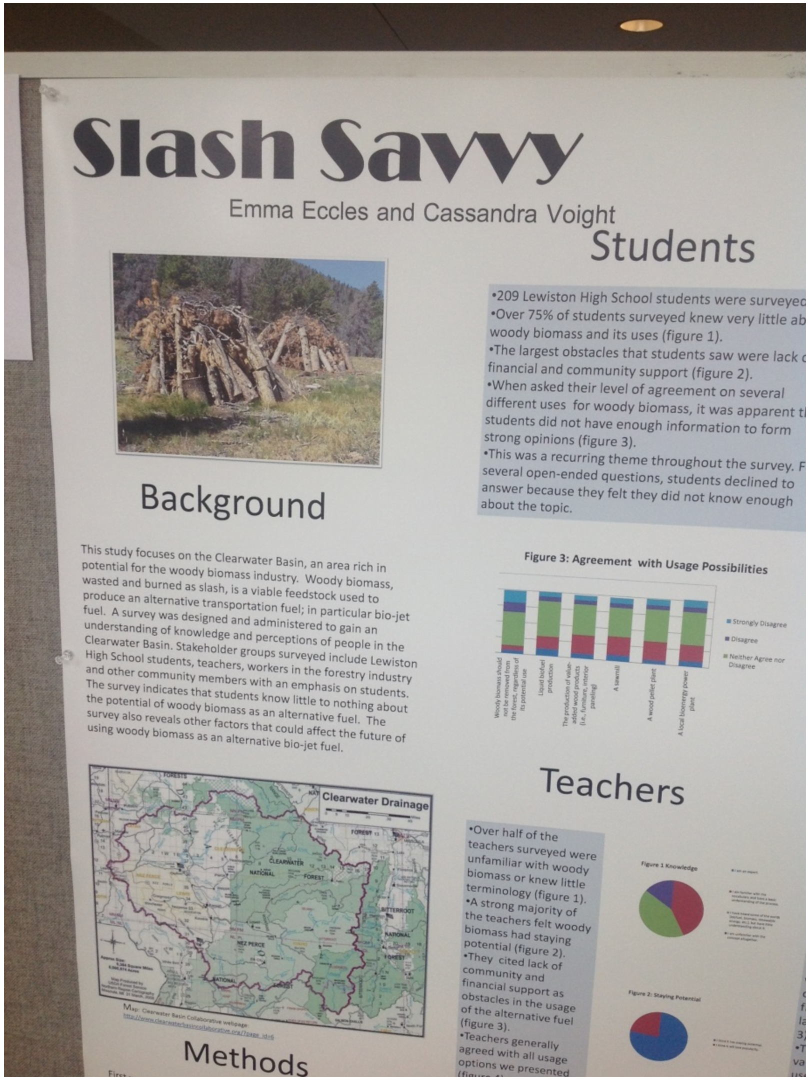
NARA

Cases: Imagine Tomorrow

Student projects from across the state brought to Pullman to compete

Cases: Imagine Tomorrow

Specific example of teacher and students from a NARA community.



Slash Savvy

Emma Eccles and Cassandra Voight

Students

- 209 Lewiston High School students were surveyed
- Over 75% of students surveyed knew very little ab woody biomass and its uses (figure 1).
- The largest obstacles that students saw were lack c financial and community support (figure 2).
- When asked their level of agreement on several different uses for woody biomass, it was apparent t students did not have enough information to form strong opinions (figure 3).
- This was a recurring theme throughout the survey. F several open-ended questions, students declined to answer because they felt they did not know enough about the topic.

Background

This study focuses on the Clearwater Basin, an area rich in potential for the woody biomass industry. Woody biomass, wasted and burned as slash, is a viable feedstock used to produce an alternative transportation fuel; in particular bio-jet fuel. A survey was designed and administered to gain an understanding of knowledge and perceptions of people in the Clearwater Basin. Stakeholder groups surveyed include Lewiston High School students, teachers, workers in the forestry industry and other community members with an emphasis on students. The survey indicates that students know little to nothing about the potential of woody biomass as an alternative fuel. The survey also reveals other factors that could affect the future of using woody biomass as an alternative bio-jet fuel.

Figure 3: Agreement with Usage Possibilities

Map: Clearwater Basin Collaborative webpage

Teachers

- Over half of the teachers surveyed were unfamiliar with woody biomass or knew little terminology (figure 1).
- A strong majority of the teachers felt woody biomass had staying potential (figure 2).
- They cited lack of community and financial support as obstacles in the usage of the alternative fuel (figure 3).
- Teachers generally agreed with all usage options we presented

Figure 1 Knowledge

Figure 2: Staying Potential

Methods

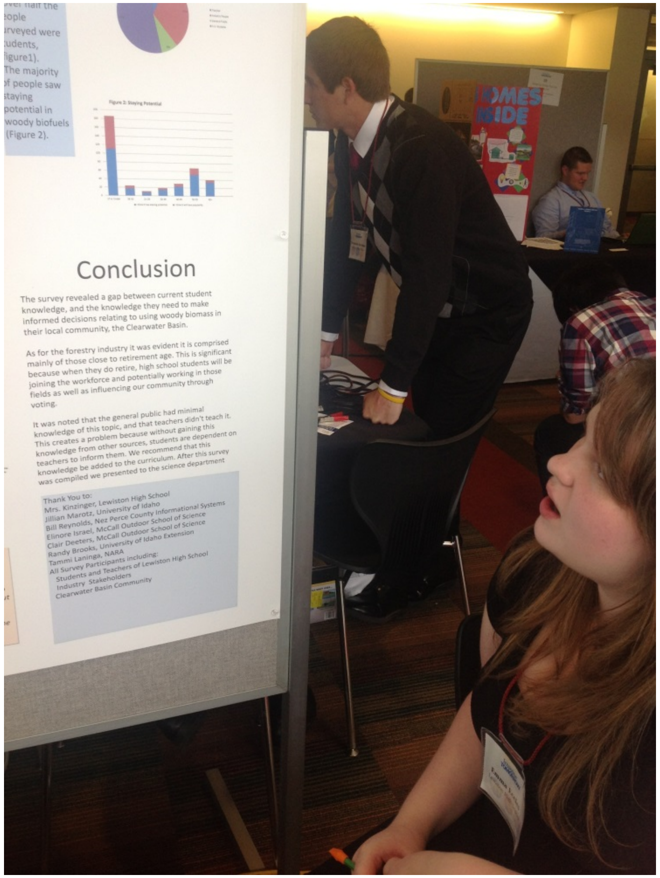


Figure 2: Staying Potential

Conclusion

The survey revealed a gap between current student knowledge, and the knowledge they need to make informed decisions relating to using woody biomass in their local community, the Clearwater Basin.

As for the forestry industry it was evident it is comprised mainly of those close to retirement age. This is significant because when they do retire, high school students will be joining the workforce and potentially working in those fields as well as influencing our community through voting.

It was noted that the general public had minimal knowledge of this topic, and that teachers didn't teach it. This creates a problem because without gaining this knowledge from other sources, students are dependent on teachers to inform them. We recommend that this knowledge be added to the curriculum. After this survey was compiled we presented to the science department

Thank You to:
Mrs. Kinzinger, Lewiston High School
Jillian Marotz, University of Idaho
Bill Reynolds, Nez Perce County Informational Systems
Elinore Israel, McCall Outdoor School of Science
Clair Deeters, McCall Outdoor School of Science
Randy Brooks, University of Idaho Extension
Tammi Laninga, NARA
All Survey Participants including:
  Students and Teachers of Lewiston High School
  Industry Stakeholders
  Clearwater Basin Community

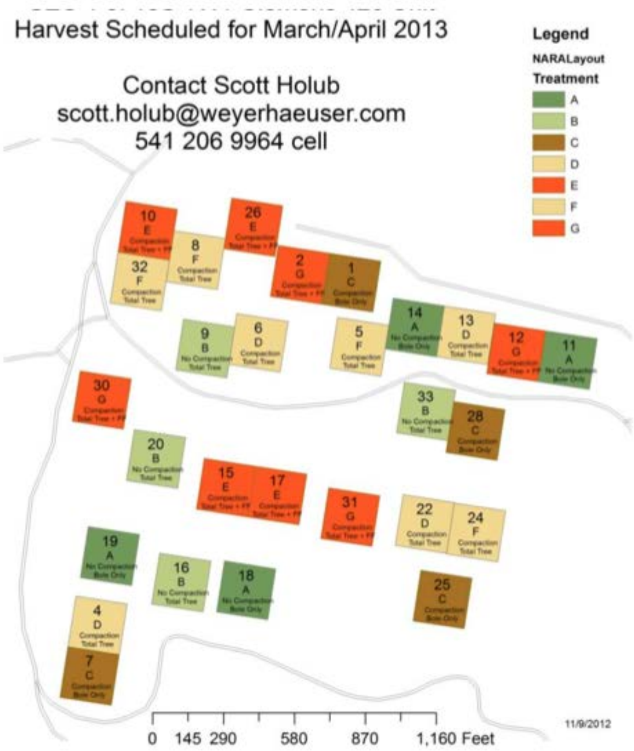
Cases: Long Term Soil Productivity

LCA
Sustainability
and
Context

Cases: Long Term Soil Productivity

Methodology that informs inquiry

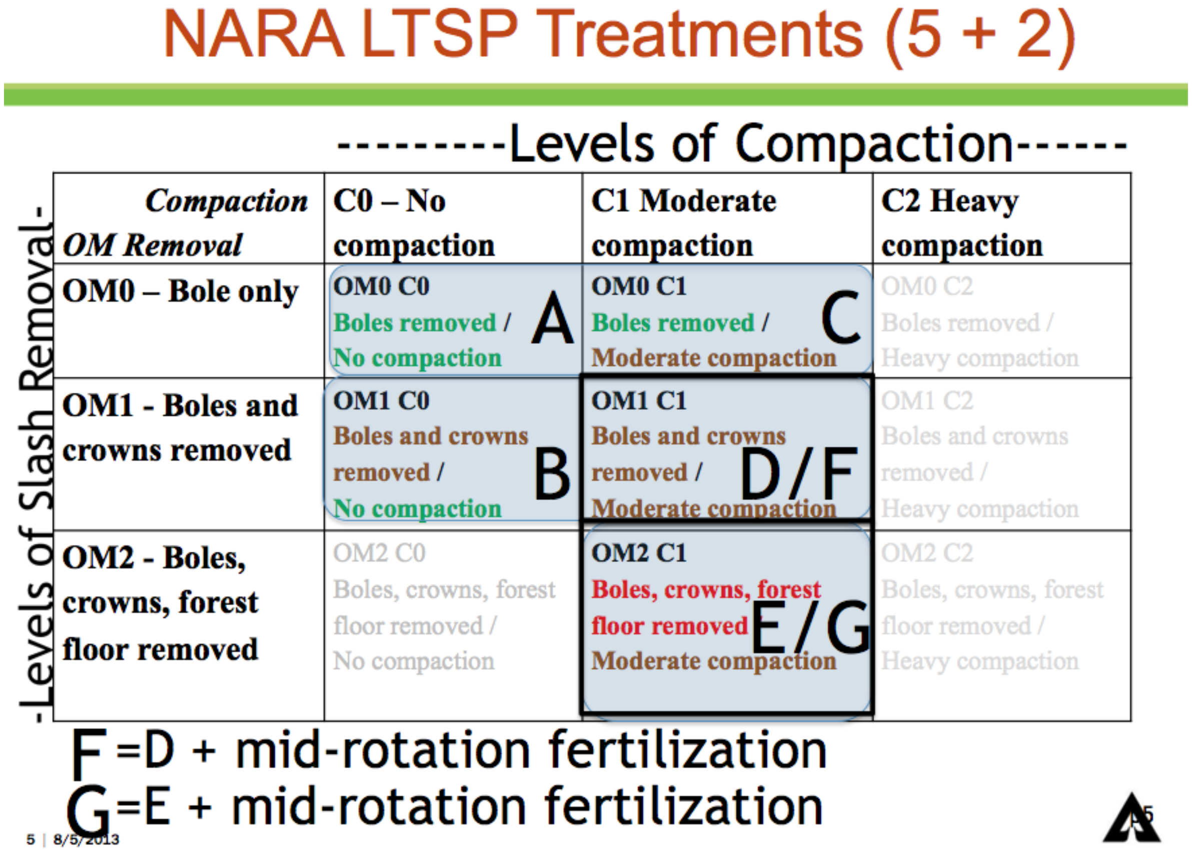
NARA LTSP - TREATMENT LAYOUT



8/5/2013

Cases: Long Term Soil Productivity

Methodology that informs inquiry



NARA LTSP Treatments (5 + 2)

---------Levels of Compaction------

-Levels of Slash Removal-

Compaction *OM Removal*	C0 – No compaction	C1 Moderate compaction	C2 Heavy compaction
OM0 – Bole only	OM0 C0 Boles removed / No compaction A	OM0 C1 Boles removed / Moderate compaction C	OM0 C2 Boles removed / Heavy compaction
OM1 - Boles and crowns removed	OM1 C0 Boles and crowns removed / No compaction B	OM1 C1 Boles and crowns removed / Moderate compaction D/F	OM1 C2 Boles and crowns removed / Heavy compaction
OM2 - Boles, crowns, forest floor removed	OM2 C0 Boles, crowns, forest floor removed / No compaction	OM2 C1 Boles, crowns, forest floor removed Moderate compaction E/G	OM2 C2 Boles, crowns, forest floor removed / Heavy compaction

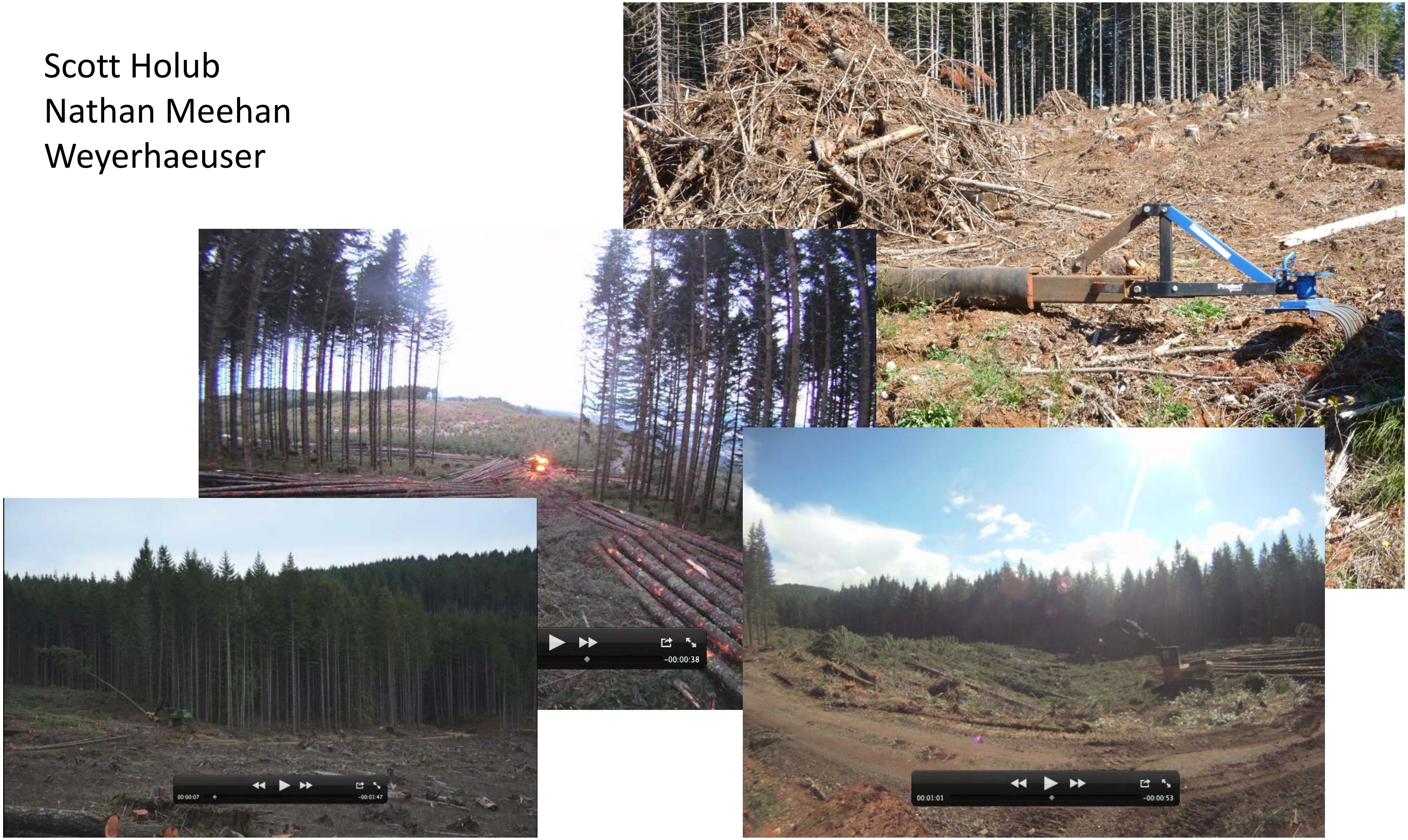
F =D + mid-rotation fertilization

G=E + mid-rotation fertilization

5 | 8/5/2013

Cases: Long Term Soil Productivity

Scott Holub
Nathan Meehan
Weyerhaeuser



Cases: Outreach Efforts

Cases: Outreach Efforts

Cases: Outreach Efforts

Cases: Outreach Efforts

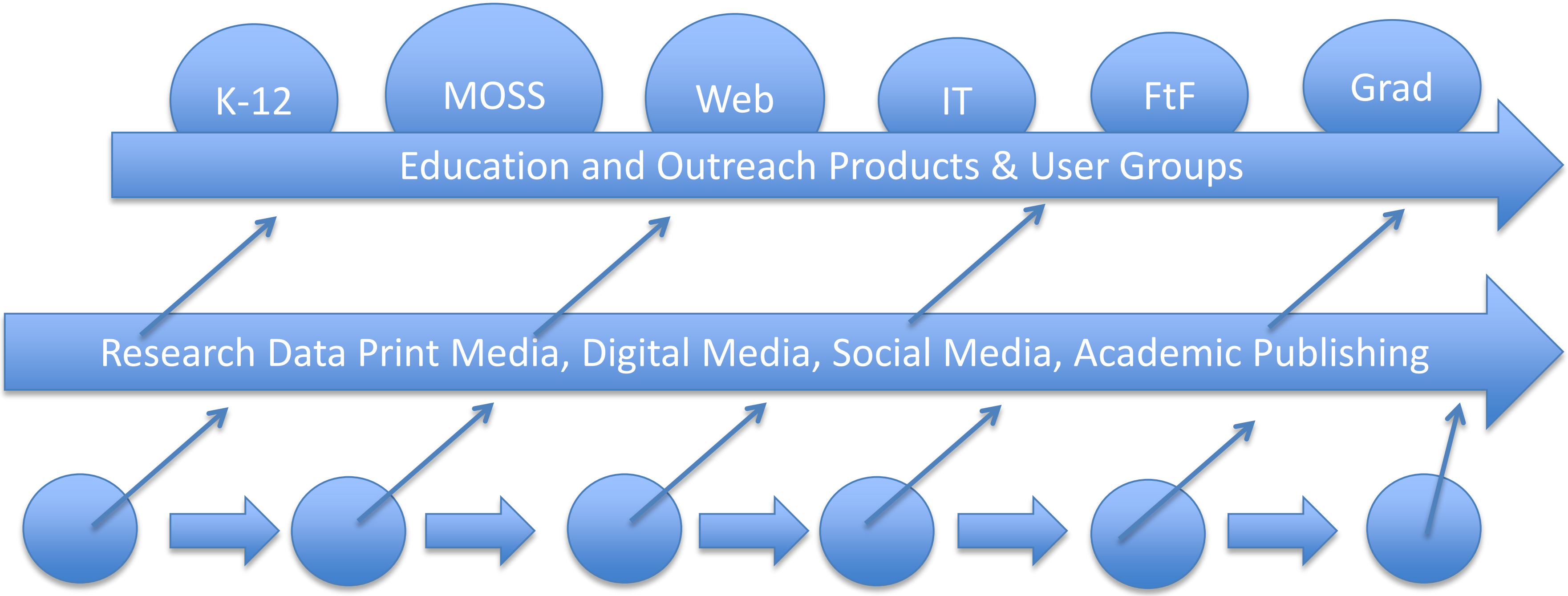
Cases: Outreach Efforts

Cases: Outreach Efforts

Cases: Outreach Efforts

Cases: Outreach Efforts

Flow for Education and Outreach of NARA research



K-12

MOSS

Web

IT

FtF

Grad

Education and Outreach Products & User Groups

Research Data Print Media, Digital Media, Social Media, Academic Publishing

-Life Cycle Analysis
-Community Partnerships
-Capitals Framework

Feed Stock

Transportation

Pretreatment

Conversion

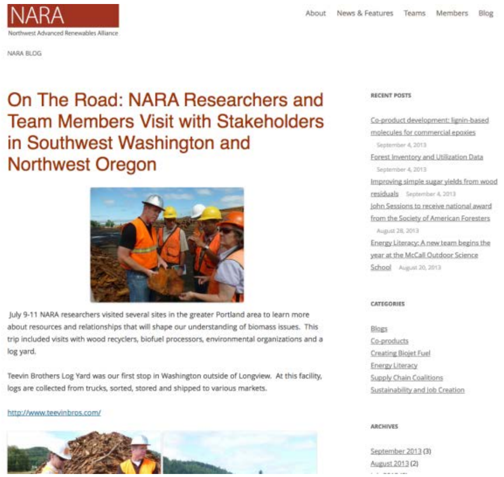
Biofuel and co-products

NARA

Moving Forward

Ways to connect to the Energy Literacy supply chain:

- Using Datasets in lessons
- Graphics to enhance projects
- Guest talks
- Student and teacher support
- Contribute to energylieteracyprinciples.org



NARA
Northwest Advanced Renewables Alliance

NARA BLOG

On The Road: NARA Researchers and Team Members Visit with Stakeholders in Southwest Washington and Northwest Oregon

July 9-11 NARA researchers visited several sites in the greater Portland area to learn more about resources and relationships that will shape our understanding of biomass issues. This trip included visits with wood recyclers, biofuel processors, environmental organizations and a log yard.

Teevin Brothers Log Yard was our first stop in Washington outside of Longview. At this facility, logs are collected from trucks, sorted, stored and shipped to various markets.

http://www.teevinbros.com/

RECENT POSTS

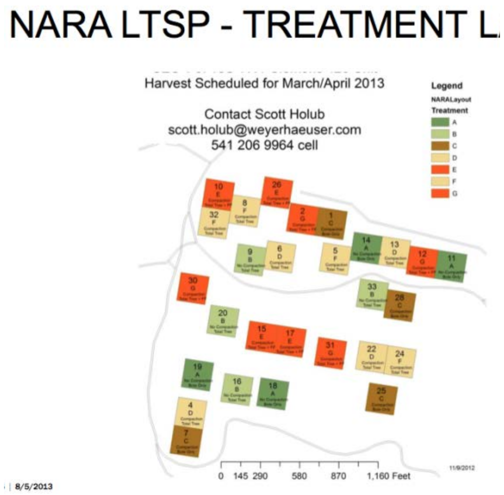
Co-product development: lignin-based molecules for commercial epoxies September 4, 2013
Forest Inventory and Utilization Data September 4, 2013
Improving simple sugar yields from wood residuals September 4, 2013
John Sessions to receive national award from the Society of American Foresters August 28, 2013
Energy Literacy: A new team begins the year at the McCall Outdoor Science School August 20, 2013

CATEGORIES

Blogs
Co-products
Creating Biojet Fuel
Energy Literacy
Supply Chain Coalitions
Sustainability and Job Creation

ARCHIVES

September 2013 (3)
August 2013 (2)

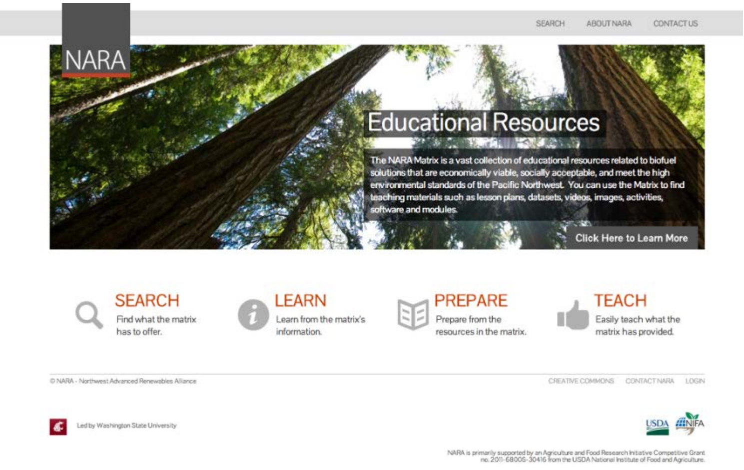


NARA LTSP - TREATMENT L

Harvest Scheduled for March/April 2013

Contact Scott Holub
scott.holub@weyerhaeuser.com
541 206 9964 cell

8/5/2013



Educational Resources

The NARA Matrix is a vast collection of educational resources related to biofuel solutions that are economically viable, socially acceptable, and meet the high environmental standards of the Pacific Northwest. You can use the Matrix to find teaching materials such as lesson plans, datasets, videos, images, activities, software and modules.

SEARCH
Find what the matrix has to offer.

LEARN
Learn from the matrix's information.

PREPARE
Prepare from the resources in the matrix.

TEACH
Easily teach what the matrix has provided.

© NARA - Northwest Advanced Renewables Alliance

Led by Washington State University

NARA is primarily supported by an Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

Education at the Speed of Research: Integrating Research and Education

R. Justin Hougham
NARA Education and Outreach
Assistant Professor, University of Wisconsin-Extension
justin@nararenewables

Todd Cohen (SEED Center) - American Association of Community Colleges; Director, Sustainability Education and Economic Development Centers

Todd Cohen directs the American Association of Community College's (AACC) Sustainability Education and Economic Development (SEED) Center, a multi-million dollar initiative designed to support the community college sector in ramping-up programs to educate America's 21st century environmental and energy sector workforce. Through his leadership, SEED has become, in less than three years, a 485-member formal community of colleges sharing and implementing promising sustainability and clean technology education and workforce practices. Todd has over 15 years experience leading large-scale strategic planning and evaluation initiatives around the country aimed at enhancing the competitiveness of regions through post-secondary, workforce and economic development collaboration.

SEED
Sustainability Education & Economic Development

AMERICAN
ASSOCIATION OF
COMMUNITY
COLLEGES

The SEED Center and Energy 101

June 2014

AMERICAN
ASSOCIATION OF
COMMUNITY
COLLEGES

Community Colleges in the U.S.

1,132 community colleges

45%

...of all U.S. undergraduates

13 million students

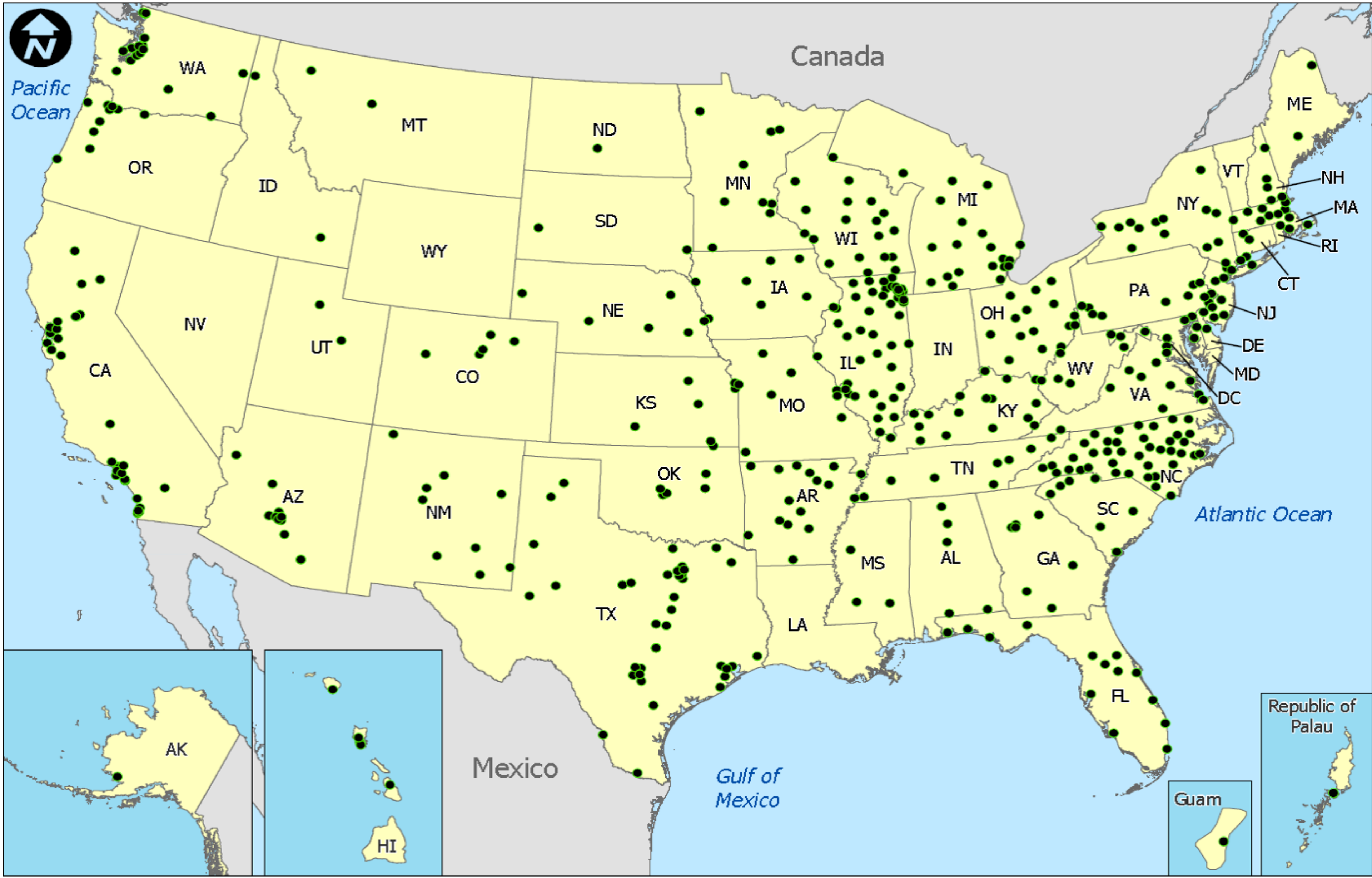
SEED center

Sustainability Education & Economic Development

Supporting community colleges in educating for and building a clean economy

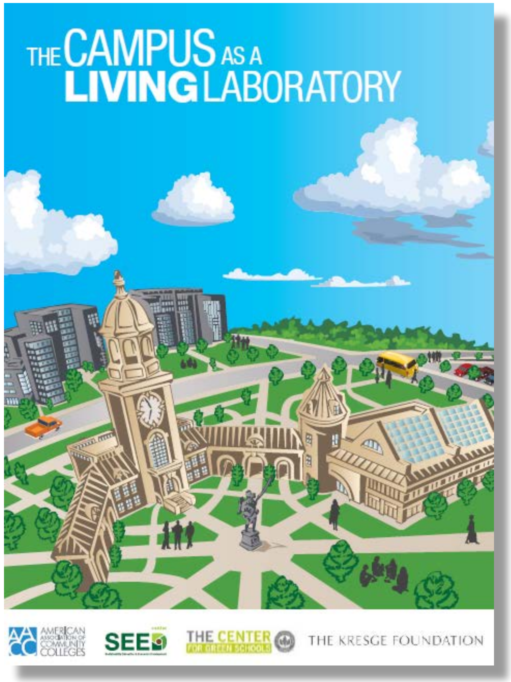
Supported by the Kresge Foundation

482 SEED Colleges



All the tools your college needs: theseedcenter.org

- ✓ **LEADERSHIP DEVELOPMENT** (senior-admin peer mentoring; sustainability messaging)
- ✓ **EDUCATION & TRAINING RESOURCES** (750+ online curricular resources and best practices, tools)
- ✓ **SHARING NETWORK** (Peer-to-peer faculty mentoring, networking, professional development opportunities)



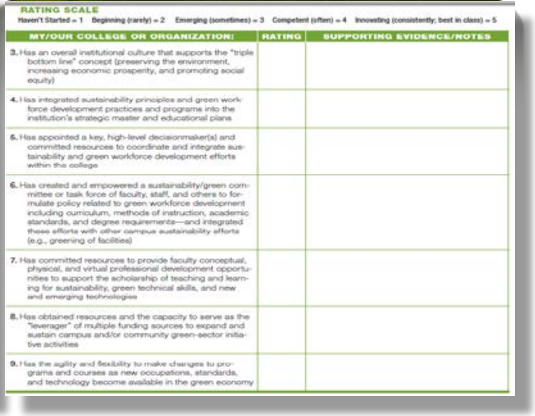
THE CAMPUS AS A LIVING LABORATORY

Free AACC SEED Webinar

December 8, 2011 (2:00PM ET)

Community Colleges Leading Rural-Based Green Economy Initiatives

REGISTER NOW!



RATING SCALE

Haven't Started = 1   Beginning (rarely) = 2   Emerging (sometimes) = 3   Competent (often) = 4   Innovating (consistently; best in class) = 5

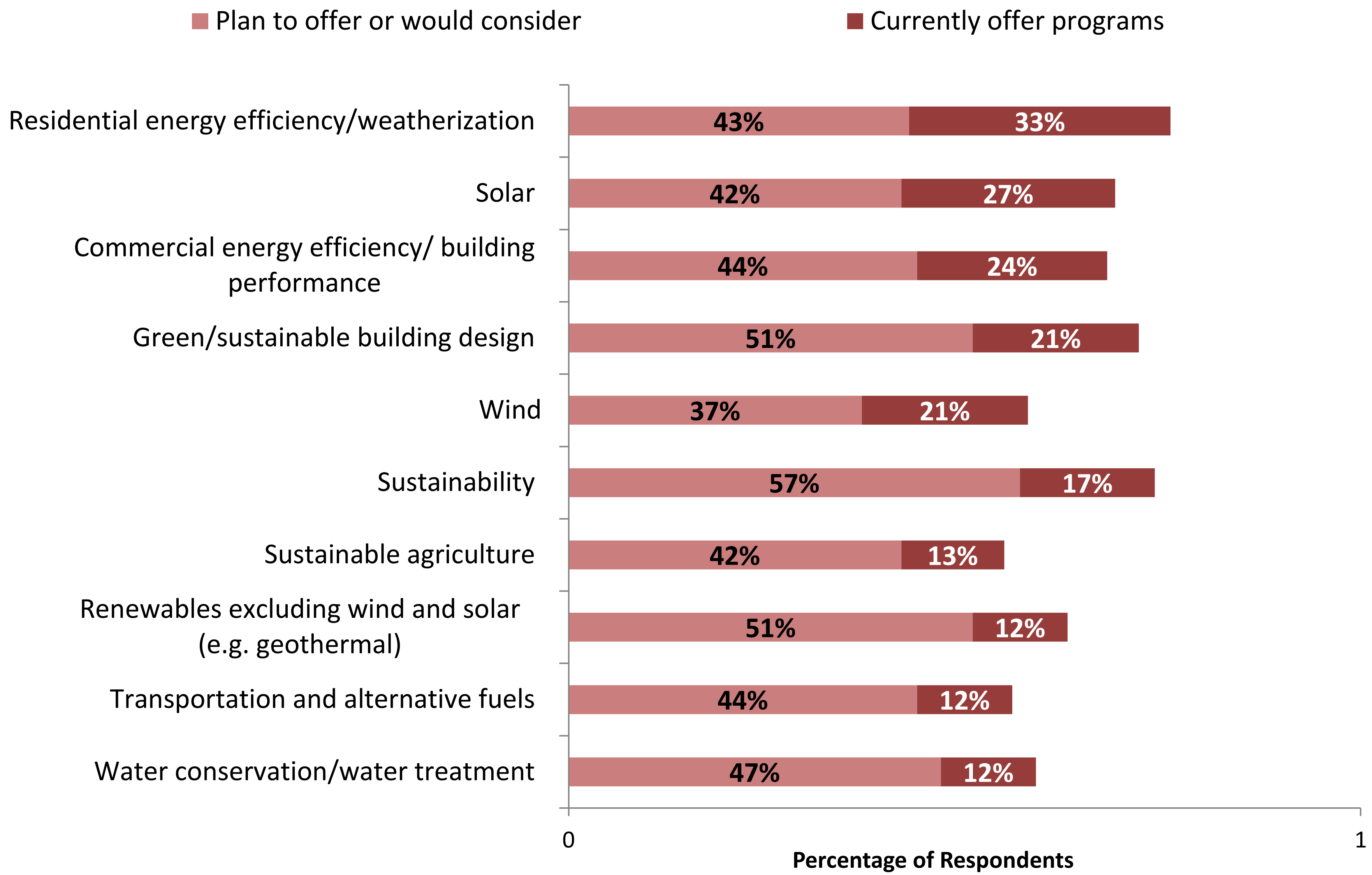
MY/OUR COLLEGE OR ORGANIZATION:	RATING	SUPPORTING EVIDENCE/NOTES
3. Has an overall institutional culture that supports the "triple bottom line" concept (preserving the environment, increasing economic prosperity, and promoting social equity)		
4. Has integrated sustainability principles and green workforce development practices and programs into the institution's strategic master and educational plans		
5. Has appointed a key, high-level decisionmaker(s) and committed resources to coordinate and integrate sustainability and green workforce development efforts within the college		
6. Has created and empowered a sustainability/green committee or task force of faculty, staff, and others to formulate policy related to green workforce development including curriculum, methods of instruction, academic standards, and degree requirements—and integrated these efforts with other campus sustainability efforts (e.g., greening of facilities)		
7. Has committed resources to provide faculty conceptual, physical, and virtual professional development opportunities to support the scholarship of teaching and learning for sustainability, green technical skills, and new and emerging technologies		
8. Has obtained resources and the capacity to serve as the "leverager" of multiple funding sources to expand and sustain campus and/or community green-sector initiative activities		
9. Has the agility and flexibility to make changes to programs and courses as new occupations, standards, and technology become available in the green economy		

2013 AACC Survey

- **80+%** of colleges offer at least one clean technology- or sustainability-focused course
- **~400** clean tech or sustainability-related programs
- College commitment to sustainability education (as either a core institutional function or important to education process): **85%**

center SEED
Sustainability Education & Economic Development

Energy-Related Programs



Community Colleges & Energy 101

- **Capacity** exists at community colleges to adapt Energy 101 curriculum
- **Interest** is strong and growing
- **Suggestions**:
  - Enhance awareness of the framework
  - Provide light TA/tools to increase adaptation
  - Connect with TAACCCT energy-related grantees (SEED has segmented those at): http://www.theseedcenter.org/Special-Pages/TAACCCT-Resources-and-Support.aspx

Contact Info

Todd Cohen

Director, SEED Center, AACC

Sustainability@aacc.nche.edu

Dr. David Blockstein (National Energy Education Summit) - National Council for Science and the Environment; Senior Scientist and Director of Education

SAVE THE DATE

National Energy
Education
Summit

January 26, 2015

Hyatt Regency Crystal City
near
Washington, DC

Organized by the Council of Energy Research and Education Leaders (CEREL)

ncseonline.org/2015-national-energy-education-summit

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Federal Resources for students and post secondary energy education

#Energy101

Dr. Matthew Garcia[1]

Science & Technology Policy Fellow
Department of Energy

September 20th, 2013

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[1] All opinion presented are my own

All image rights and credits to original creators

Opportunities for Student Engagement

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Competitions
2. Internships
3. Federal partners in education & Workforce training

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

EERE RESOURCES FOR UNDERGRADUATE STUDENTS

Looking to expand your experience outside of the classroom? The Office of Energy Efficiency and Renewable Energy (EERE) at the U.S. Department of Energy (DOE) has a number of resources available for undergraduate students, including competitions, internships, and career-planning information to help you navigate the education-to-employment pathway in energy. The following is a partial list of the undergraduate activities and programs that are offered. For a complete listing, visit our Energy Education and Workforce Development website: *energy.gov/eere/education*

Competitions

Better Buildings Case Competition

Gain practical experience and critical skills while working to solve real-world issues affecting energy efficiency in buildings. In this annual competition, interdisciplinary teams of university students develop creative solutions and showcase their ideas to a panel of judges, allowing the teams to interact directly with industry and government leaders. Become a part of the next generation of engineers, entrepreneurs, and policymakers in clean energy.
eere.energy.gov/buildings/betterbuildings/casecompetition

National Clean Energy Business Plan

The National Clean Energy Business Plan Competition is designed to build regional networks of student-focused business creation contests across the country. Six regional organizations were funded under the competition to hold clean energy business plan competitions, which are open to currently enrolled undergraduate and graduate students. Winners of the regional contests will receive $100,000 to fund their business plans and a chance to compete in the national contest.
eere.energy.gov/commercialization/natlbizplan.html

Internships

Science Undergraduate Laboratory Internships (SULI) Program

Are you interested in a Science, Technology, Engineering, and Mathematics career? The Office of Science offers research experiences for undergraduate students at the DOE National Laboratories. Interns in the SULI Program will perform research under the guidance of laboratory staff scientists or engineers, assisting on projects related to ongoing programs. There are internship openings at most of the U.S. national laboratories.
science.energy.gov/wdts/suli

DISTANCE-Solar Program

The DISTANCE-Solar Program encourages minority students to pursue careers in science and technology by supporting research associates and professors/principal investigators from selected schools as they perform renewable energy research projects during the academic year. The program is funded by the Solar Energy Technologies Office and has the dual goal of placing underrepresented minorities in Science, Technology, Engineering, and Mathematics programs, while helping to make solar cost competitive.
go.usa.gov/WKUm

Clean Cities Internships

Each year, students are able to work with the Clean Cities coalitions to increase awareness of alternative fuels and advanced vehicle technologies and their potential for petroleum reduction. Interns work with coordinators and stakeholders in the community to plan events, analyze data, research markets, design websites, and promote initiatives through social media and public relations.
eere.energy.gov/cleancities/toolbox/internship_program.html

EERE Student Internships

EERE offers exciting student volunteer internships throughout the year in its Washington, D.C., headquarters. These volunteer internships provide students with the opportunity to learn through direct experience about the field of energy efficiency and renewable energy.
eere.energy.gov/office_eere/oe_internships.html

Tribal Energy Program Internships

Looking for a summer internship? The Tribal Energy Program offers technical project internships at Sandia National Laboratories (SNL). There, interns will immerse themselves in collaborative work with SNL's renewable energy staff, Native American tribes interested in renewable systems, and SNL's American Indian Outreach Committee.
eere.energy.gov/tribalenergy/internships.cfm

Industrial Assessment Centers

Engineering students can receive hands-on training and real-world experience in energy engineering and management by participating in DOE's Industrial Assessment Centers. Teams located at 24 universities around the country conduct cost-free energy assessments of small- and medium-sized manufacturers to identify opportunities to reduce waste, improve productivity, and save energy.
eere.energy.gov/manufacturing/tech_assistance/iacs.html

Photos: (front, top to bottom) NREL, energy.gov; (back, top to bottom) energy.gov, DOE Pinterest, NREL.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For more information, visit:
energy.gov/eere/education

DOE/EE-1037 • April 2014

National Clean Energy Business Plan Competition – National Competition

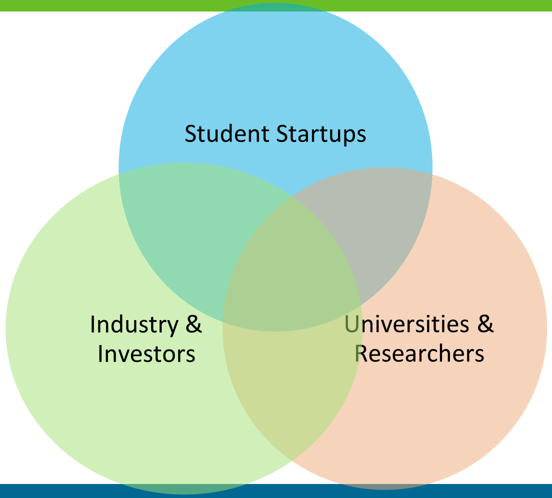
NATIONAL CLEAN ENERGY
BUSINESS PLAN COMPETITION
U.S. DEPARTMENT OF ENERGY

The National Clean Energy Business Plan Competition is a student-led competition comprised of six regional competitions, culminating in a National Competition in June.

- Western Southwest Region (deadline: February 21, 2014) – Rice Business Plan Competition run by Rice University
- Southeastern Region (deadline: February 14, 2014) – ACC Clean Energy Challenge run by University of Maryland
- Eastern Midwest Region (deadline: varies by state, check here for more information**)** – Clean Energy Trust Clean Energy Challenge run by Clean Energy Trust
- Western Midwest Region (deadline: February 24, 2014) – CU Cleantech New Ventures Challenge run by University of Colorado-Boulder
- Northeast Region (deadline: February 28, 2014) – MIT Clean Energy Prize run by Massachusetts Institute of Technology
- Western Region (deadline: March 4, 2014) – First Look West run by California Institute of Technology

About the NCEBPC

- ◊ **600 teams** involved in 2012-2013 NCEBPC
  - o More than **55 startups** incorporated
  - o **55 patents and disclosures** have been filed
  - o **89+ jobs** created
  - o More than **$19M** in follow-on funding
- ◊ Over **$700k in prizes** across the country for participants



Internships

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science.energy.gov/wdts/suli

Federal Energy and Manufacturing Education and Workforce Training

Listings of Energy and Manufacturing education and workforce related programs across the federal government including DOE programs and activities.

Energy.gov/eere/education/federal-energy-and-manufacturing-workforce-training-programs

Resources and Useful Links

Education and Workforce Homepage

Energy.gov/eere/education/education

Competitions

Energy.gov/eere/education/competitions

Internships

Energy.gov/eere/education/find-internships

Federal Energy and Manufacturing Workforce Training Programs

Energy.gov/eere/education/federal-energy-and-manufacturing-workforce-training-programs

5. Conclusions and Next Steps

#Energy101

Energy 101 Dialogue 1# Conclusion

The ask: What do we need to increase efforts and access to energy education in the nations universities and community colleges?

The takeaway: The answers, and best practices reside with the energy education community.

#Energy101

Energy 101 Dialogue 1# Next Steps

Next Steps: Finding ways to engage with you and get your input!

Energy 101 Initiative website
Energy.gov/eere/energy101

Energy 101 Inbox: Energy101@ee.doe.gov

Energy 101 Dialogue Series (Fall 2014):

Next Dialogue will concentrate on institutional issues surrounding the creation of energy minors and majors

Energy Literacy Virtual Town Hall- August 5th

Energy.gov/eere/education/events/power-collaboration-national-energy-literacy-virtual-meet