

# Energy Education & Workforce Development

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## Webinar: Energy Education and BITES

November 19<sup>th</sup>, 2012

**Matthew Garcia**

AAAS Science & Technology Fellow  
EERE-EEWD

## Webinar Agenda

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**Energy Education and the use of IT, simulations and other online learning tools in energy education**

**DOE-Education and Workforce Development:** Overview of EWD, Energy literacy and Energy 101 and IT strategy

Matthew Garcia- EERE EWD- AAAS Science and Technology Policy Fellow

**BITES:** Buildings, Industry, Transportation, and Electricity Scenarios tool, or BITES

Austin Brown- Adjunct Faculty at John Hopkins University & Senior Analyst for Strategic Planning at National Renewable Energy Lab (NREL)

**Open Session:** Discussion, Brainstorming, Questions



# Energy Education & Workforce Development

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

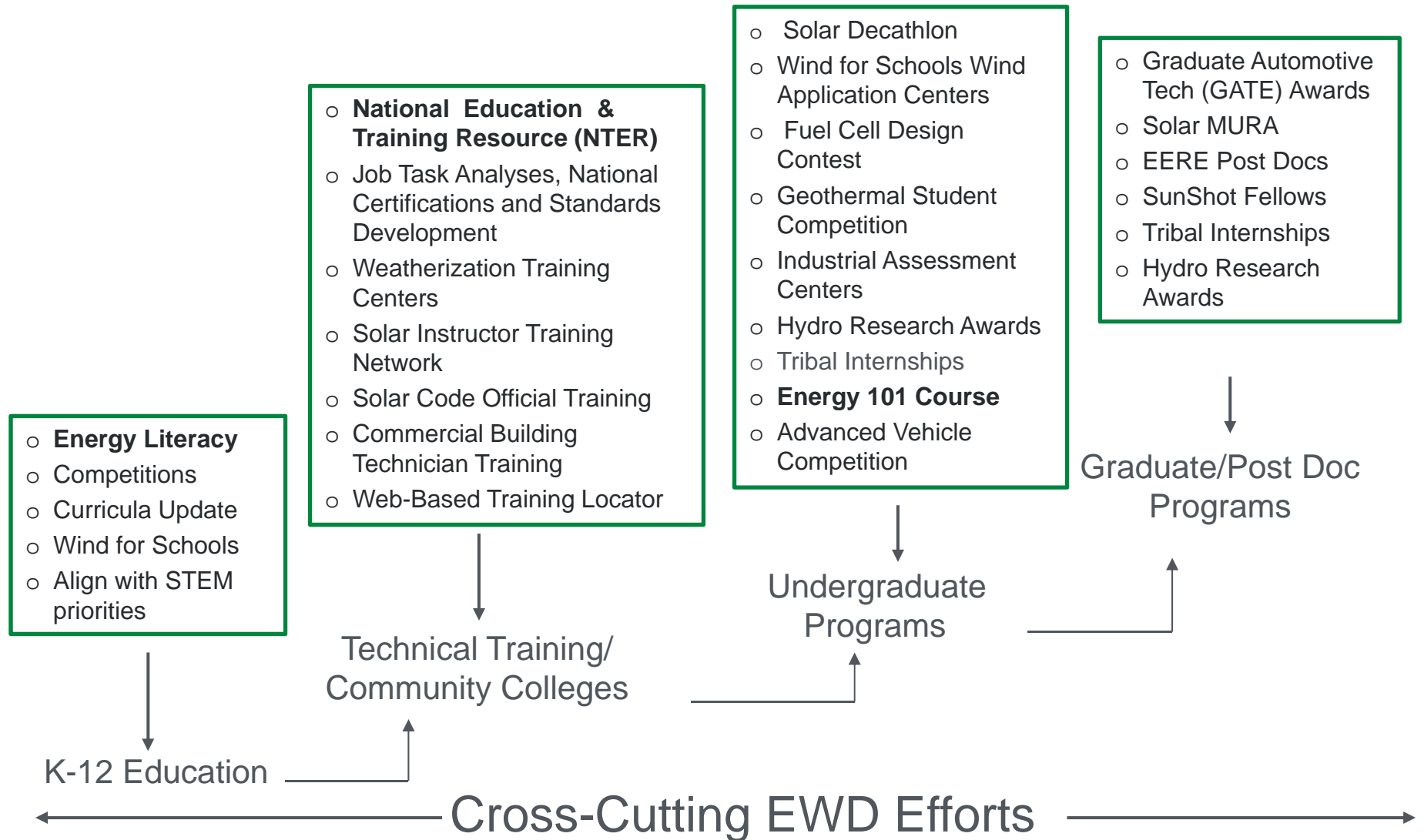


## Energy literacy and Energy Education

**Matthew Garcia**

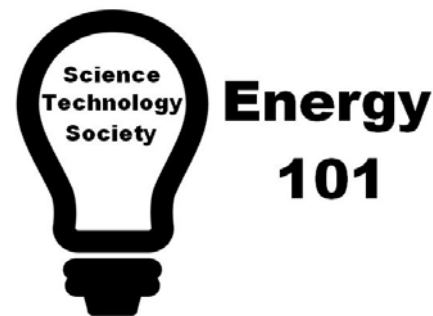
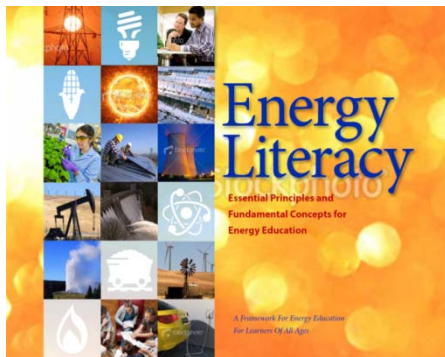
AAAS Science & Technology Fellow  
EERE-EEWD

# EERE Activities Across the Education / Training Pipeline



Web Site - Materials - Interagency Coordination - Outreach - Evaluation

1. Energy Literacy Initiative
2. Energy 101 Project
3. National Training and Education Resource (NTER)



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

**Only 12% passed a basic quiz on awareness of energy topics (general knowledge/ not technical or scientific)**

National Environmental Education and Training Foundation ; “Energy Literacy in America<sup>1</sup>” 2002,

## Americans' Perceived and Actual Understanding of Energy- August 2012; RTI International <http://www.rti.org/publications/rtipress.cfm?pid=19416>

**79 percent either agree or strongly agree that energy is a topic that “people like me” can understand**

**49% of respondents believed that “it is possible to build a machine that produces more energy than it uses”**

**59% improperly identified what the most used renewable electrical energy source in the US is (Hydropower).**

**35% unable to properly define what a renewable energy resource was**



**Results suggest there is a gap between perception and the reality of energy knowledge**

**Good News is.....**

**Majority of public agrees that energy conservation should be taught in schools, and that there needs to be a greater emphasis on education to solve our energy problems<sup>1</sup>**

(National Environmental Education and Training Foundation ; “Energy Literacy in America<sup>1</sup>” 2002)



**We then asked the nations universities & community colleges to give us.....**

a status of energy education and workforce development programs at the K-12, community college, undergraduate, graduate, and doctoral level...

Identify the greatest gaps and deficiencies in energy education and technical training

Identify the most promising ideas for increasing energy literacy, attracting the best and brightest students into the clean energy field, ensuring America has the well-trained workforce for a transformed energy sector....

- Forecasted future energy workforce
- Called for increasing energy literacy and education to fill gaps K-20.
- Identified efforts underway by universities towards more energy related course work
- Use online technology in energy education efforts
- **Coordination of efforts, sharing of resources & best practices**

- **American Association of Physics Teachers**

For the United States to modernize its energy systems and advance its energy technologies, more people must become better educated in the energy sciences

- **University of Wisconsin Energy Institute**

....support and encourage training activities that span multiple domains from undergraduate minors (certificates), majors and masters programs in energy-related fields. For developing curriculum, a national clearinghouse for course content could streamline this process.

One could provide web-based course materials to students across campuses to broaden course offering and to assist them in modifying their own in-house educational and training approaches.

- **IEEE USA**

Create tutorial or education modules that provide the fundamental basics behind efficiency of energy, energy conversion processes....fundamental laws.

- **Texas A&M University**

Distance delivery technologies are instrumental in providing quality education simultaneously to students at several institutions...leverage the capabilities of one university and make the courses available to several other campuses

- **Energy Solutions**

Current math, science, and humanities curriculums are organized as discrete hierarchies focused almost exclusively on preparing students for the next rung up in the disciplinary sequence.

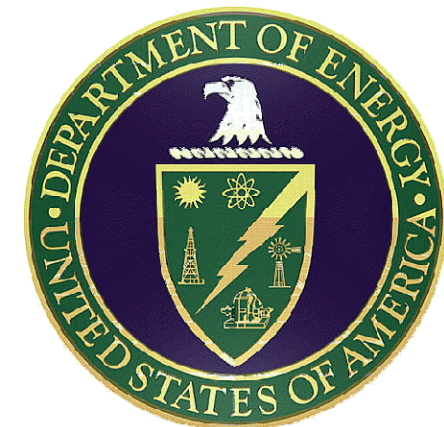
***Make energy part of a national core curriculum.***

## *DOE Strategic Plan...Promote Energy Literacy*

The Department will actively participate in the development and implementation of a coordinated national “energy education” or “energy literacy” effort. A modest understanding of energy sources, generation, use and conservation strategies will enable informed decisions on topics from home energy use to international energy policy. The Department will leverage relationships with academic institutions, other federal agencies, industry, organizations, and other stakeholders to improve awareness and understanding of energy issues.

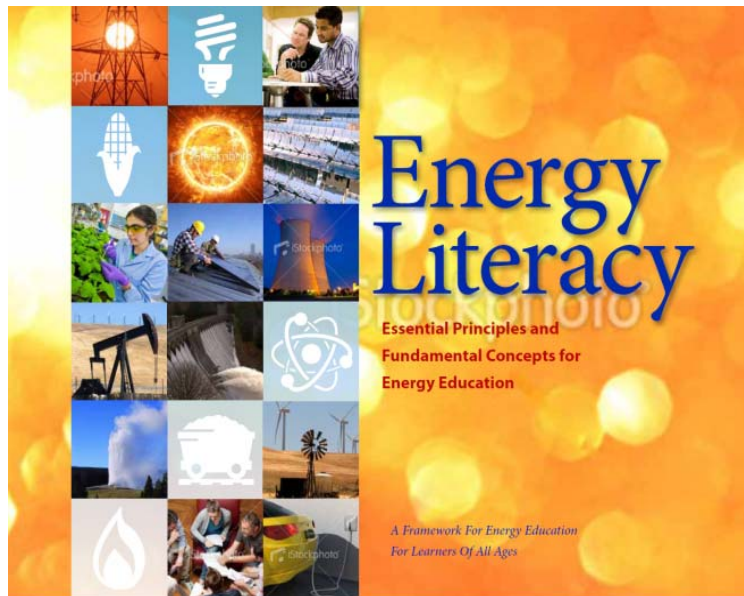
### **Targeted Outcomes:**

- Identify by 2012 the most promising educational opportunities to improve domestic energy literacy.
- Provide online energy literacy content by 2013 for the National Training and Education Resource platform. **[DOE Strategic Plan, May 2011]**






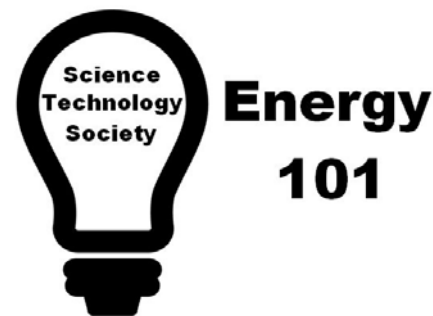
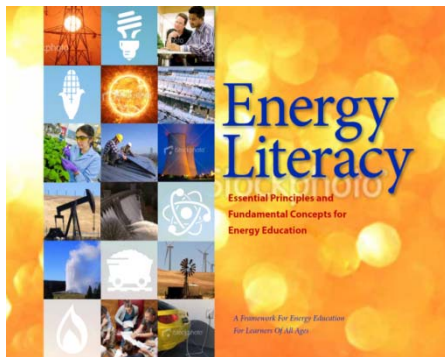
# Energy Literacy : Essential Principles and Fundamental Concepts in Energy Education



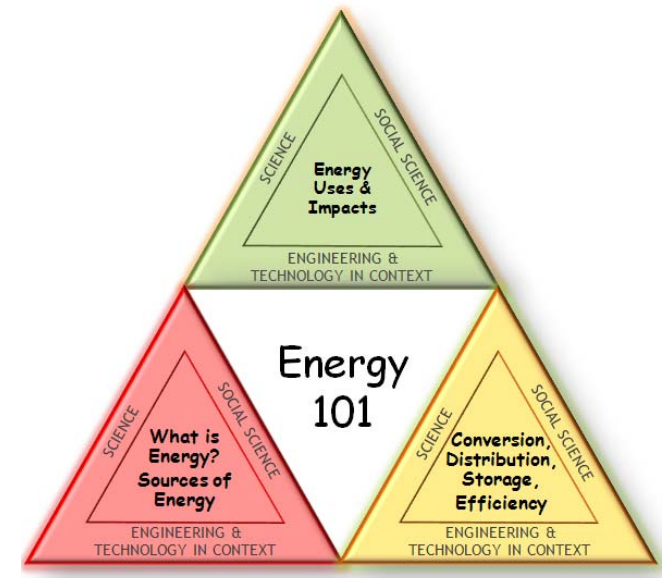
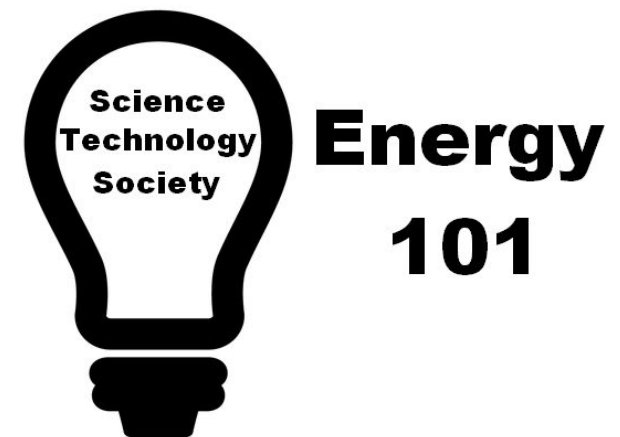
- Derived from the engagement of an expansive and broad assortment of stakeholders
- 250 different offices, organizations, and education partners
- Accuracy review by Federal Agency content experts
- 13 USGCRP agencies approved document language (DOE, DOD, DOC, HHS, DOI, State, DOT, EPA NASA, NSF, USAID, DOA, Smithsonian Institute) & OSTP

- 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. Energy Literacy Initiative
2. Energy 101 Project
3. National Training and Education Resource (NTER)



- An effort to increase the pathways to energy related degrees and energy careers offered at the nation's universities and community colleges by supporting the creation of a universal, peer reviewed and accredited undergraduate level energy fundamentals course "Energy 101"
  - Use the framework provided by the energy literacy fundamentals document as the core for the course
  - Leverage IT by using the National Training and Education Resource (NTER) for delivery, sharing, and authoring of Energy 101 course content



# Energy 101 Partners



217 members, universities, colleges,  
And related organizations  
3.5 million Undergraduate Students  
1.1 million Graduate Students

<http://www.aplu.org/energy101>



105 members, university consortium

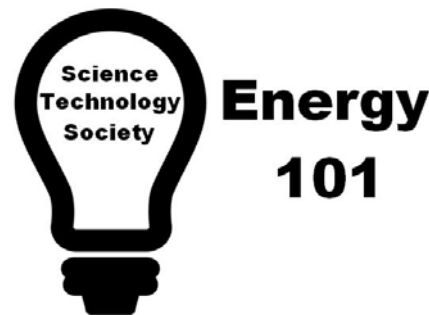
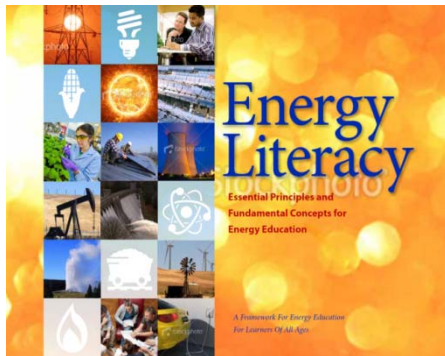
<http://www.orau.org>



- Completed gap analysis of undergraduate energy education in Higher Ed
- Creation of Energy 101 Course Outline aligned with energy literacy fundamentals
  - Reviewed by external and internal energy education experts
- Energy 101 pilot courses in Spring and Fall of 2013 to be **deployed on NTER**



1. Energy Literacy Initiative
2. Energy 101 Project
3. National Training and Education Resource (NTER)



# Deployment through the National Training & Education Resource (NTER)

The screenshot shows the NTER website homepage. At the top, it says "NTER National Training & Education Resource" and "National Training & Education Resource". There are navigation links for "Home", "Courses", "About", and "Forum". A search bar is present with the text "Search for courses!" and a link to "See All Courses". Below the search bar are tabs for "Learn", "Teach", and "Institutions". The main content area is divided into two columns. The left column has a heading "Learn new skills and advance your career" and a paragraph describing NTER as an easy-to-access, open source, web-based learning platform. It also includes a sub-heading "Update your existing knowledge or discover a new field of learning – Get started today!". The right column has a heading "NTER featured as part of US Ignite app competition!" and a paragraph about the US Ignite Partnership. Below the main content are two sections: "Featured Courses" and "Popular Courses". Each section displays several course cards with images, titles, star ratings, and the website URL "www.ntelearning.org".

Online, open source training and education platform

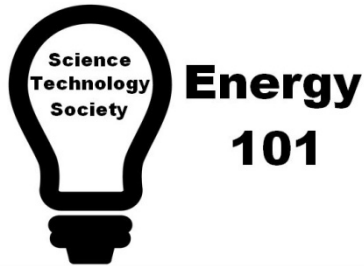
- Content Creation, Storage, and Delivery

Began as a training platform for weatherization

Proved to be very successful in this role, providing a free platform to create and delivery training content using next generation web technology and leveraging new IT based learning tools

<http://www.ntelearning.org>

# Examples, Simulations, Aps, and Energy education



Energy 101 and NTER- hope to leverage training content success and new learning tools in energy education with Energy 101

Utilization of current Simulations, calculators, aps, etc.

Creation of new simulations, calculators, aps

BITES

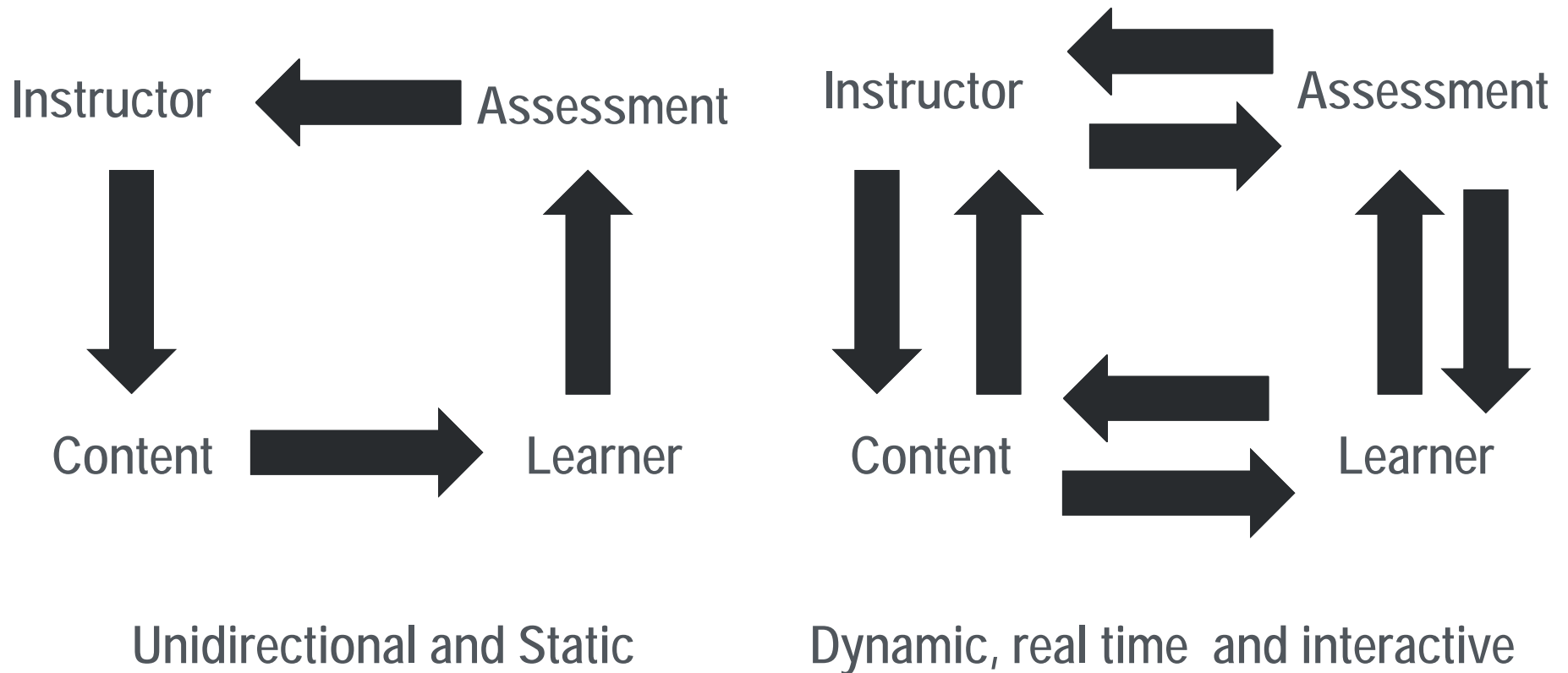
[PhET](#)

Identification of where there is a need in concepts of energy education for the Next BITES, Next PhET's

Ex. UM- Energy 101- Watershed/Solar House



# Leverage new learning tools and technology to transform energy education



Energy Literacy and Energy 101  
Department of Energy EERE Contacts

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[Matthew.Garcia@ee.doe.gov](mailto:Matthew.Garcia@ee.doe.gov)

NTER Introductory Webinar

December 6<sup>th</sup>, 1pm EST

<https://www1.gotomeeting.com/register/283694648>

Energy 101 Forum

<http://www.nerlearning.org/forum/energy101>

- <http://phet.colorado.edu/en/simulation/generator>
- <https://www.nerlearning.org/web/guest/course-details?cid=250>

## Buildings Industry Transportation & Electricity Scenarios



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# BITES

Explore and create  
energy scenarios...

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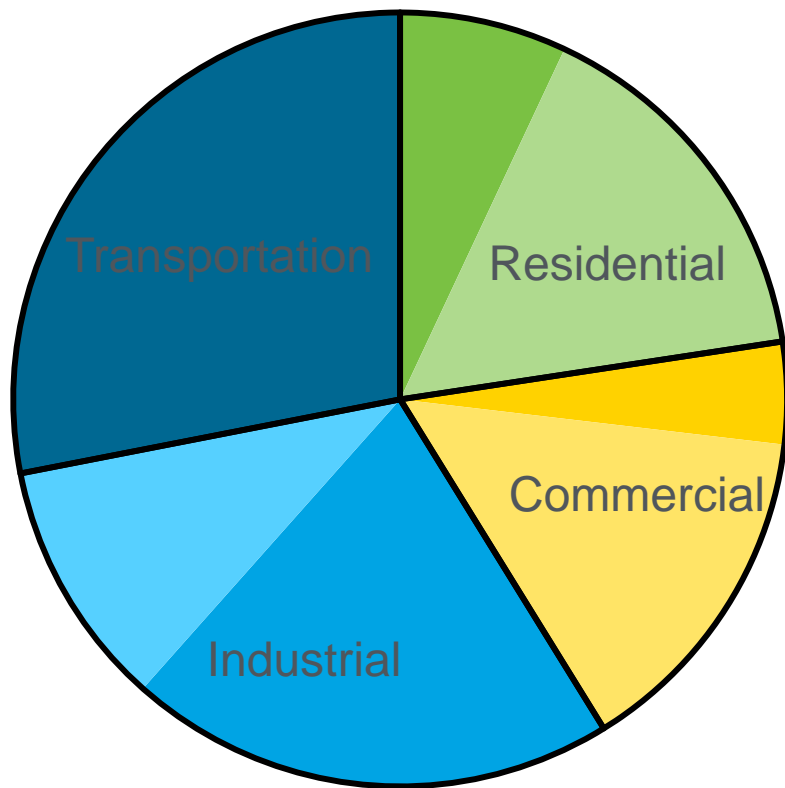
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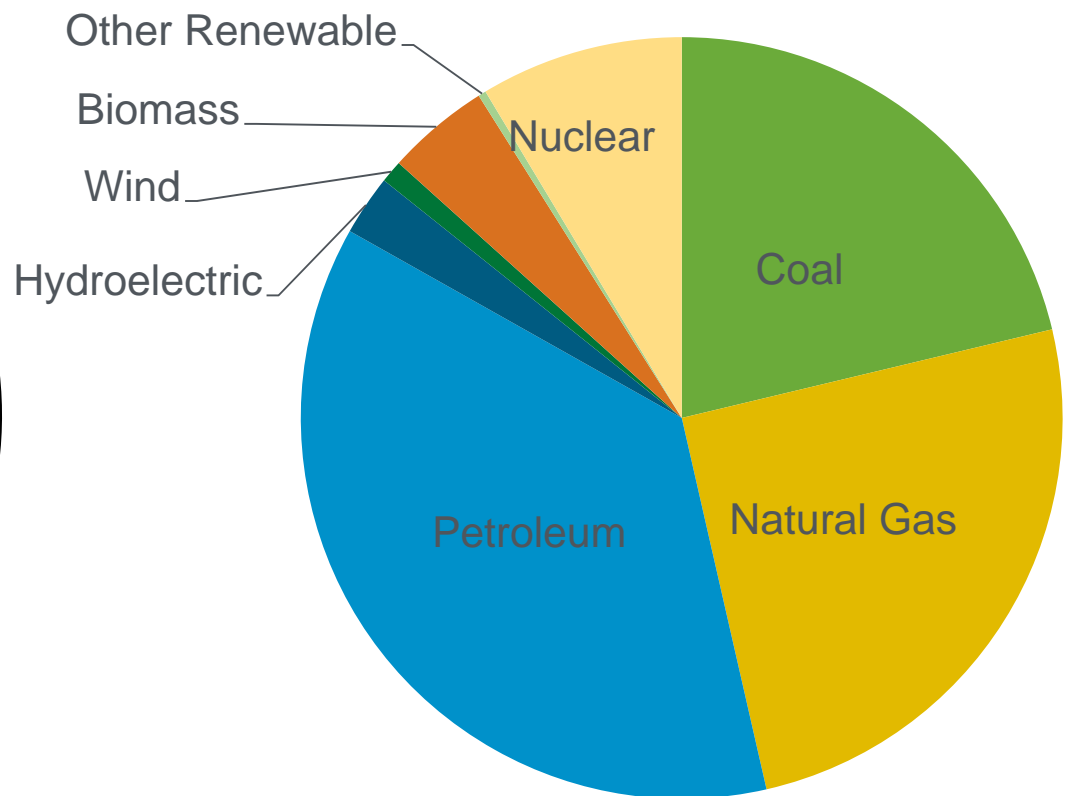
- 5 minutes: overview and history
- 10 minutes: quick demo
- 5 minutes: summary of pilot workshops thus far
- Discussion and questions.



### Primary Energy Use by Sector



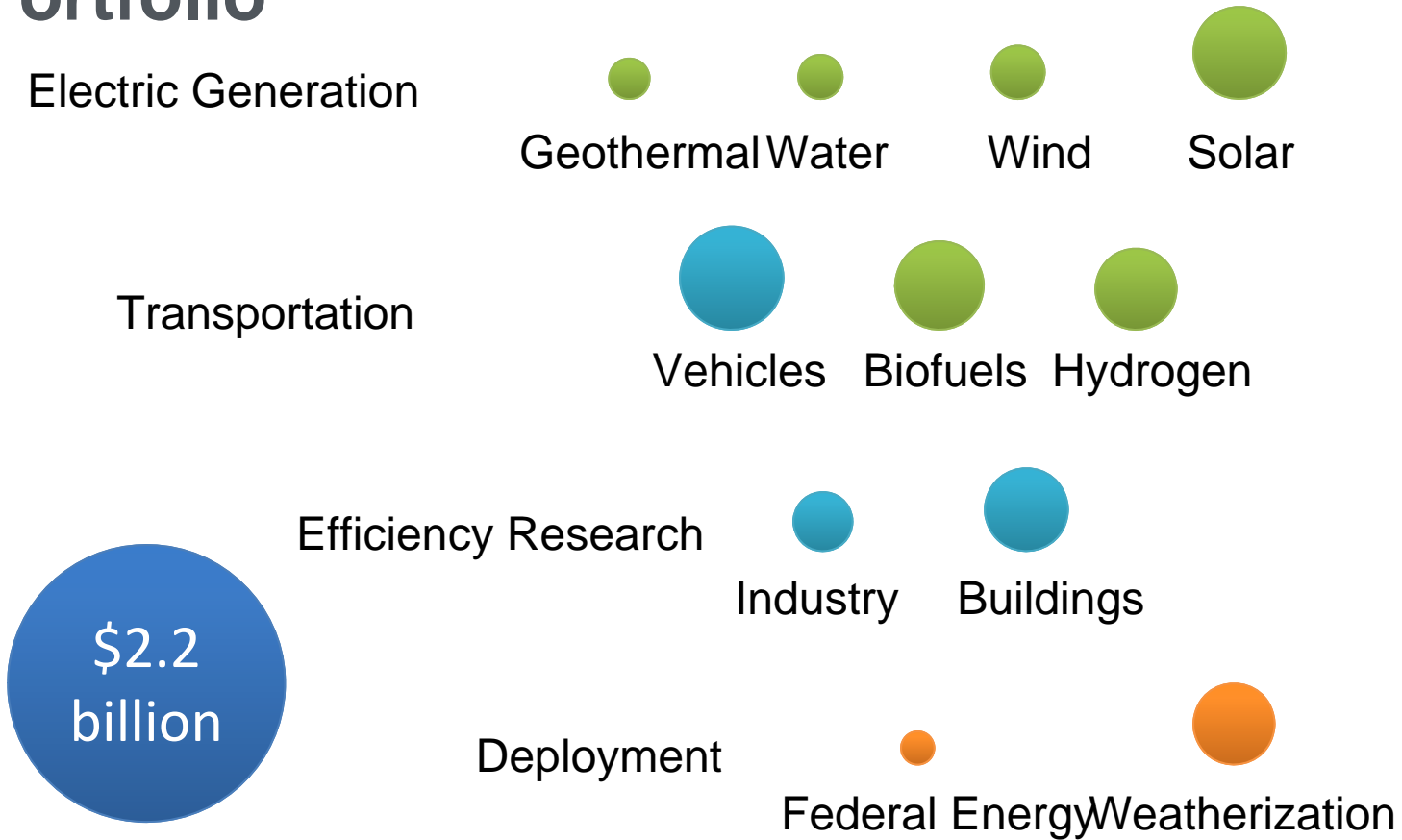
### Total Primary Energy Use by Source



Energy use (total 98 quadrillion Btu)

- Energy use is intrinsic to the whole economy
- We use a wide variety of different sources of energy for a wide variety of different end uses
- The news and other sources are inundated with pros and cons for many energy options
- Learning about and comparing the impact of various options is important, but with such a complex system, it is extremely challenging.

# The Office of **Energy Efficiency** and **Renewable Energy** (EERE): Multiple Goals and a Diverse Portfolio



\$2.2  
billion

- EERE has diverse goals (environmental, economic, energy security) and diverse programs, on the supply and demand side of energy
- We developed tools to combine the impacts of technology development and deployment in all these EERE areas
- These tools were instructive for the team, so we developed a version for the web.

# Four Sectors in BITES



## Buildings

- Building Codes
- Retrofits
- Appliance Efficiency



## Transportation

- Light-duty Vehicle Efficiency
- Heavy-duty Efficiency
- Renewable Fuels
- Demand (Miles Driven)



## Industry

- Industrial Efficiency
- Fuel Switching



## Electricity

- Natural Gas
- Renewables
- Nuclear
- Carbon Capture and Sequestration



# Demonstration

## Buildings Industry Transportation & Electricity Scenarios



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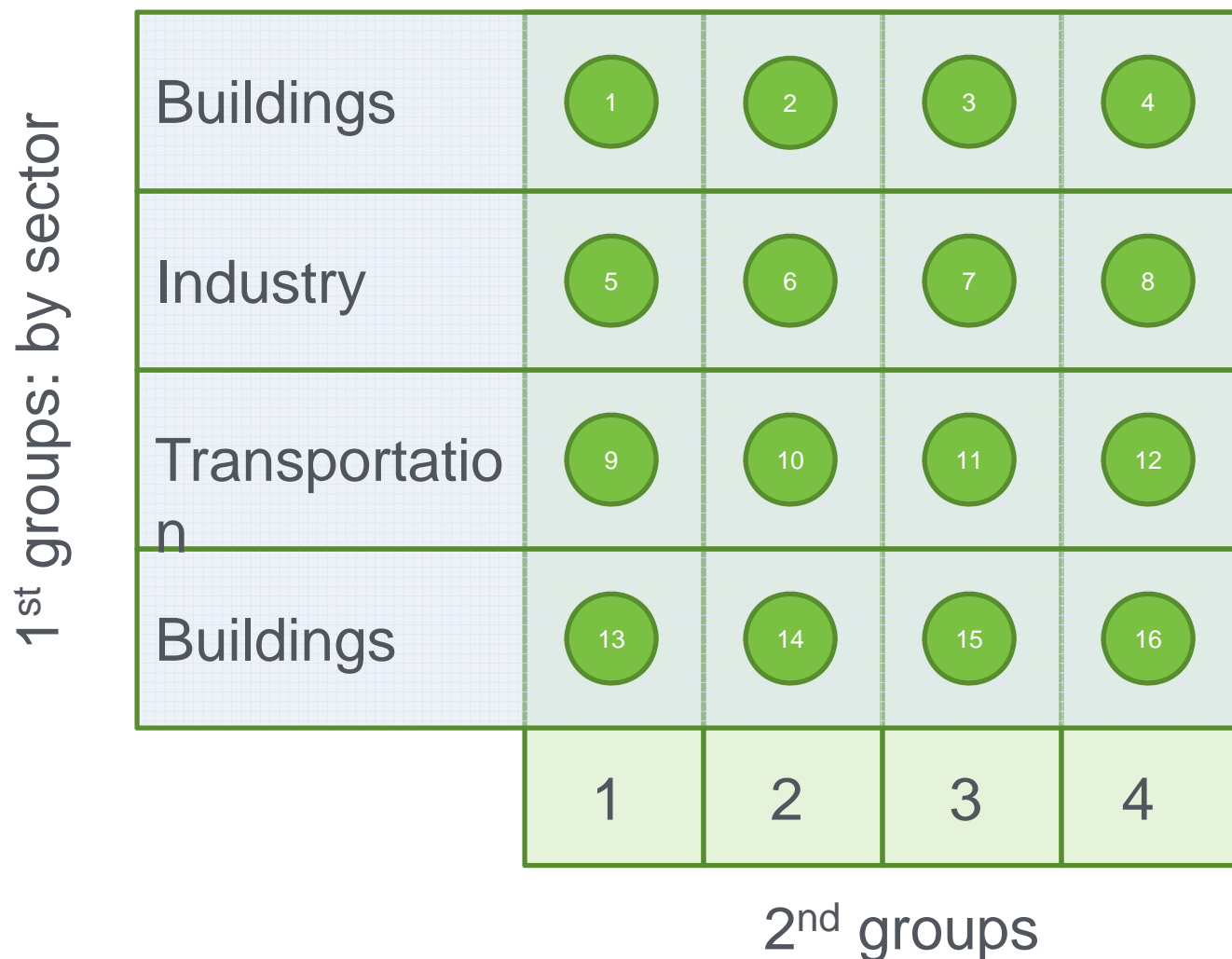
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- Gain familiarity with the U.S. energy profile
- Explore the trade-offs between sectors and individual technologies
- Generate a realistic cross-sector scenario that meets or approaches energy and carbon emission targets
- Discuss, compare, and justify selected scenarios.

- Develop a draft curriculum
- Optional: pre-lesson readings (45 minutes – 1 hour, suggested pages and links provided)
- Workshop timeline (approximately three class time hours, 10 minute break in the middle):
  - *Introduction (30 minutes)*: covers U.S. energy use, the prospects for clean energy, and societal context
  - *BITES demo (10 minutes)*: run through the features of the tool
  - *Sector exercises (45 minutes)*: student groups attempt to meet energy and emissions goals by implementing changes in one sector each (buildings, transportation, industry, electricity)
  - *Group exercises (45 minutes)*: redistribute students among different groups so each group has at least one representative from each sector to be an ‘expert’; focus on developing a combined scenario to meet goals
  - *Presentation, discussion of scenarios, and class consensus scenario (40 minutes)*: constructive discussion of the plausibility of scenario components.

# Groups



- Three pilot workshops so far
- Between 6 and 40 students
  - University of Michigan (40)
    - Single class, studying energy technology and policy; mix of graduate and advanced undergraduate students
    - Workshop near the end of the semester
    - High level of average familiarity with energy issues
  - Santa Clara University (30)
    - Sustainability interest group; mix of graduate students, advanced undergraduate students, and faculty
- Feedback incorporated into curriculum and tool development plans.



- Looking for volunteers to run or host pilot workshops
- Feedback on curriculum
  - Big or small changes?
  - Continue to develop one version, or split into different lengths and expertise levels?
- Feedback on overall site (usability, etc.).

# Questions?

- Beta version: <https://bites.nrel.gov/>.
- For more information: [Austin.brown@nrel.gov](mailto:Austin.brown@nrel.gov).

(Some screenshots from the demo just in case)

# BITES

Explore and create energy scenarios...

[Get Started](#)

## Welcome to the BITES Tool - Beta

The Buildings Industry Transportation Electricity Scenarios (BITES) Tool is a scenario-based tool for analyzing how changes in energy demand and supply by economic sector can impact carbon dioxide emissions. BITES permits the rapid screening and exploration of energy options and technologies that can lead to major reductions in greenhouse gas emissions and reductions in oil dependence.



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New Scenario

## Featured Scenarios

	Scenario Name	Description	Mode	Shared?
	<a href="#">TEF Scenario</a>	Based on the Transportation Energy Futures study as presented at the World Renewable ...	Advanced	Public

## My Scenarios

	Scenario Name	Description	Mode	Shared?
	<a href="#">scenario_1</a>	[New Scenario Description]	Basic	Private
	<a href="#">Intro Video</a>	The scenario described in the BITES introduction video	Basic	Public
	<a href="#">SCU Workshop</a>	SCU Consensus	Basic	Private

## Shared Scenarios

	Scenario Name	Description	Mode	Shared?
	<a href="#">AEO 2010 Base Case</a>	Advanced mode inputs using 2010 AEO reference data	Advanced	Reference



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## Create New Scenario

Name:

Quick Demo

Input Mode:

- Basic
- Advanced

Base Data:

AEO 2011

Description:

[New Scenario Description]

Create

Cancel

New Scenario

## Featured Scenario

Scenario



TEF Sce

## My Scenarios

Scenario



scenario



Intro Vide



SCU Wor

## Shared Scenarios

Scenario Name

Description

Mode

Shared?



AEO 2010 Base Case

Advanced mode inputs using 2010 AEO reference data

Advanced

Reference

[Buildings](#)[Industry](#)[Transportation](#)[Electricity](#)[User Comments](#)

Click on the link below to post a comment to this scenario.

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## Quick Demo (AEO 2011 Base Case)

**Buildings**

Industry



Transportation



Electricity

Improvements to New Buildings in 2030

30%

*(30 to 75)*

Percent of Existing Buildings Retrofitted by 2050

0%

*(0 to 100)*

Percent Efficiency Improvement of Building Retrofits in 2050

15%

*(0 to 39)*

Heating, Cooling and Appliance Efficiency Improvement in 2050

0%

*(0 to 35)*

Fuel Switching in 2050

0%

*(0 to 100)*[Reset](#)[Save](#)[Copy](#)[Share](#)[Delete](#)[Generate Outputs](#)

## Summary

Summary Info

**Total Emissions by End Use Sector**

Total Emissions by Sector

Delivered Energy

Primary Energy

Primary Energy by Source

Oil Consumption

Biomass Consumption

Electric Demand

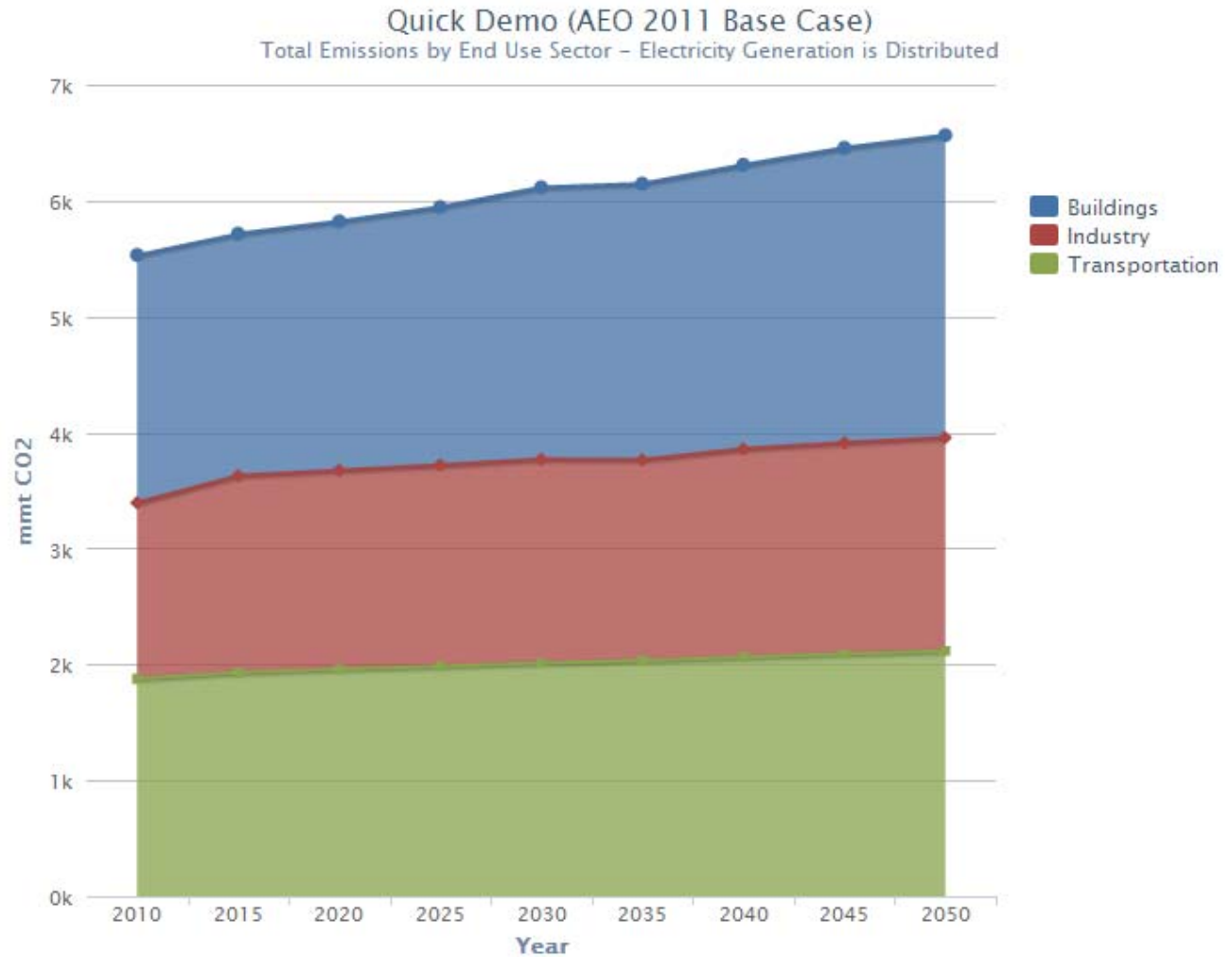
Buildings

Industry

Transportation

Electricity

Benchmarking



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Buildings

Industry

Transportation

Electricity

User Comments

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## Quick Demo (AEO 2011 Base Case)



Light Duty Vehicle Fleet Miles Per Gallon in 2050	38 mpg (38 to 75)
Non-Light Duty Vehicle Efficiency in 2050	0% Covering all non-LDVs (0 to 60)
Gallons of Biofuels by 2050 (in billions)	34 billion gallons (34 to 65)
Vehicle Miles Traveled per Light Duty Vehicle in 2050	13500 (10000 to 15000)



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Transportation

Electricity

User Comments

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## Quick Demo (AEO 2011 Base Case)



Buildings



Industry



Transportation



Electricity

Light Duty Vehicle Fleet Miles Per Gallon in 2050

60

mpg (38 to 75)

Non-Light Duty Vehicle Efficiency in 2050

20%

Covering all non-LDVs (0 to 60)

Gallons of Biofuels by 2050 (in billions)

34

billion gallons (34 to 65)

Vehicle Miles Traveled per Light Duty Vehicle in 2050

13500

(10000 to 15000)

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User Comments

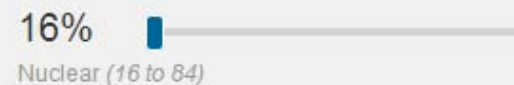
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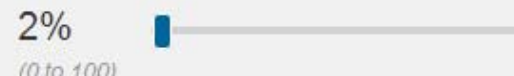
## Quick Demo (AEO 2011 Base Case)



### Electricity Generation Mix in 2050



### Percent Fossil Fuel Carbon Capture and Sequestration in 2050



Summary

Summary Info

- Total Emissions by End Use Sector
- Total Emissions by Sector
- Delivered Energy
- Primary Energy
- Primary Energy by Source
- Oil Consumption
- Biomass Consumption
- Electric Demand

Buildings

Industry

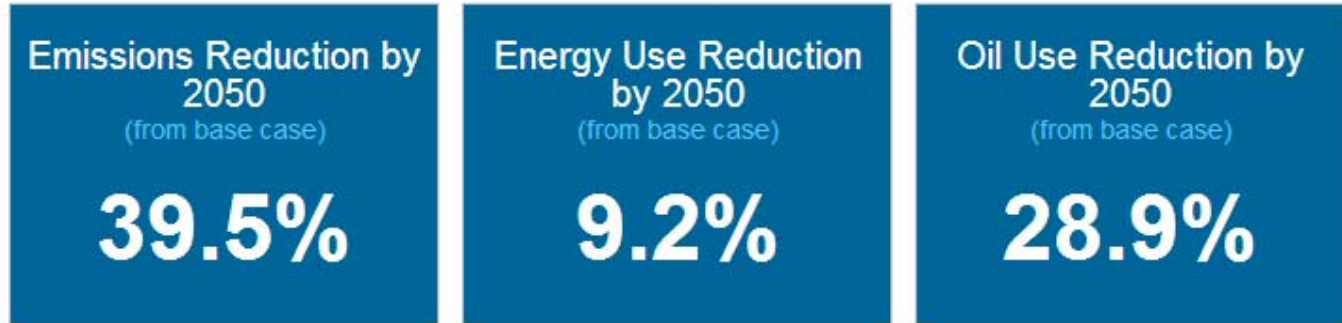
Transportation

Electricity

Benchmarking

Quick Demo (AEO 2011 Base Case)

Summary Info



<b>Name:</b>	Quick Demo
<b>Description:</b>	[New Scenario Description]
<b>Input Mode:</b>	Basic
<b>Base Case:</b>	AEO 2011 Base Case
<b>Author:</b>	abrown
<b>Created:</b>	Mon Nov 19 2012
<b>Last Update:</b>	Mon Nov 19 2012

Close



Summary

Summary Info

**Total Emissions by End Use Sector**

Total Emissions by Sector

Delivered Energy

Primary Energy

Primary Energy by Source

Oil Consumption

Biomass Consumption

Electric Demand

Buildings

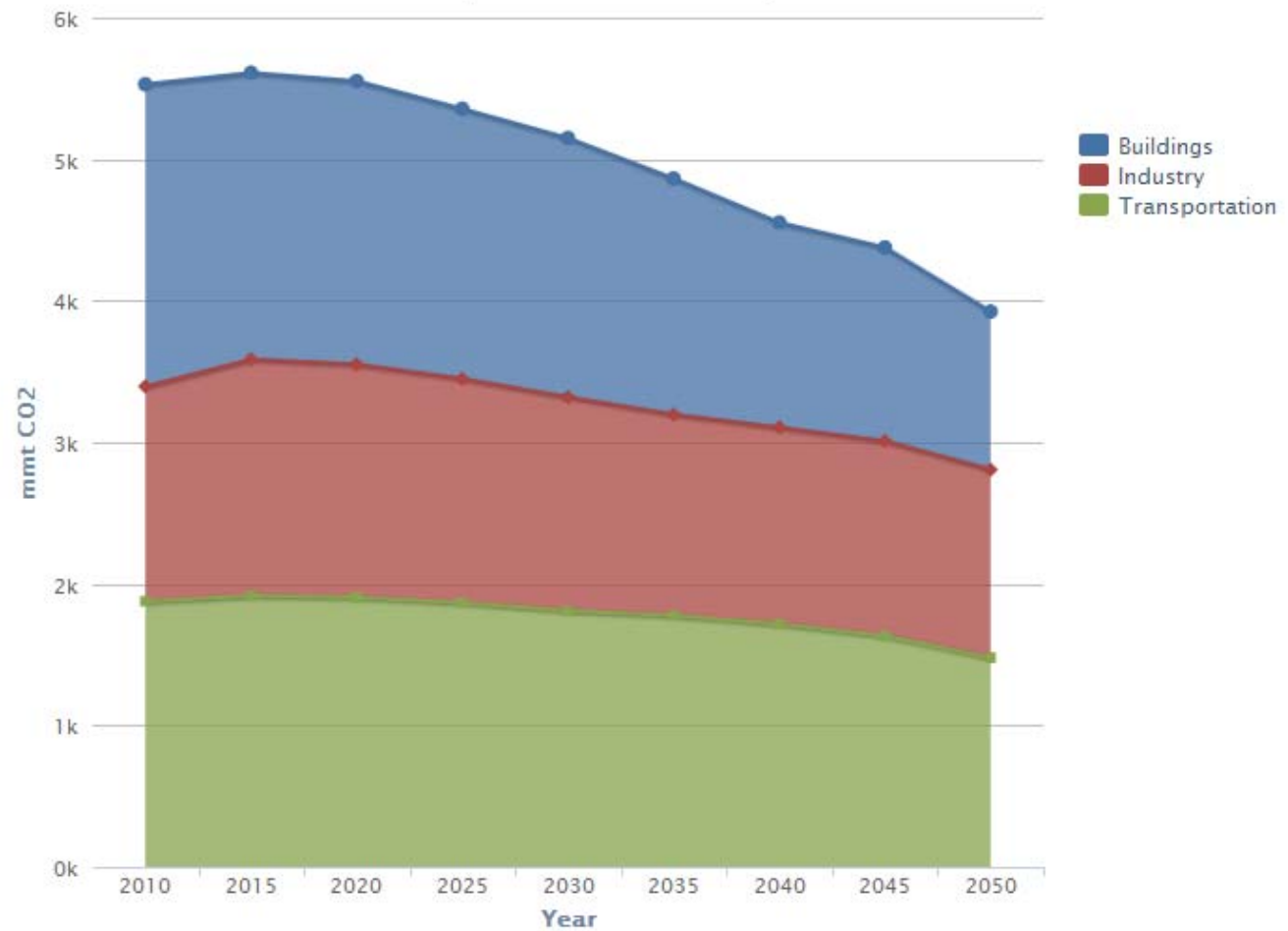
Industry

Transportation

Electricity

Benchmarking

Quick Demo (AEO 2011 Base Case)  
Total Emissions by End Use Sector – Electricity Generation is Distributed



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Summary

Buildings

Industry

Transportation

Electricity

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**Total Emissions**

Transportation Emissions

Buildings Emissions

Industry Emissions

Electricity Emissions

Energy Consumption

Petroleum Consumption

Biomass Consumption

Electric Demand

Quick Demo (AEO 2011 Base Case)

Total Emissions



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