

**North Carolina Solar Center  
College of Engineering  
North Carolina State  
University**

Louisiana State University Energy  
Conference

April 21, 2010

- Dr. Pam Carpenter-Program Manager  
Clean Energy Education and Workforce



**1981 the Solar House was built as a research and demonstration in PV and ST**



## North Carolina Solar Center

- Created in 1988, the North Carolina Solar Center originally focused on solar energy.
- Over the years, the "Solar Center" has grown and expanded and serves as a clearinghouse for renewable energy programs, information, research, technical assistance, and training for the citizens of North Carolina and beyond.
- Through its programs and services the Solar Center seeks to stabilize energy costs for consumers, stimulate local economies, reduce dependence on foreign fuels, and mitigate the environmental impacts associated with fossil fuels.



## North Carolina Solar Center's Programs

- Clean Transportation
- Clean Energy Education and Workforce
- Economic Development
- Biofuels
- Distributed Generation
- Healthy Built Homes and green building
- Database for State Incentives for Renewable Energy (DSIRE),
- Training programs in Renewable Energy Technologies

## North Carolina Solar Center's Programs

- Opportunities to learn about green technologies
  - Undergraduates
  - Graduates
  - Youth Build
  - Volunteers



## Education Programs

- Junior Solar Sprint with six schools
- Outdated website
- Limited resources for educators, parents, and students
- We did have the Solar House and a wealth of information and experience in renewable energy technologies

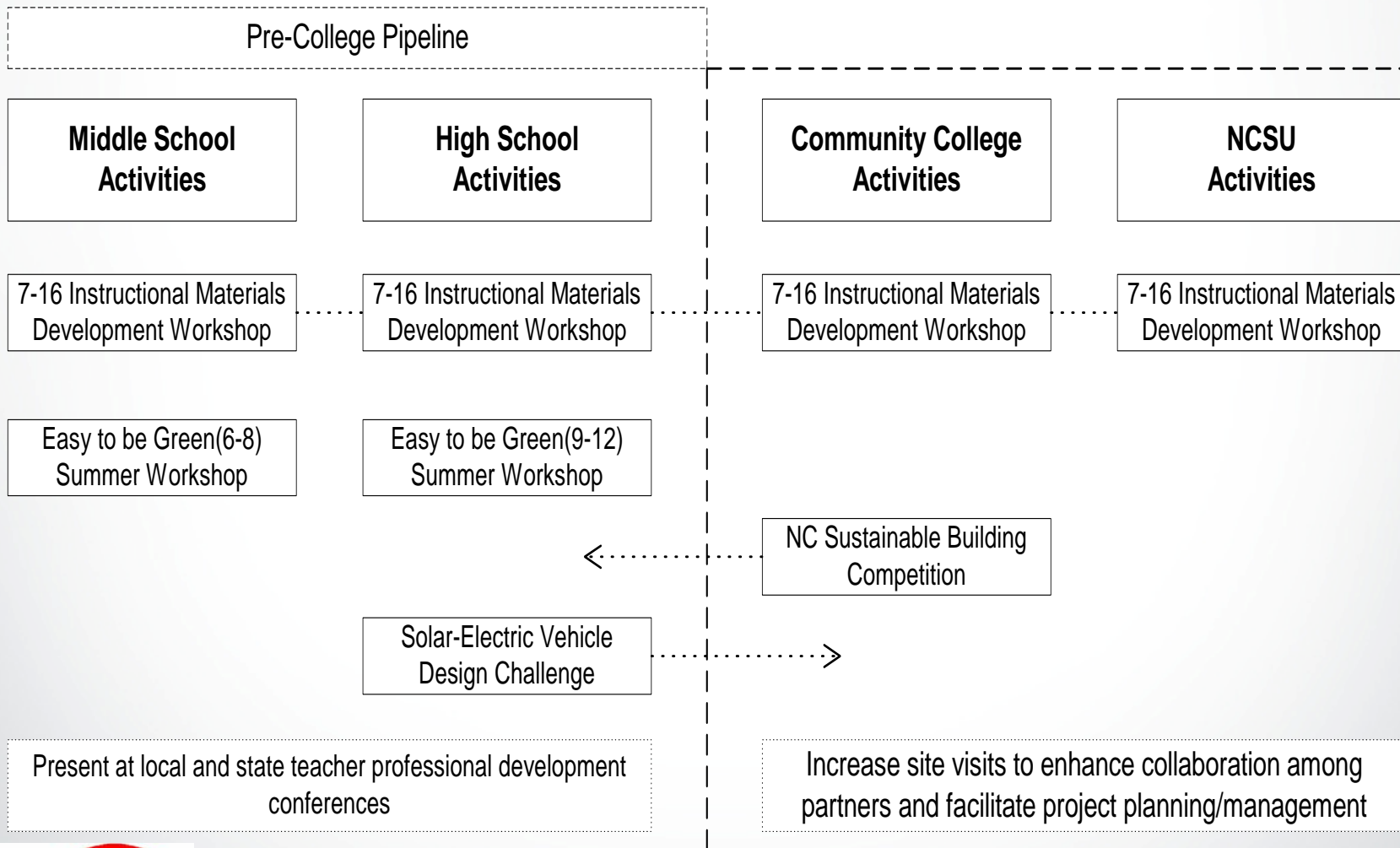
## NC State Collaboration

- Finding collaborative partners to build programs
- Seeking funding sources
- Working with industry, Department of Public Instruction, Community Colleges, and Department of Commerce to identify needs

COLLEGE of EDUCATION *Connecting to the Future*



# Pipeline





- ▣ Educate and inform middle and high school students, community colleges, and undergraduates preparing the workforce in renewable energy technologies
- ▣ Science, Technology, Engineering, and Mathematics (STEM)
  - \*Sixty-one percent of jobs today require STEM skills and only 21 percent of our children have them.
- ▣ Prepare and inform future consumers to become technologically fluent in energy technologies
  - \*Source: Kauffman Foundation



**Project**

- [Home](#)
- [About](#)
- [Contact Us](#)

**Data**

- [Data Export](#)
- [RSS Feeds](#)
- [Charts](#)
- [Heliotronics Portal](#)

**Learning Activities**

- [Tour](#)
- [Units](#)

**Resources**

- [System Components](#)

**Renewable Energy Data Acquisition System**

Energy data for each system listed below can be viewed and downloaded for research and learning. Performance readings for each system is averaged over a fifteen minute period and made available for data export or RSS feeds.



**House**

- 5.4 kW Photovoltaic Panel (24 SunPower Residential SPR-225)
- Solar Thermal Water Heater
- Passive Solar Sun Space Design
- Geothermal Heat Pump



**Garage**

- 3 kW Photovoltaic Panel (Solar Cells)
- Hydrogen Fuel Cell



**Annex**

- .18 kW Photovoltaic Panel (18- KANEKA G-SA060 Thin Film Silicon)
- Wind Turbine (Wisper 200)
- Solar Thermal Water Heater



NC State University



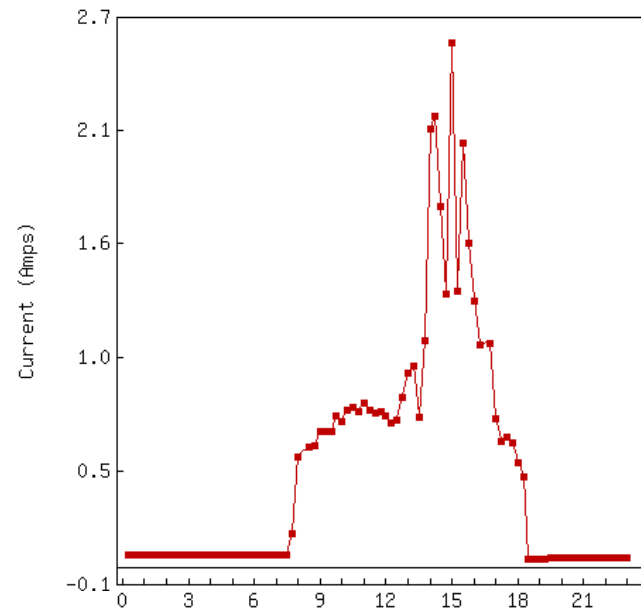
Advancing Renewable Energy for a Sustainable Economy

North Carolina **Solar Center**

Sunviewer.net™ Solar Energy & Weather Data

[ go back ]

**15-minute AC Current values for 31-Oct-2009 for NCSC Test Stand**



*Learning goal: to use a data-rich learning environment for developing students higher order thinking skill, problem solving skills and decision making skills.*

- Factual and Conceptual Knowledge
- Procedural Knowledge
- Knowledge Application
- Metacognitive Skills





# Curriculum Development

- Undergraduate-  
Technology,  
Engineering,  
Science
- Community  
Colleges







- Virtual and physical modeling, testing, and analysis

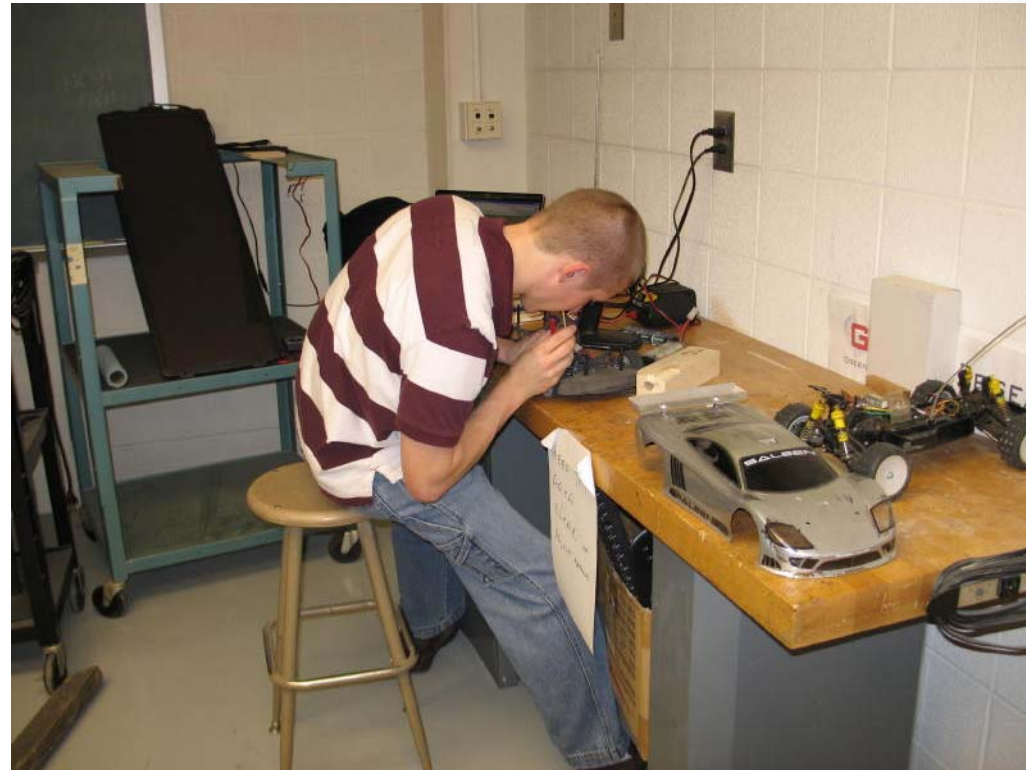






## Summer Workshops and Online Resources

- Middle and high school summer workshops for teachers and students





## *Researching the Effectiveness of Learning*

**Knowledge:** **Multiple-choice pre/post tests** designed to evaluate students' general knowledge about renewable energy sources.

**Journals** were analyzed to assess procedural knowledge

**Application:** Each course has activities that require application of knowledge gained; **rubrics** developed to measure student performance on activities.

**Metacognition:** Students asked to keep journals, record thoughts & thinking steps; 26-item **Metacognition Inventory (MI)** designed to evaluate students' awareness of cognitive processes.





## *Phase II Goals*

- 1) Expand Data Acquisition System
- 2) Expand Curriculum Development
- 3) Refine Student Assessment
- 4) **Outreach/Pre-College Pipeline**
- 5) **Develop Virtual World**
- 6) Instructional Materials Development Workshop
- 7) “It’s Easy to Be Green” Summer Workshops for Middle and High School Students
- 8) NC Sustainable Building Competition
- 9) **Electric Vehicle Design Challenge**



GREEN RESEARCH FOR INCORPORATING DATA IN THE CLASSROOM



## *Sustainable Transportation Education Program (STEP)*

- President Obama's announcement of \$2.4 billion in R&D, education, and outreach for the electrification of transportation
- Paradigm shift towards electrification of transportation
- Education and outreach for prepared workforce and informed consumers
- Dispelling misconceptions about electric vehicles

# STEP



SUSTAINABLE TRANSPORTATION EDUCATION PROGRAM



People. Performance. Excellence.



# GRID<sub>c</sub>

GREEN RESEARCH FOR INCORPORATING DATA IN THE CLASSROOM



- Hands-on component; students learn about battery technologies, chassis design, charging and discharging, design solar charging station.
- Pilot program with 6 high schools, 3 middle schools; expand to include additional schools, community colleges.
- Final event, May 22, 2010 at NC State with range and speed competition.





- Teacher training, curricula on electrification of transportation which includes: electric vehicles, plug-in hybrids, infrastructure, alternative fuels, & careers in STEM as relates to automotive, supporting infrastructures.
- Industry driven curricula are STEM-based; involve problem-solving, critical thinking, inquiry-based learning with relevance to real world.



**Progress Energy**

People. Performance. Excellence.



GREEN RESEARCH FOR INCORPORATING DATA IN THE CLASSROOM





- **STEP advisory board** comprised of experts from utilities, automotive, higher education, and technologies and engineering to provide guidance and vision for the program.
- **National recognition and interest-**
  - Capitol Hill
  - Ford
  - NSF
  - American Solar Energy Society (ASES)
  - Plug In 2010 - Electric Power Research Institute (EPRI)
- Expansion to other states-



GREEN RESEARCH FOR INCORPORATING DATA IN THE CLASSROOM



People. Performance. Excellence.



- Outreach through faculty, staff, and students to middle and high schools
  - EcoCAR Challenge
  - WEEL



GREEN RESEARCH FOR INCORPORATING DATA IN THE CLASSROOM



- *NCSU EcoCAR Challenge Team*
- Conversion of Saturn Vue to B20DEREV
  - B20DEREV (B20 Biodiesel Extended Range Electric Vehicle)
- Outreach to middle and high schools
  
- [http://ncsuecocar.com/?page\\_id=64](http://ncsuecocar.com/?page_id=64)



## *NCSU Wolfpack Energy Efficient Locomotion (WEEL)*

- Hybrid technologies and fuel efficiency without compromising aesthetics and vehicle performance
- Outreach



- <http://www.mae.ncsu.edu/org/weel/Introduction.html>

# *From Physical to Virtual Solar House*







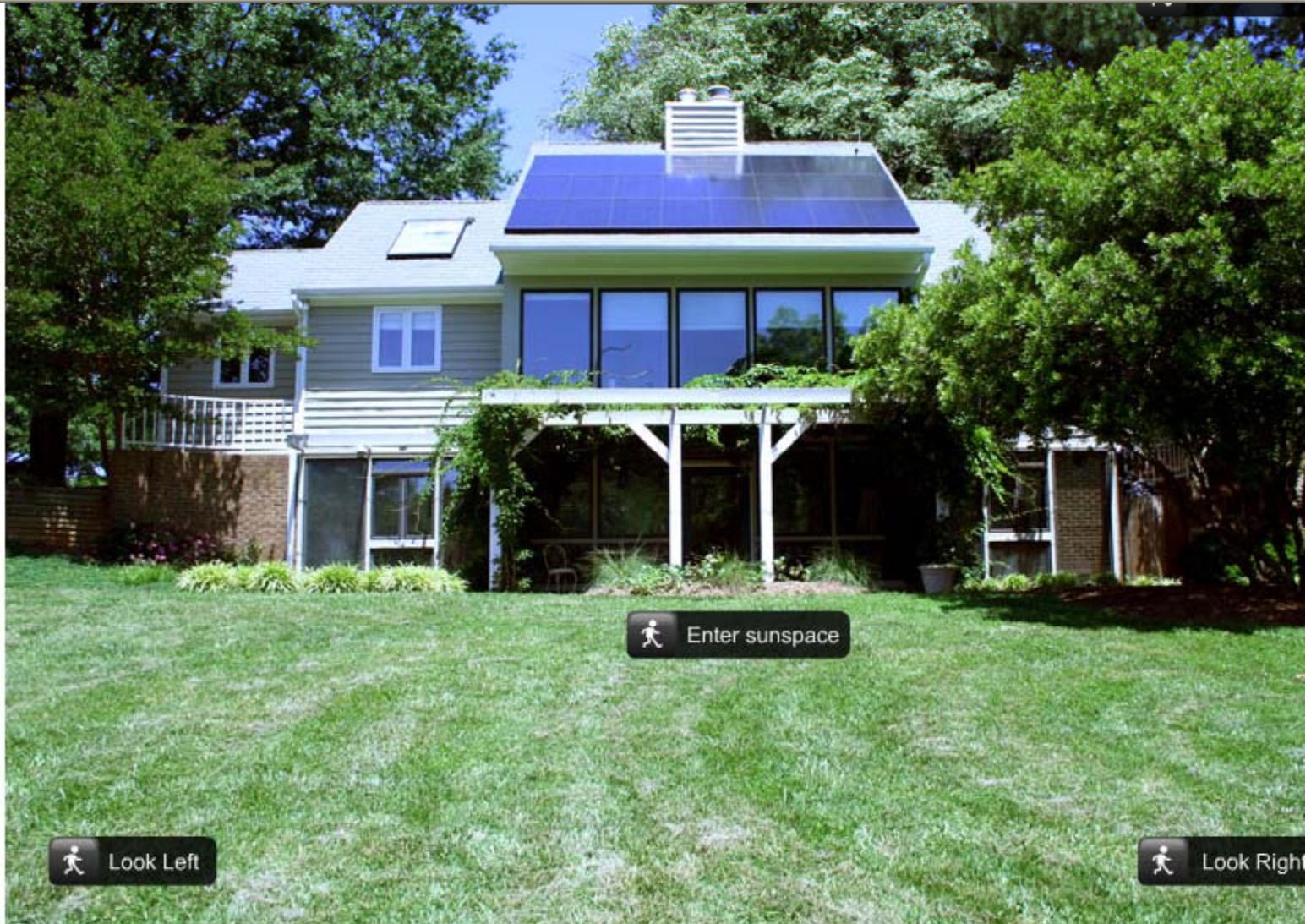
http://www.ncsc.ncsu.edu/virtualsolarhouse.php




File Edit View Favorites Tools Help


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North Carolina Solar Center - [Page Title]



 Enter sunspace

 Look Left

 Look Right



- Solar House is open to the public and offers scheduled tours
- K-20 students
- Homeowners
- Contractors
- Government



- Physical barriers to visit the Solar House
- Applied and received internal funding through NC State's Extension, Engagement, and Economic Development Seed grants
- Create a virtual Solar House with online resources for educators and students
- Funding allowed hiring students and a recent graduate to work on project



# North Carolina Solar Center

*Advancing Clean Energy For A Sustainable Economy*

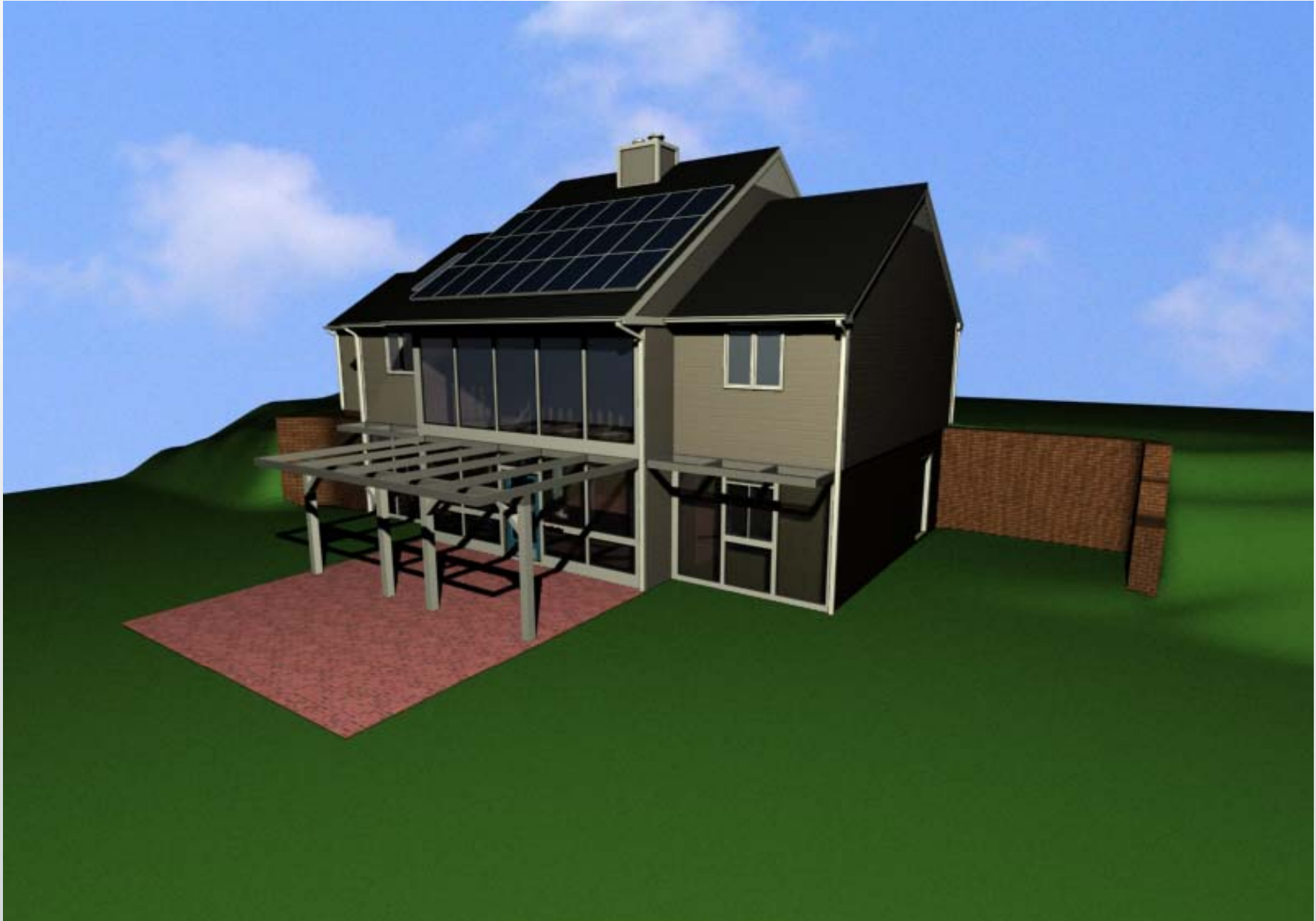
- ABOUT
- PROGRAMS
- SERVICES
- RESEARCH
- NCSU SOLAR HOUSE
- INFORMATION RESOURCES
- CALENDAR

## North Carolina Virtual Solar House

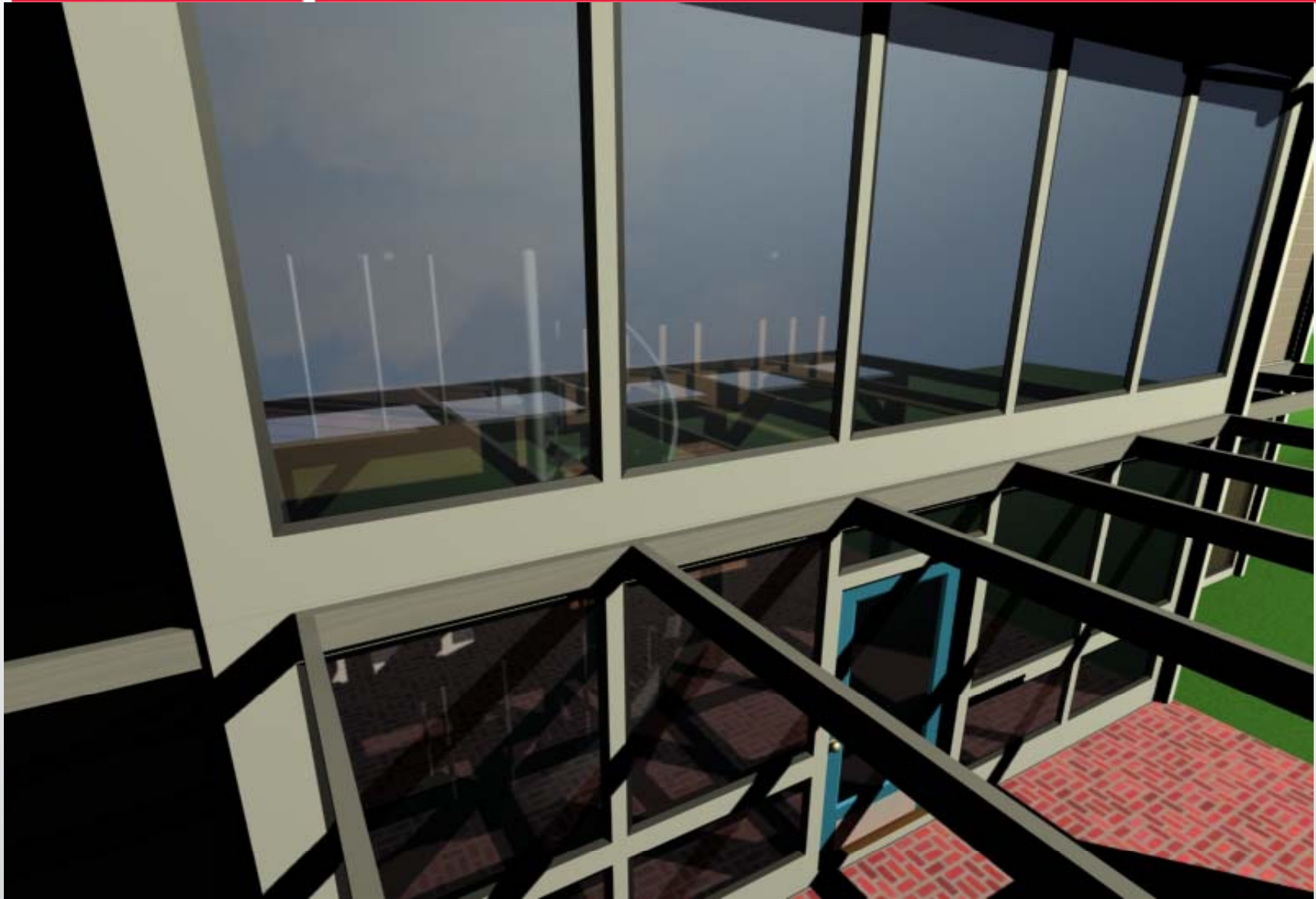


- Phase II of GRIDc provides funding to create a true 3D virtual world integrating the data of the renewable energy technologies.

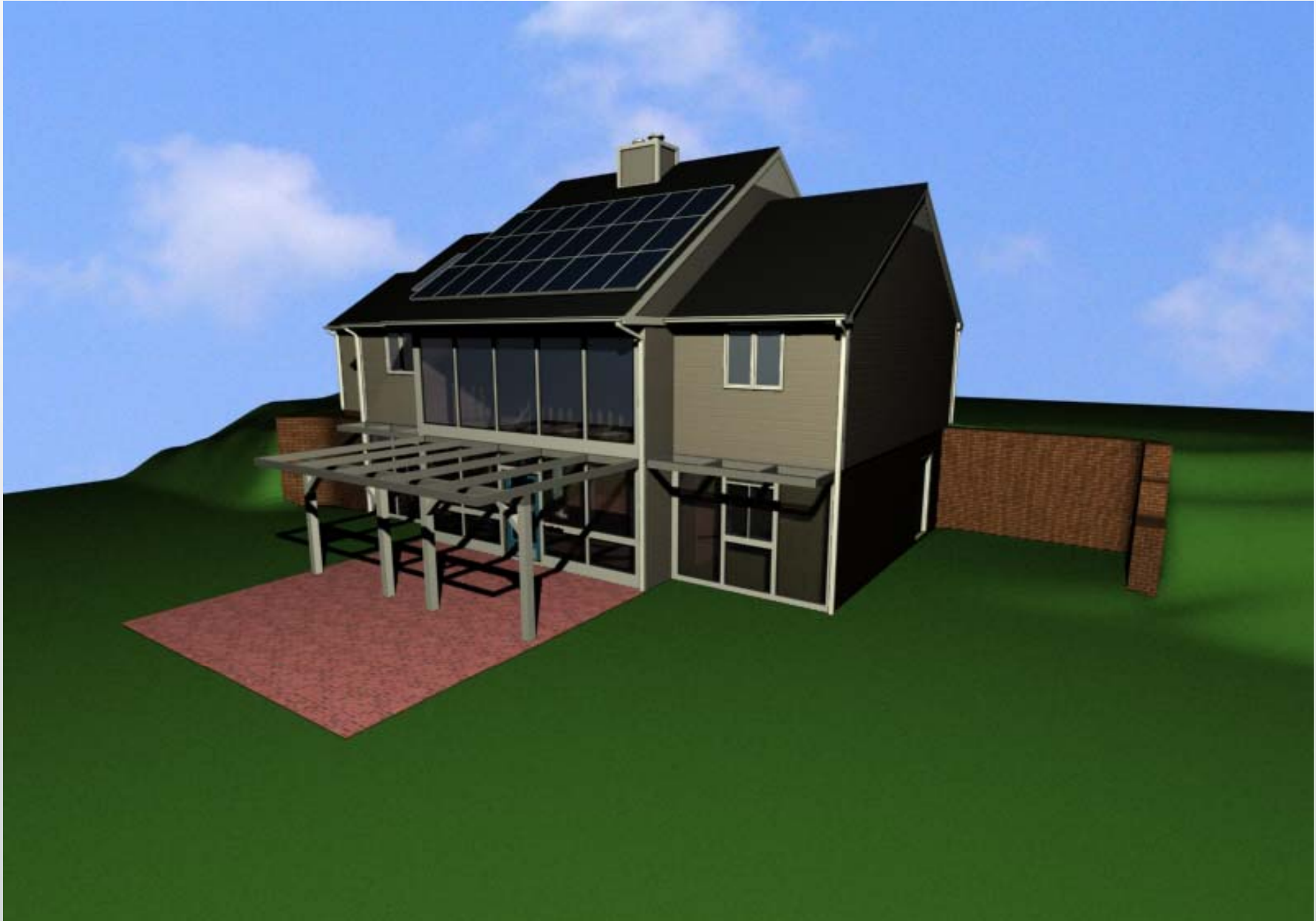


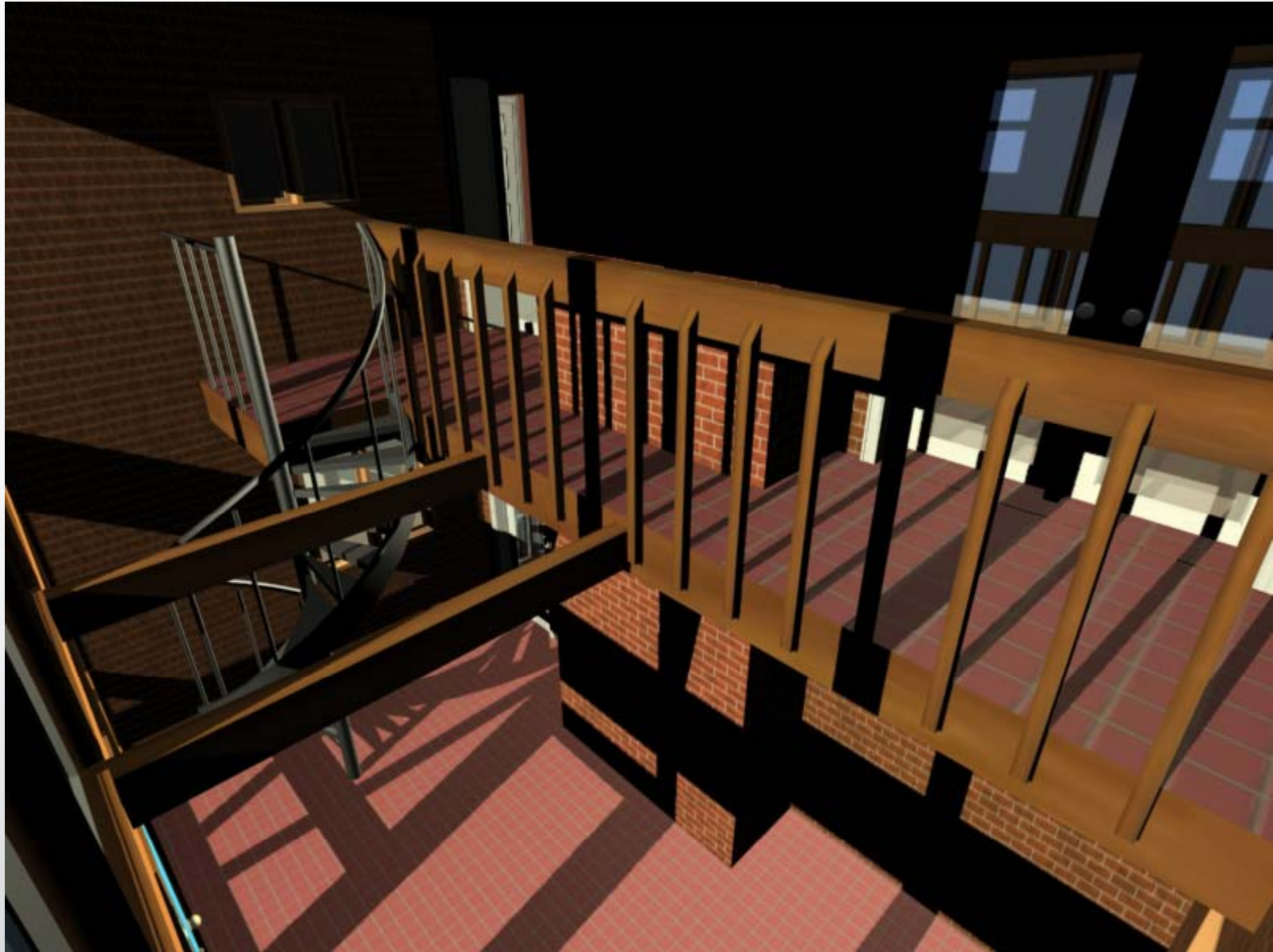












## Components to create successful programs

- Collaboration
- Continue to build upon the GRIDc project
- Funding to expand the programs
- Interdisciplinary team working together bringing different skill sets
- University students are part of the team



# Solar Center Renewable Energy Training Programs



## Solar Center Renewable Energy Diploma Program

- Four years of effective training in PV, ST, biofuels, healthy built homes and green building
- Need to training community college instructors to prepare for classroom and ensure well trained workforce
- Vital to obtain funding to develop an advanced program for train-the-trainer





**One of nine U.S. Centers  
Solar Workforce Development North Carolina Solar  
Center**

**“Southern Mid-Atlantic Solar Training”**

- Address critical need for quality trainers in PV, SHC at community colleges and other candidates in partnering states
- Develop and implement teaching materials for trainers to provide standardized system of practice
- Provide classroom and hands-on training
- Develop new certificate program to train new trainers to provide training in solar industry



## **Solar Workforce Development North Carolina Solar Center**

### **“Southern Mid-Atlantic Solar Training”**

- Assist in development of standardized curricula for Local Educational Institutions (LEIs )
- Training includes technical, sales, design, policy, financial modeling, and curricula development
- Create online training and reference modules and online financial tools for LEIs



# Hands-on training





# Training





# *NCSC Clean Transportation Education Projects*

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# NC Solar Center/NCSU

## Clean Fuel Advanced Technology (CFAT)

**2006-2012 project focused on reducing transportation related emissions in 24 NC counties that do not meet national air quality standards through education, outreach & emission reduction subawards:**

- **\$2.1 M Funding for transportation related emission reduction projects**
  - ~ 2006 ,2007 & 2008 call for projects resulted in 30 project awards including E85 & biodiesel infrastructure projects, hybrid-electric buses & utility trucks, natural gas fueling & vehicles, diesel retrofits, neighborhood electric vehicles and truck stop electrification
  - ~ funding has gone to public and private sector including: local governments, national park, fuel distributors, service station owners and technology providers

# CFAT Education, Outreach & Recognition

- **Fact sheets & Technology Options Information**
  - Technology overview, news, incentives, meetings, annual conferences, events etc
  - Posted on [www.cleantransportation.org](http://www.cleantransportation.org)
  - Partnered with NC Clean Cities Coalition for education and outreach
- **Mobile Clean Air Renewable Energy ( CARE)**
  - Statewide initiative to recognize exemplary efforts to accelerate use of alt fuels & advanced transportation technologies.
  - Annual awards for Individual, Fleet, Product Provider & Policy Categories
  - Annual Mobilizing NC Conference showcasing alt fuel and advanced transportation solutions- May 26,2010 Details at [www.NCMobileCARE.org](http://www.NCMobileCARE.org)
- **Technical Assistance Program (TAP)**
  - Presentations about transportation technology options
  - Individual consultations to assess and evaluate specific fleet applications including costs and emissions/petroleum displacement benefits



## CTEP- What is it?

- Clean Transportation Education Project is a 2 year initiative funded by the U.S. DOE and administered by the NC Solar Center/NCSU Clean Transportation Program that is delivering 48 workshops across the US- 8 in each of 6 DOE regions over the next 2 years
- FREE ½ day workshops will be conducted in 4 subject areas
- ✓ Biodiesel, Ethanol, CNG/LPG Fuel Economy/ Idle Reduction (Incl Electric & Hybrid Elec)

# CTEP- What is it?

An **EDUCATION** project focused on **PARTNERSHIPS**

- **Education Partners** ~Wake Tech Community College, Raleigh NC
- **Industry Partners**
- **Regional Clean Cities Coalitions**



South Central Region : Lauren Stuart: Greater Baton Rouge Clean Cities

Workshop Host partners ~ OK,LA,KS Clean Cities coalitions

## Clean Transportation Educational Keys

- Make it easy to make a change ( i.e provide grants incentives and easy to apply for process
- Provide unbiased choices in an easy to assess manner
- Strive to understand what your “customer” or target audience wants
- Recognize achievements/changes to business as usual



## **Roles & Responsibilities**

- Educational Partners- developing workshop content and auxiliary materials (factsheets), workshop surveys, remote participation
- NCSC- developing & disseminating workshop invitations, developing media/press release templates, agenda, coordination
- Regional Host partners- all site arrangements, registration, helping secure Industry & Success Story Speakers, promotion

## How to get involved

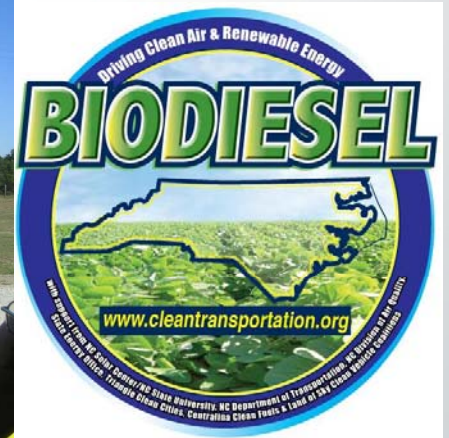
- Contact your Regional Partner representative about hosting a workshop in your region
- Even if you don't host a workshop help promote remote participation. Workshops will have option to attend workshop from their computer via a webinar-
- More info [www.altfueled.org](http://www.altfueled.org)

## **Mobilizing NC Conference**

- May 26<sup>th</sup>-North Carolina State University

# Questions & Comments

[cleantransportation@ncsu.edu](mailto:cleantransportation@ncsu.edu)



## Questions and Comments

- [pam\\_carpenter@ncsu.edu](mailto:pam_carpenter@ncsu.edu)
- [www.GRID\\_C.net](http://www.GRID_C.net)
- [ncsc.ncsu.edu](http://ncsc.ncsu.edu)
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