Sustainable Energy Education in the United States: Students' Perspectives

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Introduction

- What is sustainability?
- Sustainability education in the United States and around the world.
- Improving sustainability education in the United States.

Definitions of Sustainability

compiled by Afghan *et al* (1998)

- "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."—*Brundtland Commision*
- "The development requires taking long-term perspectives, integrating local and regional effects of global change into the development process, and using the best scientific and traditional knowledge available."—*Agenda 21*
- "It means balancing of economic, social, environmental and technological considerations, as well as the incorporation of a set of ethical values."—*Council of Academies of Engineering and Technological Sciences*

Definitions of Sustainability

- “The protection of the environment is essential for human well-being and the enjoyment of fundamental rights, and as such requires the exercise of fundamental duties.”—*Earth Chapter*
- “Then I say the Earth belongs to each generation during its course, fully and in its right no generation can contract debts greater than may be paid during the course of its existence.”—*Thomas Jefferson*

Key Questions

- How does one establish a working definition of sustainability?
- What role should safety/surety play?
- Is sustainability independent of scale and locale?
- Is relative sustainability important?

Sustainable Energy Education in the United States

- Focused on primary and secondary schools
  - EnergySmart Schools (EREN/DOE)
  - Teacher/scientist and school/university partnerships
  - Web resources for educators
  - Individual lessons in educator literature
  - Appears limited in scope

Sustainable Energy Education in the United States

- Higher education less organized
  - –NREL university partnerships
  - –Scattered university courses and programs
  - –Financial support not part of a directed program
  - –Little or no coordination between programs, especially those focusing on different technologies

Sustainable Energy Education Abroad

- Australia, Japan, and Europe
  - –Well-structured programs at several universities
  - –Degrees available in sustainable energy and related fields at some universities (e.g., Murdoch, UNSW)
  - –Broad, long-term support from government, university, and/or industry

Needed: Renewable Energy Education At All Levels

Primary School
Visual Demonstrations
Qualitative Understanding

Secondary School
Simple Quantitative Analysis
Basic Scientific Principles

University
Increased Analytical Sophistication
Specialization in a Technical Field

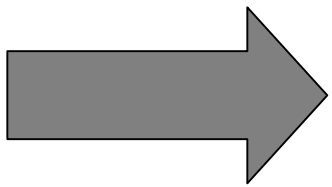
Primary and Secondary School

- Why teach about renewable energy?
  - Illustrate scientific and mathematical concepts
  - Promote responsible choices in energy consumers
  - Promote enthusiasm and preparation for university programs
- Sample topics:
  - Definition(s) of sustainability and its importance
  - Availability and cost of renewable energy sources
  - Technical details appropriate to grade level

Introduction to Sustainable Energy Technologies

Energy Technologies

- Wind
- Solar Thermal
- Photovoltaics
- Biomass
- Hydroelectricity
- Tidal
- Geothermal
- Coal
- Oil
- Natural Gas
- Nuclear



Discussion Topics

- Science and technology
- Sustainability
- Economics
- Integration of technologies

Topics to be Discussed for Each Sustainable Energy Technology

Environmental Impact

- Manufacturing
- Operating waste and pollution
- Land use
- End of use disposal

Economics

- Cost of raw materials
- Maintenance
- Disposal
- Pay back time calculation

Availability of Resources

- How much?
- Where?
- When?

Legislative Measures

- Clean Energy Act
- National Sustainable Fuels and Chemicals Act

Program Structure

Objective:

Education in the fields of *power generation* and *energy utilization in the built environment* by means of economically and environmentally sustainable systems and technologies.

Course Program

Introduction to the historical evolution and background of sustainable development. Social, cultural, economic, political and environmental perspectives on sustainability.

Power Generation:
Technologies (*conventional and renewable/alternative*) aimed at providing energy at least financial, environmental and social cost.

Energy Utilization and Conservation:
Sustainable technologies used for space conditioning purposes (comfort heating/cooling, ventilation, air cleaning, humidification/drying).

Course Program

Energy Management:

Energy system analysis, energy efficiency issues, energy economics, life cycle cost and analysis, energy development strategies.

Obstacles to Implementation:

Difficulty in adding new courses and programs to existing curricula, particularly at the undergraduate level, and attracting/retaining students.

Employment Options

- Likely fields of employment:
  - Energy policy development
  - Energy planning
  - Energy management
  - Energy education and information
  - Energy research, consulting and design
- Primary employers:
  - Utilities
  - Government departments
  - Energy consultants
  - Universities

Case Study: Sustainable Education at Georgia Tech

- Sustainability topics integrated into 150+ courses
- Dedicated sustainable energy course: Solar Cells
- University Center of Excellence for Photovoltaics Research and Education (UCEP)
  - Graduated 12 Ph.D. students in PV fabrication and modeling
  - Designed and installed a 342 kW rooftop grid-connected Georgia Tech Aquatic Center PV system
- Institute for Sustainable Technology and Development
  - Alliance of research and educational centers at Georgia Tech, facilitating development and implementation of a comprehensive agenda for enhancing the curriculum, research programs, and campus management.

Conclusions

- Sustainable energy education is a necessary component for transformation into a sustainable economy.
- Education is the the best way to introduce the concepts of sustainability into mainstream culture.
- “If You Build It, They Will Come”— sustainability must be incorporated into education at all levels.
- Education alone is insufficient—industry and legislation must keep pace.