NATSCI-169 COURSE

MILWAUKEE AREA TECHNICAL COLLEGE
TECHNICAL AND APPLIED SCIENCES (MATC/T&AS)

Sustainable Facilities Operations Program

NATSCI-169 Energy in Nature, Technology and Society

National Science Foundation - National Center for Building Technician Education

Center for Energy Conservation & Advanced Manufacturing
ECAM
Milwaukee Area Technical College

BEST
Building Efficiency for a Sustainable Tomorrow

NSF

2014-05-18

ENERGY IN NATURE, TECHNOLOGY AND SOCIETY,

Course Documentation

This material is based upon work supported by the National Science Foundation under Grant Number (DUE 1204930).

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Technical and Applied Sciences Department
6665 South Howell Avenue
Oak Creek, WI 53154
Phone 414.571.4570

Table of Contents

Catalog description 1
- Class hours 1
- Units 1
- Entry skills needed 1
- Syllabus 1

Student learning outcomes 1
- Understanding of earths limitations to sustain human activity 1
- Limitations of different energy sources 2
- Impact from humans on global warming and other pollution 2

Exit skills 2
- Energy basics: 2
- Electricity: 2
- Fossil fuels: 3
- Air pollution and the relationship to energy use: 3
- Global warming and thermal pollution 3
- Renewable energy: 3
- Nuclear energy: 4

Course materials 5
- Principal text 5
- Lecture materials and handouts 5
- Other reference materials 5
- Software needed 5
- Lab setup and materials 6
- Equipment & instruments required 6

Assessment 6
- Methods 6
- Sample test questions 6
- Sample of weekly assignments 7
- Project - Report 7

Adaptability to on-line format 7

Appendix A – Sample syllabus A-1

Appendix B –Sample Power Point B-1

Appendix C – Sample Homework C-1
- Homework Example 1
- Report Rubric 3
- Weekly Article 4

Weekly Article Rubric 5
Appendix D – Sample Quiz D-1

Catalog description

This course provides an introduction to the essential roles of energy in nature and human activity. It is an interdisciplinary general education course intended for all students who desire basic understanding of the forms and applications of energy and their influence on the development of civilization, geopolitics, economics and our environment. In addition to traditional sources of energy, special emphasis is given to renewable energy. Field trips may be arranged.

Class hours

48 hours of lecture

Units

3 Credits

Entry skills needed

The following are required for admission to the program:

- A high school diploma or GED
- Demonstration of proficiency in basic skills through a course placement assessment

In addition, the potential for success in the program will be enhanced if students have some work experience and/or a strong interest in sustainability and facilities management. You should also possess conceptual abilities, critical thinking, problem-solving, computer and organizational skills.

Syllabus

See Appendix A for sample syllabus, course schedule, and policies.

Student learning outcomes

The exit skills listed in the next section support these three outcomes:

Understanding of earths limitations to sustain human activity

The student can explain human's impact on the environment and restrictions on earth's ability to provide resources.

Limitations of different energy sources

The student can describe the limitations of each energy sources. Fossil fuels & nuclear are finite and renewable sources have space and continuous load limitations.

Impact from humans on global warming and other pollution

A student will be able to describe the impact of burning fossil fuels on the environment and the relation to global warming. Also, the impact of extracting all the energy such as fossil fuels is discussed in detail.

Exit skills

Course content to achieve student learning outcomes:

Energy basics:

1. Student is able to determine either the number of years or annual inflation rate given that a specific quantity will double (years to double = 70 / rate)
2. Student understands the importance of oil for our society.
3. Student learns that earth's resources are finite and face extraction rate issues (Hubbert Curve)
4. Student understands that there are basic laws of physics governing the everyday energy we see such as Newtons Laws of Motion and the laws of thermodynamics.
    a. Different forms of energy
    b. Equation for efficiency.
    c. Energy spontaneously transfers from a hot source to a cold source
    d. The usefulness of energy degrades as it is used.
    e. Nothing is 100% efficient

Electricity:

1. Student understands that electrical circuits are a flow of electrons and learns the language describing volts, amps and electrical power.
2. Student can differentiate between a parallel and series circuit.
3. Student articulates the difference between a dry and wet cell battery.
4. Student is able to describe a fuel cell inputs and outputs in terms of fuel, exhaust, and energy (electrical and heat). Plus how it is more efficient than the standard electrical generating process.
5. Student can list the current most popular sources / fuels used for generating electricity today.
6. Student describes the relationship between magnetic fields and electricity in terms of attraction and repulsion.

7. Student describes the impact of a magnetic field on a coil of wire and lists the applications (motor, generator, transformers).
8. Student is able to describe the electrical generation process and losses getting the electricity from the power plant to the end use.

Fossil fuels:

1. Student explains that fossil fuels are a chemical form of energy, just as food.
2. Student can list the three fossil fuels.
3. Student can calculate the years left of a fossil fuel based on the reserve amount and consumption rates and then explains why that number is inaccurate.
4. Student lists the benefits and disadvantages of fossil fuels.
5. Student knows where the major supplies of three fossil fuels (in terms of countries or parts of the world) can be found.
6. Student describes the extraction methods of the three fossil fuels.
7. Student lists the primary uses for each of the fossil fuels.

Air pollution and the relationship to energy use:

1. Student describes the impact of solar on earth temperatures, pressures, and wind/current movements.
2. Student explains how natural dispersion of pollutants affects the globe.
3. Student discusses the relationship of burning fossil fuels with CO2, sulfur oxides, particulates and other pollutants.
4. Student articulates the impact of pollutants reaction in the atmosphere when exposed to heat and UV.

Global warming and thermal pollution

1. Student defines the greenhouse effect.
2. Student list some of the major consequences of global warming
3. Student list three major greenhouse gases and their sources
4. Student explains the major contributor to greenhouse gases.
5. Student defines global warming potential (GWP) and the relative impact of CO2, methane, and CFCs.

Renewable energy:

1. Student lists five renewable energy types.
2. Student describes the difference between solar thermal and photovoltaic energy.
3. Student explains active and passive solar heating.
4. Student lists at least three different uses of solar thermal (heating homes, DHW and pools)
5. Student lists and discusses the advantages and disadvantages of solar, wind, hydro, geothermal, and biomass.

Nuclear energy:

1. Student describes an atom and names its parts.
2. Student explains radioactivity in terms of non-stable atoms.
3. Student describes the basic difference between fusion and fission reactions.
4. Student lists the pros/cons of fission power.
5. Student lists the pros/cons of fusion power.

Course materials

Principal text

Hinrichs, Roger, and Merlin Kleinbach. Energy Its Use and the Environment.5th edition. Boston: Brooks/Cole, 2013. Print. ISBN 9781111990831

Lecture materials and handouts

- Presentations (PowerPoint):
    - CH01 Introduction
    - CH02 Energy Mechanics
    - CH03 Conservation of Energy
    - CH04 Heat and Work
    - CH06 Solar Energy Characteristics and Heating
    - CH07 Energy From Fossil Fuels
    - CH08 Pollution
    - CH09 Global Warming and Thermal Pollution
    - CH10 Electricity Circuits and Superconductors
    - CH11 Electromagnetism and the generation of electricity
    - CH12 Renewables
    - CH13 Atom and its Nucleus
    - CH14 Nuclear Power
    - CH16 Fusion
    - CH17 Biomass from plants to Garbage
    - CH18 Geothermal Energy

Other reference materials

Earth, The Operators Manual, http://earththeoperatorsmanual.com/ - This is a good video showing a straight forward link between global warming and humans.

Software needed

Access to computer with:

- Microsoft Office Programs (Word, Excel, PowerPoint, etc.).
- Adobe Reader (for pdfs). Price: Free. Source: www.adobe.com.
- Access to computer with internet access. (i.e. Internet Explorer, Mozilla Firefox, Safari, etc.).

Lab setup and materials

None required, lecture only course, although a tour of the renewable energy systems on campus is conducted.

Equipment & instruments required

None required.

Assessment

Methods

- Chapter Reviews:
- Weekly Articles:
- Homework:
- Class Participation:
- Report
- Report Presentation
- Exams – a mid-term and a final. Each covers only ½ of the semester.

Sample test questions

There are seventeen quizzes and two exams given during the semester.

From the mid-term exam – True/False section:

____ 8 A flow of neutrons in a conductor is called an electrical current.

____ 9. Fossil fuels are the major reason that the modernization of the world from rural to urban has taken place.

____ 10. Some people assert that energy prices should reflect what it will cost to replace the dwindling supplies of nonrenewable fuels such as oil and natural gas, rather than just what it costs to obtain them.

____ 11. Energy conservation can have positive impact on our health.

____ 12. The world's strong dependence on oil will continue to be a factor in limiting economic growth.

____ 13. When we burn gasoline for instance in our car, we are releasing energy through a chemical reaction.

____ 14. As with the rate of water flow through a pipe, electrical resistance is inversely proportional to the length of a wire: the longer the wire, the greater is its resistance.

Sample of weekly assignments

Weekly Articles:

There are six weekly articles due during the semester. These articles are to be based on recent news articles in the media (such as newspapers).

The Weekly Articles expose the students to all the relative aspects for this class to society today. Many students do not pay attention to our impact on the earth. This course along with this homework requires students to look for it.

The format to be followed is:
ARTICLE TITLE:
SOURCE:
DATE:
ARTICLE ATTACHED? Yes / No
RELATION TO CLASS: What specifically does it relate to in the book or lectures?
SUMMARY:

A rubric for scoring the Weekly Articles is provided in Appendix C.

Solar Tour Homework:

Refer in Appendix C

Project - Report

There is a report that has to be researched, written and presented. The topic of the report can be related to anything that is discussed in the class. Typical topics are solar, wind, oil, coal, hybrid cars, and recycling. A rubric for the report is provided in Appendix C.

Adaptability to on-line format

This course can be delivered on-line due to its lecture format and presently a section each semester is offered online at MATC.

The entire course is in BlackBoard online but taught in lecture / discussion format. Test including final exam are online. All homework is available online.

Appendix A – Sample syllabus

Energy in Nature, Technology and Society

MILWAUKEE AREA TECHNICAL COLLEGE
Course Syllabus

Spring, 2014

Course: *Energy in Nature, Tech & Soc*		**Credits:** *3*
Subject Abbreviation: NATSCI	**Course Number:** 169	**Section Number:** 201
Class Meets: *Fridays, 9 AM to 11:55 AM in room #A234*		
Instructor: *Ted Wilinski*		
Office: *E108*	**Office Hours:** *Fridays from 11:55AM to 1 PM*	
Phone number: *(414) 571-4570*	**E-mail:***wilinskt@matc.edu*	

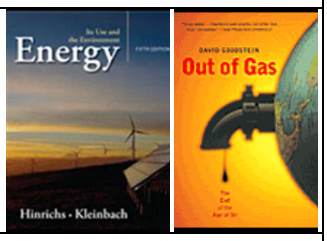
Course Description: *This course provides an introduction to the essential roles of energy in nature and human activity. It is an interdisciplinary general education course intended for all students who desire basic understanding of the forms and applications of energy and their influence on the development of civilization, geopolitics, economics and our environment. In addition to traditional sources of energy, special emphasis is given to renewable energy. Field trips may be arranged.*

Prerequisites: *None*

ADA Statement:
If you have a disability that impacts your classroom performance and wish to request an accommodation, contact the Office of Student Accommodations (414)297-6838. They may require documentation regarding your disability to enable them to comply with your request. Admission of a disability is voluntary and will be handled in a confidential manner. MATC does not discriminate against individuals with disabilities and fully complies with the Americans with Disabilities Act.

To ensure your academic success in this program, you are strongly encouraged to provide your instructor with a copy of the Instructor Notification Form from the Office of Student Accommodations. This should be done at the beginning of the semester.

Textbook(s): *REQUIRED: Hinrichs, Roger, and Merlin Kleinbach. Energy Its Use and the Environment.5th edition. Boston: Brooks/Cole, 2013. Print. ISBN 9781111990831*
PLEASE NOTE: In the event that the MATC book store does not carry any of the above texts, students may purchase their copies through the online vendors or book stores of their choice.
Supplies: ***Optional*** *textbook – Goodstien, . Out Of Gas. 04. Norton, 2004. Print. ISBN 9780393326475*



Attendance Policy: **Miss first two classes and you are automatically withdrawn from the class!**
Attendance will be taken on a daily basis. Students are expected to attend class regularly and to arrive on time. It is the student's responsibility to discuss absences with the instructor and follow up with an email. No email, no consideration for an excused absence. When an absence occurs, the student is responsible for making up the work. Work can be found in Blackboard. As a general rule, no exceptions for not meeting due dates are given for being absent. If there is an exception, it has to be detailed in a response from the instructor to your email explaining the absence. Miss 4 classes and you will be withdrawn from the course .

Tests/Assignments Make-up Policy:
It is the responsibility of the student to keep track of work and grades. In Blackboard, the "MyGrades" tab can be very helpful to check on completed work and view your grades. Ignorance of not knowing an item was due is not an excuse.

Any late work will have 5% taken off for each day it is late. For instance, a chapter review done the morning of class will be considered one day late. Five percent will be taken off the score. So, if a score of 13 points out of 15 is awarded for that chapter review, then 13/15= .867 or 86.7%. Five percent will be taken off, or 87%-5% = 81.7% for a final score.

Any item over two weeks late is not accepted and the student will receive a zero for that grade.

There can be extenuating circumstances but these have to be discussed and agreed upon in writing by both parties at the time the work is due, not after the two week period.

Assessment Activities: note: assessment activities are subject to change as the semester progresses.

- **Chapter Reviews:** *These are "tests" taken in Blackboard that are simply going over the reading material for that week. It is assumed that the student reads the chapter first. Refer to Blackboard for details.*
- **Weekly Articles:** *Each assigned week the student will read, listen to or watch a current news item. The intent is to have the student start to see all the issues of the day that relate to the class. Refer to Blackboard for details.*
- **Homework:** *There are several homework items that are assigned during the semester to help with understanding of the course materials. Refer to Blackboard for details.*
- **Class Participation:** *There are activities, such a question answered the first minute of class (and handed in right away) that are part of each class. If you are not in class when that item is submitted, there is no making it up.*
- **Reports:** *There is a report required for this course. Make sure you follow the rubric used for scoring reports. Submittal of a report topic roughly 3 weeks ahead of time and submittal of an outline one week ahead of time is required. Refer to Blackboard for details.*
- **Presentations:** *Each student is required to present their report in class. Use of power point is encouraged but not required. Length of presentation varies depending on the size of the class, but it is typically about 5 minutes with time for questions afterwards. Refer to Blackboard for details.*
- **Exams:** *There are two exams, each covering ½ of the semester (no overlap). One is at mid-term and one is at the end of the class. These exams are typically about 75 questions randomly selected from the Chapter Reviews along with some generated just for the exam. Refer to Blackboard for details.*

Grading Standards: note: grading standards are subject to change as the semester progresses.

- **20% Chapter Reviews:** *Each Chapter Review is weighted the same. There will typically be 17 chapter reviews in a semester. Assuming 17, each is worth 1/17 x 20% = 1.176% of the final grade.*
- **20% Weekly Articles:** *Each Weekly Article is weighted the same. There will typically be 11 chapter reviews in a semester. Assuming 11, each is worth 1/11 x 20% = 1.818% of the final grade.*
- **5% Homework:** *Each Homework is weighted differently. Typically the Solar Homework Worksheet is worth the largest portion at 4% of the final grade with the two carbon footprints are the remaining 1% of the final grade.*
- **10% Class Participation:** *There will be various activities each day in class that require you to submit work in class. If you are not there, late or leave early there is no opportunity to make it up. See Blackboard and listen first day of class for more details.*
- **15% Reports:** *Report is weighted as 13.5% of the final grade. Report outline is weighted as 1% of the final grade. Report topic is 0.5% of the final grade.*
- **5% Presentations:** *Each Presentation is weighted as 2.5% of the final grade.*
- **25% Exams:** *Each Exam is weighted as 12.5% of the final grade.*

Refer to Blackboard for details.

Grading scale is as follows:

A --4.00 Superior	for grades between 94% and 100%
A- -3.75	for grades between 90% and less than 94%
B+-3.25 Above Average	for grades between 87% and less than 90%
B --3.00	for grades between 84% and less than 87%
B- -2.75	for grades between 80% and less than 84%
C+-2.25 Average	for grades between 77% and less than 80%
C --2.00	for grades between 74% and less than 77%
C- -1.75	for grades between 70% and less than 74%
D+-1.25 Below Average	for grades between 67% and less than 70%
D --1.00	for grades between 64% and less than 67%
D- -0.75	for grades between 60% and less than 64%
U --0.00 Unsatisfactory/Failing	for grades less than 60%

Instructor Support: Students are encouraged to contact the instructor before or after class, and during office hours, if they have questions or problems related to the class. It is suggested that students contact the instructor immediately in order to avoid falling behind in class. Please do not wait until the end of the semester to discuss issues that should have been resolved much earlier.

Academic Support Services: In addition to obtaining course-related assistance from the instructor, students may obtain assistance from the Academic Support Centers located at the Milwaukee, North, South, and West campuses. These centers are open to all MATC students. Services include, but are not

limited to, assistance in computer applications, course assignments, Internet use, math, science, social studies, study skills, and writing. Please call the Academic Support Center at your campus for more information.

Instructor Recommended Withdrawals: You may be dropped for absenteeism when:

1. You are absent three consecutive classes.
2. Your attendance is sporadic (e.g., you miss three class periods), and you are unable to make up the instruction missed.
3. You fail to meet attendance requirements of licensing agencies.
4. You pose a safety hazard to yourself or others because of missed instruction critical to safe class or lab performance.
5. You are unable to make up instruction missed in a lab/shop class.
6. You have not attended class during the first two weeks of the term.

Dropping or Changing Courses: Students who are considering dropping the course should first discuss this with their instructor, counselor, or faculty advisor before dropping. They may be able to recommend an alternative course of action. Please be aware that dropping a course could result in a student being placed on warning or suspension at the end of the semester. Also, please be aware that dropping a course does not mean you will be refunded.

Students who wish to drop a course may voluntarily withdraw from the course up to two weeks before the last day of the semester. Course Change forms are available in the Registration office at the Milwaukee Campus or in Student Services at the regional campuses.

A student who does not report for the final examination and does not formally withdraw nor arrange for an incomplete grade, will be given a U grade for the course.

Incompletes: A grade of Incomplete may be granted, at the discretion of the instructor, in cases where the student has completed at least 75% of the course with a C or better at the time the Incomplete is requested. Students must complete the missing work within one semester or else the Incomplete grade will revert to a U.

Student Complaint Procedure: MATC has established a formal system to assist students in resolving academic problems and course-related issues. In order for a complaint to be valid, the following steps must be followed in order:
Step 1: Meet with the instructor to discuss any questions related to the course (e.g., requirements or assignments) or if you are experiencing academic problems. If the issue is unresolved after meeting with the instructor,
Step 2: Meet with the associate dean of the department. If the issue is unresolved after meeting with the associate dean,
Step 3: Meet with the dean of the department. If the issue is unresolved after meeting with the dean,
Step 4: Go to the Office of Student Life for assistance.

Retention Alert: MATC is interested in the success of all of its students. Retention Alert is a tool that instructors, along with the counseling and advising department, use to help improve student success. There are three areas of Retention Alert: financial, personal/confidential, and retention. Retention Alert is designed to identify students who may be at risk of academic difficulty or failure as early as possible. Throughout the semester, an instructor may create Retention Alerts or referrals for some of their students. After a referral is made, the student will be contacted by someone by phone or email to discuss resources or set up an appointment to meet in person. The Retention staff follows up with the student and the student's instructor to facilitate support efforts. Prevention and intervention are key with students so timing and resources are important. With Retention Alert, hopefully students can get the help they need, when they need it.

OTHER IMPORTANT INFORMATION:

No cell phones, no texting, no ear buds or other head phone set up, no computers.
Please refer to the links in Blackboard under the “Syllabus” tab. Those links are:

- Student Code of Conduct
- Student Accommodation Services
- Student Handbook

WEEK 01 JANUARY 24

- CHAPTERS COVERED:
  1. Chapter 1: Introduction
- DUE THURSDAY NIGHT:
1. Nothing Due This Week
- In Class Participation:
  1. Sign Syllabus Receipt Form and turn into instructor
  2. Work on weekly articles
  3. Report Topic – start selection process early so you can use weekly articles to help research

WEEK 02 JANUARY 31

- CHAPTERS COVERED:
  1. Chapter 2: Energy Mechanics
- DUE THURSDAY NIGHT:
1. Chapter Reviews: 1 & 2
2. WA01
- In Class Participation:
  1. CP Quiz Doubling Time
  2. Discuss weekly articles

WEEK 03 FEBRUARY 7

- CHAPTERS COVERED:
  1. Chapter 3: Conservation of Energy
- DUE THURSDAY NIGHT:
1. Chapter Reviews: 3
2. WA02
- In Class Participation:
  1. CP Quiz?
  2. Discuss weekly articles?

WEEK 04 FEBRUARY 14

- CHAPTERS COVERED:
  1. Chapter 4: Heat and Work
- DUE THURSDAY NIGHT:
1. Chapter Reviews: 4
2. WA03
- In Class Participation:
  1. CP Quiz?
  2. Discuss weekly articles?

WEEK 05 FEBRUARY 21

- CHAPTERS COVERED:
  1. Chapter 10: Electricity
  2. Chapter 11: Electromagnetism
- DUE THURSDAY NIGHT:
1. Chapter Reviews: 10 & 11
- In Class Participation:
  1. CP Quiz?
  2. Discuss weekly articles?

WEEK 06 **FEBRUARY 28**

- CHAPTERS COVERED:
  1. Chapter 13: The Atom
  2. Chapter 14: Nuclear Fission

- DUE THURSDAY NIGHT:
1. Chapter Reviews: 13 & 14

- In Class Participation:
  1. CP Quiz?
  2. Discuss weekly articles?

WEEK 07 **MID TERM EXAM** **MARCH 7**

- MID TERM EXAM (Chapters 1, 2, 3, 4, 10, 11, 13, & 14 covered)
  1. In Class Exam
  2. Notes Allowed
  3. 60 Questions:
     - Most from Chapter Reviews
     - 4 or 5 word problems

WEEK 08 **MARCH 14**

- CHAPTERS COVERED:
  1. Chapter 6: Solar Energy

- DUE THURSDAY NIGHT:
1. Chapter Reviews: 6
2. WA04

- In Class Participation:
  1. Report Topic Discussion

WEEK 09 **MARCH 21**

- CHAPTERS COVERED:
  1. Chapter 12: Electricity from Solar & other renewables
  2. Solar Tour

- DUE THURSDAY NIGHT:
1. Chapter Reviews: 12
2. WA05

- In Class Participation:
  1. Report Topic Discussion?
  2. Discuss weekly articles?

WEEK 10 **SUSTAINBILITY SUMMIT WEEK** **MARCH 28**

- ATTEND SUMMIT! – Visit me Wednesday at the MATC Booth.:

- DUE THURSDAY NIGHT:
1. Nothing – **Enjoy the Summit!**

- In Class Participation:
  1. No Class this week, ATTEND SUMMIT

WEEK 11 **APRIL 4**

- CHAPTERS COVERED:
  1. Chapter 7: Energy from Fossil Fuels

- DUE THURSDAY NIGHT:
1. Chapter Reviews: 7

1. WA Summit

- In Class Participation:
  1. Report Outline Discussion?
  2. CP Quiz?
  3. Discuss weekly articles?

NO CLASS – SPRING BREAK **APRIL 11**

NO CLASS – SPRING BREAK **APRIL 18**

WEEK 12 **APRIL 25**

- CHAPTERS COVERED:
  1. Chapter 17: Biomass
  2. Chapter 18: Geothermal
  3. Chapter 16: Fusion

- DUE THURSDAY NIGHT:

1. Solar Worksheet
2. Chapter Reviews: 16, 17 & 18
3. Report Topic

- In Class Participation:
  1. Presentation Discussion
  2. CP Quiz?
  3. Discuss weekly articles?

WEEK 13 **MAY 2**

- CHAPTERS COVERED:
  1. Chapter 8: Air Pollution & Energy
  2. Chapter 9: Global Warming

- DUE THURSDAY NIGHT:

1. Chapter Reviews: 8 & 9
2. Report Outline

- In Class Participation:
  1. CP Quiz?
  2. Discuss weekly articles?

WEEK 14 **REPORT PRESENTATIONS** **MAY 9**

- REPORT PRESENTATIONS:
  1. Each Student will present their report to the class

- DUE FRIDAY IN CLASS

1. Hard Copy of Report
2. ***Before class*** – upload report & presentations

- In Class Participation:
  1. Present Report

WEEK 15 **FINAL EXAM** **MAY 16**

- FINAL EXAM (Chapters 6, 12, 7, 17, 18, 8, 9, & 16 covered)
  1. In Class Exam
  2. Notes Allowed
  3. 60 Questions:
     - Most from Chapter Reviews

Appendix B –Sample Power Point

Chapter 1: Introduction

General Class Format
(the 3 hours of face time)

- 1 minute quiz at start of 1st hour.
- Discussion of Homework
- Weekly Article Discussions By Students – Typically several people will discuss their article for that week.
- Discussion of Chapter Review
- Lecture on days Topic
- Group / class discussion / work

Question of the day!

- Between 1900 and 1980, per capita energy use rose from 80 million to 320 million Btu per year.
- Did the quality of life improve that much?
- Do you believe that you are four times better off than your great-grandparents?

Energy: An initial Definition

–A building block of modern society
–Needed to create goods
–Drives the economy
–Makes our lives easy
–renewable resource - an essentially inexhaustible alternative energy source to oil, gas, coal, or uranium used to produce electricity or heat
–Capacity for vigorous action: Inherent power potential forces

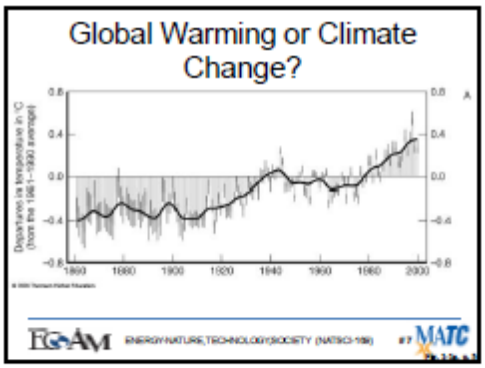
Energy Use and the Environment

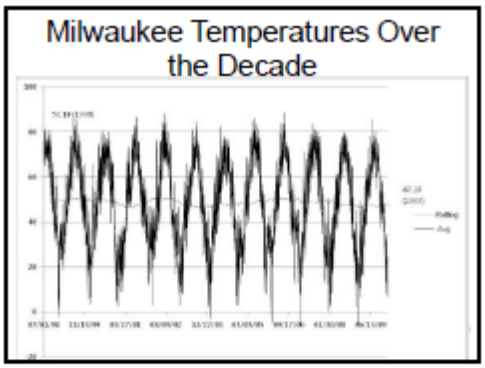
- 1970's brought earth day and
- Progress made to improve air and water quality
- 4.5 pounds of garbage per person per day in US – landfills are full!
- Storyofstuff.com

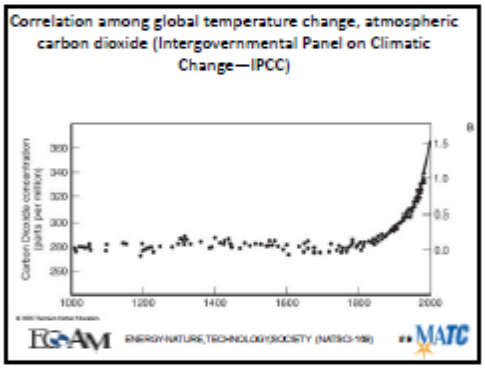
FOCUS ON 1.1 OUR EARTH—THEN AND NOW

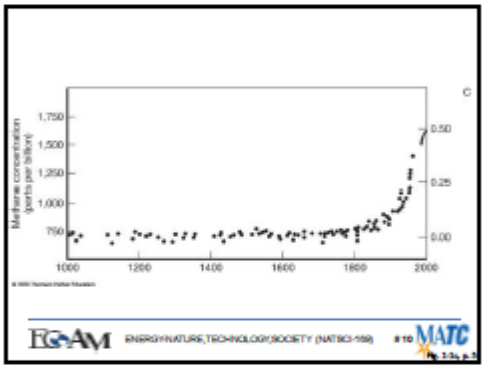
	1970	1990	2010
World population	3.3 billion	5.4 billion	6.8 billion
10^9 Tons of lead emitted, United States	204	5	1
Tons of waste recycled	8 million	49 million	83 million
Tons of garbage generated annually in United States	121 million	160 million	250 million
Percentage of oil imported to United States	23%	51%	53%
Percentage of federal budget spent for environment	3%	1.5%	1.3%
Atmospheric CO_2 concentration (ppM)	325	350	384
World CO_2 emissions, 10^9 tons/yr	14	21	31

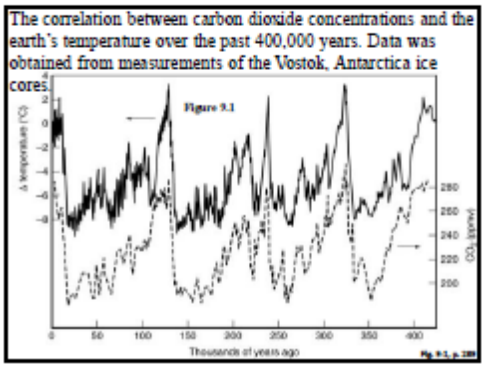
Source: eia.gov and epa.gov

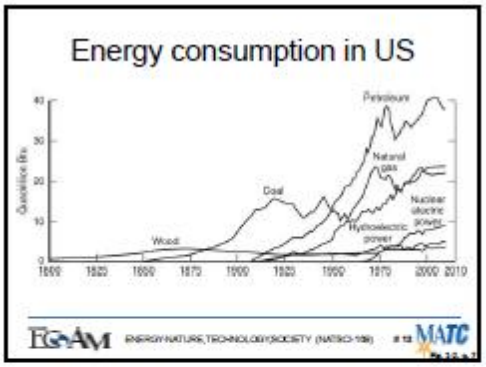

Global Warming or Climate Change?
ENERGY-NATURE,TECHNOLOGY&SOCIETY (NATSCI-169)
MATC

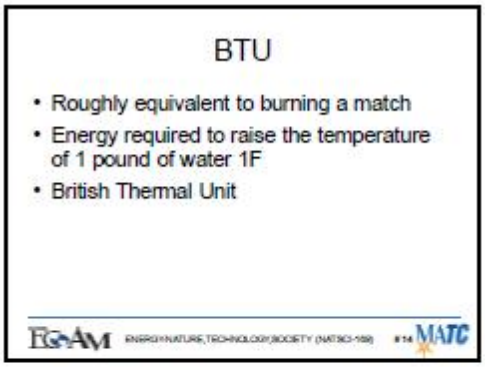

Milwaukee Temperatures Over the Decade

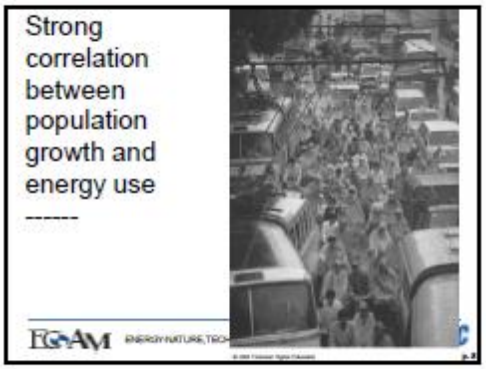

Correlation among global temperature change, atmospheric carbon dioxide (Intergovernmental Panel on Climatic Change—IPCC)
ENERGY-NATURE,TECHNOLOGY&SOCIETY (NATSCI-169)
MATC

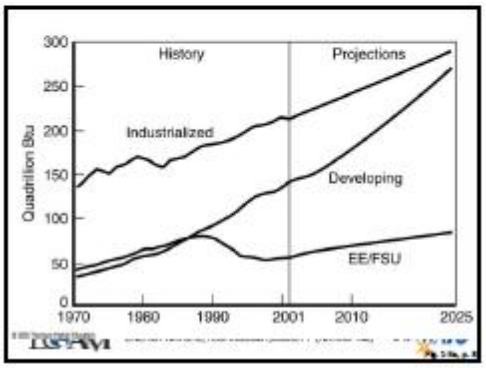

ENERGY-NATURE,TECHNOLOGY&SOCIETY (NATSCI-169)
MATC

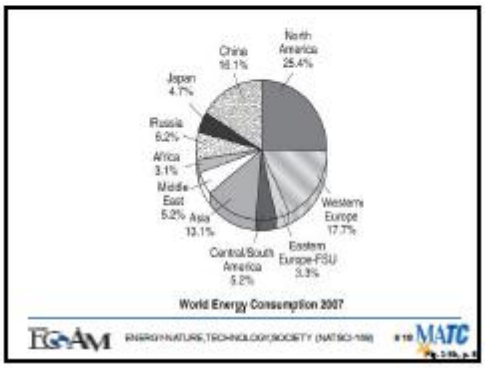

The correlation between carbon dioxide concentrations and the earth's temperature over the past 400,000 years. Data was obtained from measurements of the Vostok, Antarctica ice cores.
Figure 9.1
Thousands of years ago

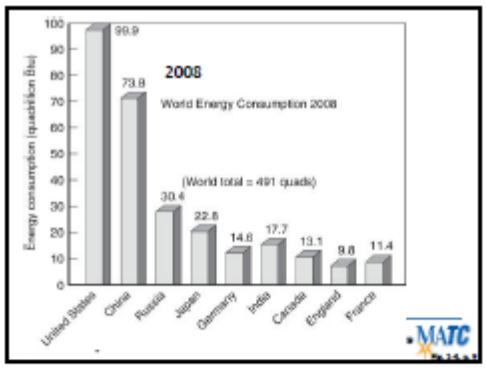

Energy consumption in US
Petroleum
Natural gas
Coal
Nuclear electric power
Hydroelectric power
Wood
1800 1820 1840 1870 1900 1920 1950 1970 2000 2010

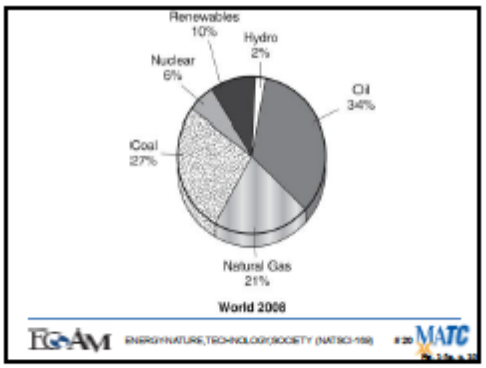

BTU
• Roughly equivalent to burning a match
• Energy required to raise the temperature of 1 pound of water 1F
• British Thermal Unit

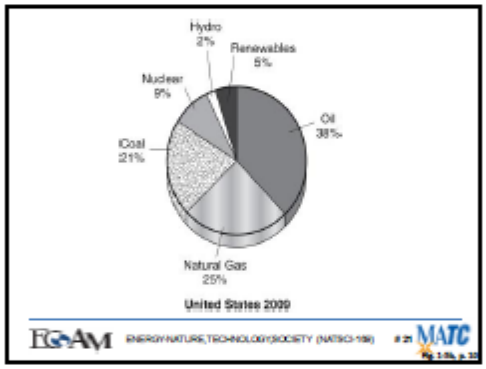

Strong correlation between population growth and energy use

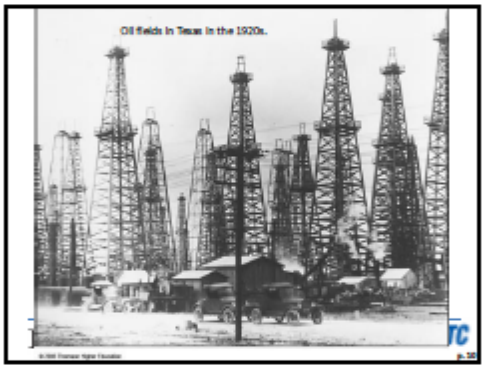

History
Projections
Industrialized
Developing
EE/FSU
Quadrillion Btu
300
250
200
150
100
50
0
1970 1980 1990 2001 2010 2025

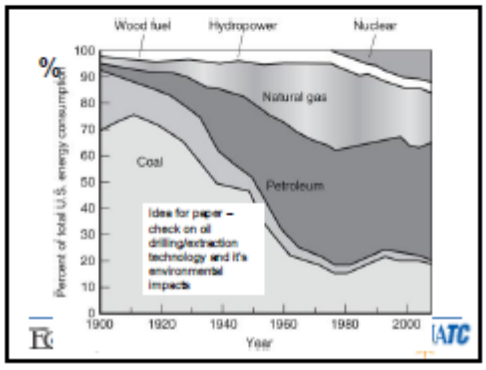

North America 25.4%
China 16.1%
Japan 4.7%
Russia 6.2%
Africa 3.1%
Middle East 5.2%
Asia 13.1%
Western Europe 17.7%
Eastern Europe-FSU 3.3%
Central/South America 5.2%
World Energy Consumption 2007

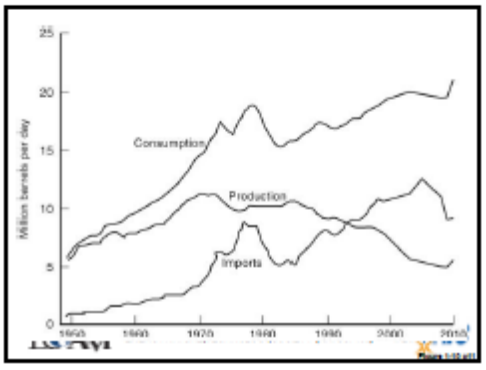

2008
World Energy Consumption 2008
(World total = 491 quads)
Energy consumption (quadrillion Btu)
99.9
73.8
30.4
22.8
14.8
17.7
13.1
9.8
11.4
United States
China
Russia
Japan
Germany
India
Canada
England
France

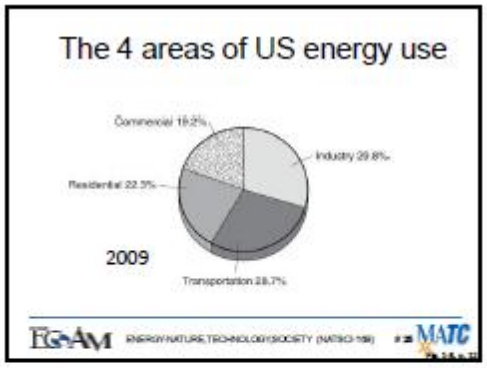

Renewables 10%
Hydro 2%
Nuclear 6%
Oil 34%
Coal 27%
Natural Gas 21%
World 2008


Hydro 2%
Renewables 5%
Nuclear 9%
Oil 38%
Coal 21%
Natural Gas 25%
United States 2009


Oil fields in Texas in the 1920s.


Wood fuel
Hydropower
Nuclear
%
Natural gas
Coal
Petroleum
Idea for paper – check on oil drilling/extraction technology and it's environmental impacts
Percent of total U.S. energy consumption
Year


Consumption
Production
Imports
Million barrels per day



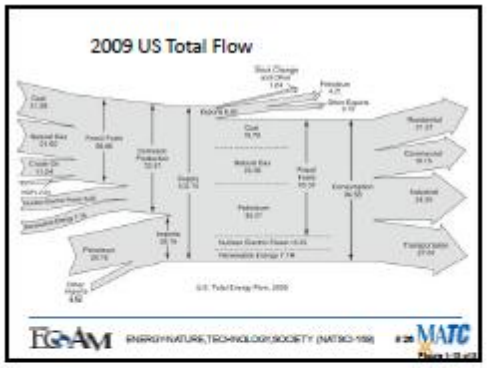
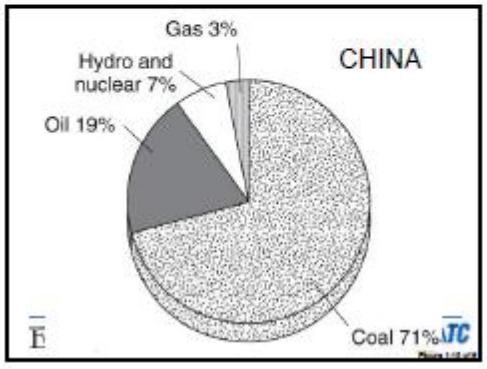


Table 1.1 WORLD AND UNITED STATES PROVEN RESERVES: 2008

Resource	World	United States	Lifetime*
Oil	1342 × 10^9 bbl 7.7 × 10^{15} Btu	294 × 10^9 bbl 0.13 × 10^{15} Btu	10 years
Natural gas	6254 × 10^{12} cf 6.1 × 10^{15} Btu	237 × 10^{12} cf 0.24 × 10^{15} Btu	12 years
Coal	0.98 × 10^{12} tons 23 × 10^{15} Btu	0.26 × 10^{12} tons 6.4 × 10^{15} Btu	250 years
Oil sands	525 × 10^9 bbl 3.0 × 10^{15} Btu	32 × 10^9 bbl 0.17 × 10^{15} Btu	12 years

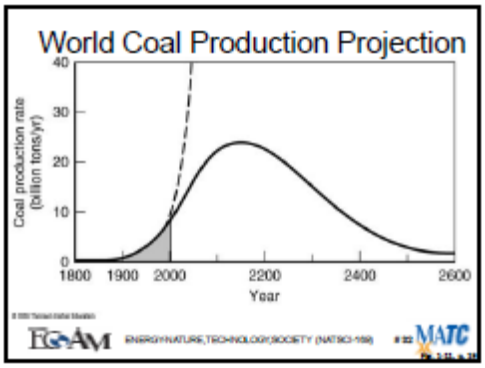
*Ratio of U.S. reserves to 2008 U.S. production rate

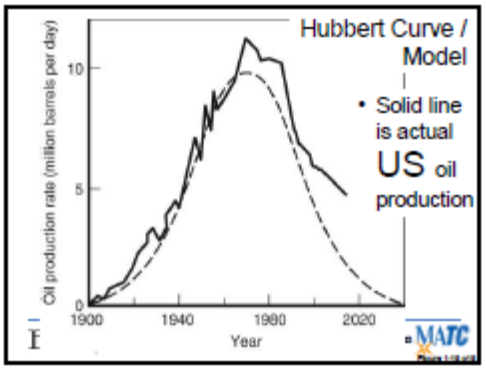


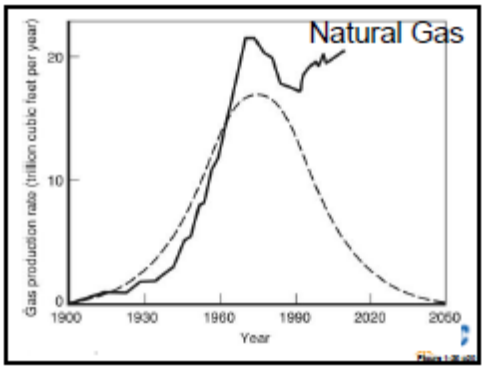
Exponential Growth

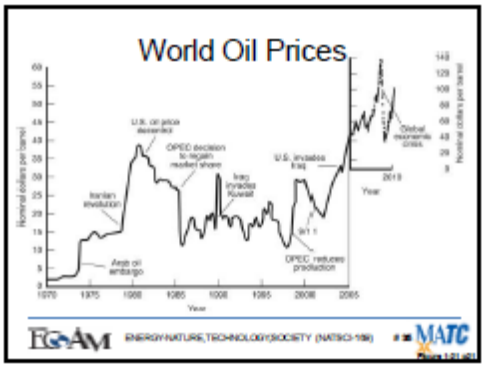
10.0% Growth

	Total $	Interest	Total $	Interest	Total $	Interest	Total $	Interest
0	$1,000	$0	11	$2,853	$259	22	$8,140	$740
1	$1,100	$100	12	$3,138	$285	23	$8,954	$814
2	$1,210	$110	13	$3,452	$314	24	$9,850	$895
3	$1,331	$121	14	$3,797	$345	25	$10,835	$985
4	$1,464	$133	15	$4,177	$380	26	$11,918	$1,083
5	$1,611	$146	16	$4,595	$418	27	$13,110	$1,192
6	$1,772	$161	17	$5,054	$459	28	$14,421	$1,311
7	$1,949	$177	18	$5,560	$505	29	$15,863	$1,442
8	$2,144	$195	19	$6,116	$556	30	$17,449	$1,586
9	$2,358	$214	20	$6,727	$612	31	$19,194	$1,745
10	$2,594	$236	21	$7,400	$673	32	$21,114	$1,919









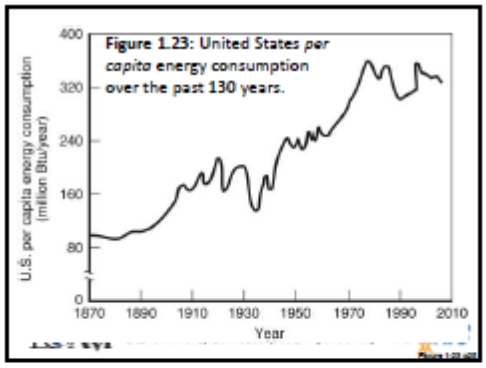


Figure 1.23: United States per capita energy consumption over the past 130 years.
U.S. per capita energy consumption (million Btu/year)
400
320
240
160
80
0
1870
1890
1910
1930
1950
1970
1990
2010
Year

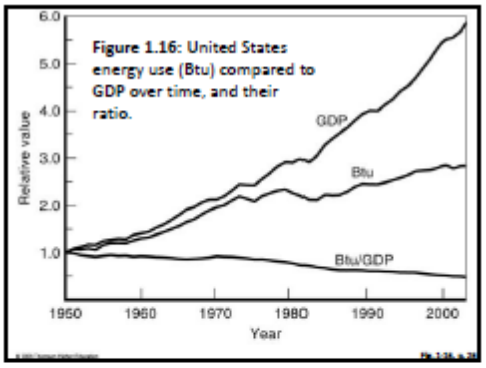
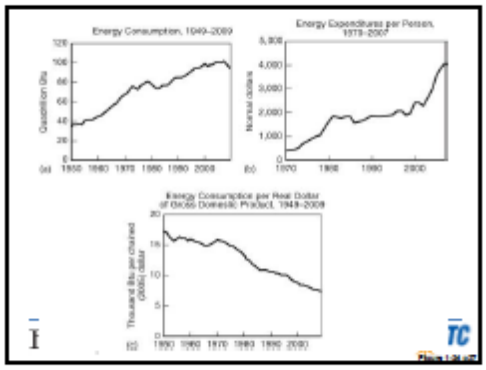
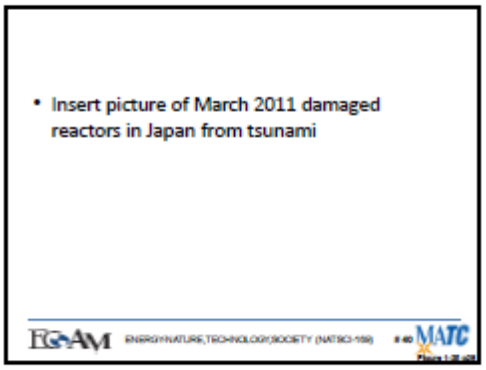
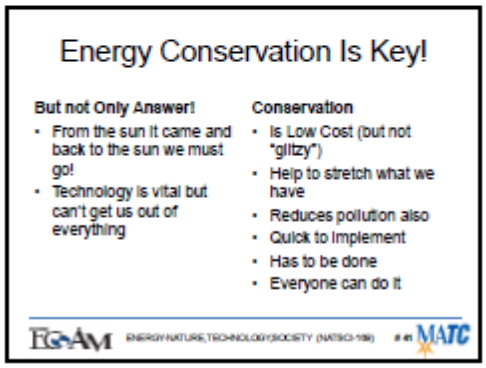
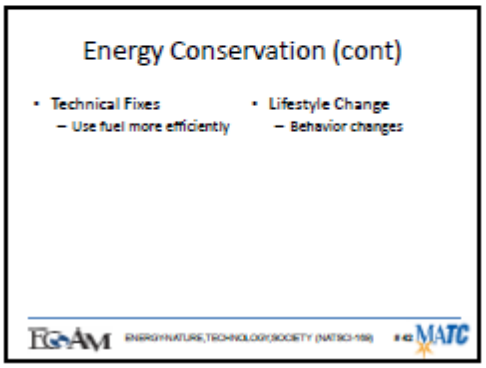


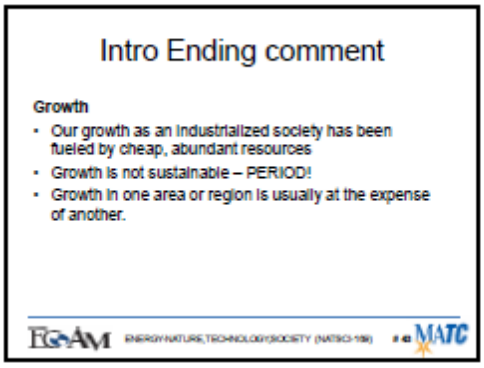
Figure 1.16: United States energy use (Btu) compared to GDP over time, and their ratio.
Relative value
6.0
5.0
4.0
3.0
2.0
1.0
GDP
Btu
Btu/GDP
1950
1960
1970
1980
1990
2000
Year


Energy Consumption, 1949–2009
Energy Expenditures per Person, 1970–2007
Energy Consumption per Real Dollar of Gross Domestic Product, 1949–2009


• Insert picture of March 2011 damaged reactors in Japan from tsunami
ENERGY/NATURE,TECHNOLOGY/SOCIETY (NATSCI-169)
MATC


Energy Conservation Is Key!
But not Only Answer!
• From the sun it came and back to the sun we must go!
• Technology is vital but can't get us out of everything
Conservation
• Is Low Cost (but not "glitzy")
• Help to stretch what we have
• Reduces pollution also
• Quick to Implement
• Has to be done
• Everyone can do it
ENERGY/NATURE,TECHNOLOGY/SOCIETY (NATSCI-169)
MATC


Energy Conservation (cont)
• Technical Fixes
– Use fuel more efficiently
• Lifestyle Change
– Behavior changes
ENERGY/NATURE,TECHNOLOGY/SOCIETY (NATSCI-169)
MATC


Intro Ending comment
Growth
• Our growth as an industrialized society has been fueled by cheap, abundant resources
• Growth is not sustainable – PERIOD!
• Growth in one area or region is usually at the expense of another.
MATC

Appendix C – Sample Homework

Homework Example

Energy - Nature, Technology, Society
NATSCI-169
Homework Solar Tour

YOU MUST SHOW ALL YOUR WORK (eg- equations, not just the answer)
Watch Your Rounding (should be 3 digits eg – 3.33 ft Not 3 ft)

DATA FROM TOUR:

What is the total kW size of the collectors? __21 _kW = 216 watts/panel x 97 panels 20,952 watts

Collector Width: _3.25_ft Number of collectors panels: __25 + 25 + 31=81_ on roof
_8__ fixed ground mount
Collector Length: __5.375_in/ft __8__ tracking ground mount
__97__ *Total*

From display in hallway: http://www.we-energies.com/residential/energyeff/active_installdata.htm
http://view2.fatspaniel.net/WEEnergies/matcMequon/HostedAdminView.html?&eid=131470

Month	kWh/month
Mar 2013	_1704_
Apr	_2718____
May	_2788____
Jun	_2870____
Jul	_2720____
Aug	_2452____
Sep	_2317____
Oct	_1572____
Nov	_1265____
Dec	_ 732____
Jan	__1394__
Feb	__1036___
TOTAL	_23568__kWh for the year (**METERED kWh from the kiosk or web site**)

QUE S T I O N S:

1. How big is each collector in square feet (sf or ft^2)?

Width ___3.25__feet x Length __5.375_____feet = __17.5___ ft^2 each collector

2. What is the total square footage of collector surface?

# of collectors _97_ x __17.5___ ft^2 each collector = _1698__ ft^2 total

3. **ANNUAL SOLAR RADIATION FALLING ON PANELS (ASR)**: If the average Solar Radiation from Sun for Milwaukee WI is ~150 kWh per ft^2 per yr, what is the total solar radiation possible to hit the solar collectors?

   ___1698_____ ft^2 total x 150 kWh per ft^2 per yr = 254,700 kWh per yr maximum (ASR energy)

4. What is the estimated efficiency of the solar collectors based on the kWh's calculated above?

Efficiency (1) = Useful Energy Out / Energy In = kWh out of collectors / kWh from Sun

Efficiency = __23,568_ Metered kWh produced by array / _254,700_ kWh/yr maximum (ASR energy) x 100% = __9.25__ %

5. **EQUIVALENT FULL LOAD HOUR ESTIMATE (EqFLHr)**: Another way to calculate estimated electric energy produced by a solar collector is to multiply the total kW of the system by 1450 kWh/yr/kW. Based on this, how much solar energy would you expect this array to produce in a year?

   21 kW x 1450 eqflhrs = 30,450 kWh/yr

6. Based on your result from EqFLHr and using the maximum solar energy for the year, determine the efficiency. Result from EqFLHr / ASR x 100 = %

   30,450 kWh/yr / 254,700 kWh/yr x 100 = 11.9 %

7. Another rule of thumb is to estimate solar PV installations at a cost of $5000 to $8,000 per kW. Based on this and the total kW of the solar system at MATC South, determine the potential cost **range** of the system.

   $5000 x 21 = $105,000 $8000 x 21 = $168,000

8. If the cost of electricity is $0.125/kWh, what is the value or savings generated by the solar panels based on the metered kWh?

   30,450 x $0.125 = $3806.25/yr 23,568 x $0.125 = $2946/yr

9. Often there are tax credits and other financial incentives (as with any fossil fuel production). For solar this can equate to 50% of the project cost. If you subtract off the potential 50% incentives from the cost above, what is the simple payback for the lower end of the cost range?

   Simple payback = years = (Cost-incentives) / annual savings

   ($105,000- $52,500) / $3806 = 13.8 yrs

Report Rubric

A report is due at the end of the semester along with a presentation of that report. This is the report rubric.

Student Name: _____ sub1 _____/ 32 Q _____/ 49

32 REPORT TOPIC _____ 19 sub2 _____/ 19 bonus _____

pts	CATEGORY		pts	CATEGORY	total _____ 51
1	**COVER PAGE**	_____ / 4	1	**Introduction**	_____ / 2
1	Title		1	one page max	
1	Student Name				
1	Date		1	**Summary / Conclusions**	_____ / 9
			1	Not same as Exec Summary/intro	
			2	Gives quick overview of what was just discussed	
	Table Of Contents	_____ / 5	5	Makes conclusion	
1	Introduction	- Not inteneded to be the titles of various sections of the report - OK to list more items/sections in the Table of Contents			
1	Other items			**Spelling**	_____ / 4
1	Summary / conclusions		4	No Errors detected	
1	References			many errors 0 1 2 3 4 No errors	
1	Page numbers				
	-1 for error message			**Grammar / writing**	_____ / 4
10	**Body of Report 5-10 pag**	_____ /10	4	No Errors detected	
	_____'total pages in body			many errors 0 1 2 3 4 No errors	
2	**1.5 Spaced or less**	_____ /2			
	minus 1x 1.5x plus		19	***sub total2 -***	_____
2	**12 point font or less**	_____ /2			
	minus 10 12 plus			**Quality Points Available**	_____ / 49
3	**Sections labeled in rep**	_____ /3	14	Technical 1 2 3 4 5 6 7 8 9 10 11 12 13 14	
			10	Class Topic 1 2 3 4 5 6 7 8 9 10	
1	**References**	_____ / 6	25	Overall Writing 2 3 4 5 6 7 8 9 10 12 14 15 18 20 22 23 24 25	
3	References (3 required)		BONUS POINTS		
2	MLA format followed		2	***Double Sided***	_____ / 2
	(http://citationmachine.net/)		1	***Appendices - bonus points +1***	_____ / 4
	Author, title, publisher, year, media		3	*Nicely / neatly done (up to +3)*	
32	***sub total1 -*** _____		2	**Pictures/Figures/tables**	_____ / 4
			2	*referred to in body of report bonus (up to +2pts)*	
			-2	***If in a binder or folder - minus 2 points***	_____ / -2
			-1	***If not uploaded in BB - minus 1 point!***	_____ / -1
				bonus total -	

COMMENTS:

- note: not all errors (for instance spelling & grammar) are noted on the report or here by the
- describe acronyms: The first time it is used the full written out name should prescede the acronym in parenthesis
- a power point is not a report, will not be graded.

ok to write in first person!

___ Run-on sentences?

___ Need to separate paragraphs?

If not five pages, 8 points off. Then 1 extra for each page less.

Weekly Article

There are 6 weekly news articles required during the semester.

Weekly Article Due Week #___

NAME: _____

NATSCI 169: Energy – Nature, Technology, Society

ARTICLE TITLE: _____

SOURCE: _____

DATE: _____

Article Attached? Yes / No _____

What specifically does it relate to in the book or lectures? _____

Summary: _____

Weekly Article Rubric

Below is the rubric for those articles.

Rubric

Name	Weekly Article
Description	
Rubric Detail	

	Levels of Achievement				
Criteria	Novice	NC	Competent	CP	Proficient
Title	0 Points If no title	2 Points Multiple Issues	3 Points	4 Points Not properly capitalized or some other issue	5 Points There and correct
Source (Name of media source)	-5 Points If a full url is used	0 Points If a ".com" or other listed (not a full url) or not here	1 Points 2 or 3 of following: something wrong or if not spelled out or acronym used (if not formal way source is referred to)	3 Points something wrong or if not spelled out or acronym used if not formal way source is referred to)	5 Points There and correct
Date	0 Points If not here	1 Points If over six months old	2 Points If there but something wrong or if in past 6 months	4 Points If more than three weeks old	5 Points If less than three weeks old
Article attached or url pasted here	0 Points If not here	5 Points	10 Points If there but something wrong	15 Points	20 Points There and correct

How related to class topics	0 Points If not here	10 Points If general topic listed (say "solar" or "wind") with no discussion	15 Points If general topic listed and discussed	20 Points If 2 of 3 items: 1) Chapter of book cited 2) Page of book cited 3) Good general discussion	25 Points If all 3 items: 1) Chapter of book cited 2) Page of book cited 3) Good general discussion
Summary of Article	0 Points none	5 Points If only one sentence or cut and pasted w/ minor changes	24 Points ok or only one paragraph	32 Points Good and less than two full paragraphs	40 Points Great summary and two full paragraphs or more
Spelling, capitalization, punctuation, grammar, and sentence structure	-10 Points Multiple issues	-7.5 Points	-5 Points Some issues	-2.5 Points	0 Points none
Miscellaneous	-4 Points	-3 Points	-2 Points	-1 Points	0 Points

View Associated Items

Print Close Window

Appendix D – Sample Quiz

D

NATSCI169 5th CH01
Introduction

TRUE/FALSE

1. Fossil fuels are the major reason that the modernization of the world from rural to urban has taken place.

   ANS: T
   First couple of sentences of page 1.

2. Energy is the "capacity for vigorous action"

   ANS: T
   page 2

3. We can see energy, such as in the flame of a fire.

   ANS: F
   page 2 - "We cannot see energy, only its effects"

4. When we burn gasoline for instance in our car, we are destroying energy.

   ANS: F
   page 3 "Energy is not created or destroyed, but just converted or redistributed from one form to another,"

5. The proper use of energy requires consideration of social issues as well as technological ones. Sustained economic growth in this century, together with improvements in the quality of everyone's lives, may be possible only by the well-planned and efficient use of limited energy resources and the development of new energy technologies.

   ANS: T
   page 3

6. Not only does the use of fossil fuels impact the environment, but the mining or gathering of those resources can have devastating impacts.

   ANS: T
   page 4 Not only is the Gulf oil spill an example, but think of the strip mines out west and in other parts of the world, mountain top removal in Appalachia for coal, and so on.

7. The number of people in the world who rely on biomass as their primary energy source is roughly 2.7 billion. The forms of biomass they rely on are items such as wood and animal waste.

   ANS: T
   page 7

8. Currently developing countries use more energy than industrialized countries.

   ANS: F
   page 7

9. Oil has been drilled in the United States since at least 1859 (over 150 years ago).

   ANS: T
   page 9

10. Fossil fuel use will be over a relatively large interval of time when considered in the context of the history of humanity.

    ANS: F
    page 10

11. "Energy is not an end in itself but is valued for what can be done with it."

    ANS: T
    page 12

12. Of the three fossil fuels, oil is the easier to estimate how much of the resource we have.

    ANS: F
    page 12 & 14 It actually is coal. Oil and natural gas tend to be at varying depths, scattered and found only by exploration.

13. The United States and the world are running short of fossil fuels. Americans have no difficulty understanding this concept.

    ANS: F
    pg 15 "To Americans most of all, it is still difficult to understand that they are running short of the fuels that propelled the United States into the position of global economic leadership that it occupies. The nation progressed by recognizing no limits, by making the most of its citizens' ingenuity, and by taking chances. The economy was built on a price of $3 per barrel of oil. That is no longer the case. To remain strong economically, each of us must acknowledge the limits of our resources. Failure to recognize this finiteness is certainly one element responsible for the energy crises of the past."

14. If a quantity is growing at the same percentage (rate) each year, it is an exponential growth. An example of this is money placed in an account that has an interest rate of 3% annually.

    ANS: T
    page 17

15. At a zero growth rate for coal production, U.S. coal resources will last about five hundred years.

    ANS: T
    pg 18

16. The use of a particular resource will continue to grow exponentially until we have exhausted that fuel and then suddenly stop.

    ANS: F
    page 18

17. M.K. Hubbert analyzed the growth and decline of resources. He worked for the U.S. Geological Survey. The result of his analysis is basically a bell shaped curve which he used to predict when the US would peak in oil production.

    ANS: T
    page 18-19

18. The book implies that world coal resources are large enough to last (at current rate of use) more than five hundred years, and that the peak in production will not occur for almost two hundred years.

    ANS: T
    page 19 & 20: Note, later in the semester there may be some contradictory information to this 500 year supply that you should be looking for.

19. The term "Peak Oil" means that we are running out of oil.

    ANS: F
    pg 20 This is not correct since there is still plenty of oil left. It just means that it will be harder to get and more expensive in the future.

20. Large discoveries of natural gas in the past decade have basically tripled the amount of recoverable gas resources in the US.

    ANS: F
    pg 20 - double

21. The experts believe that oil has already peaked globally and that we are now facing ever more expensive to extract oil reserves.

    ANS: T
    pg 21

22. The laws of physics place limits on how successful technical fixes can be for energy conservation efforts.

    ANS: T
    page 24

23. Some people assert that energy prices should reflect what it will cost to replace the dwindling supplies of nonrenewable fuels such as oil and natural gas, rather than just what it costs to obtain them.

    ANS: T
    page 25

24. Uses for fossil fuels such as pharmaceuticals and plastics is less important than as a source of energy.

    ANS: F
    page 26

25. Energy conservation can have positive impact on our health.

    ANS: T
    page 26
    Conservation measures can be readily practiced in some way by each individual with the incentive of saving money as well as energy. Such practices can also contribute to our own health; for example, bicycle riding provides more exercise than driving a car.

26. Economic growth always means increasing the amount of energy used!

    ANS: F
    page 26

27. The United States energy intensity (btu/GDP) continues to decrease.

    ANS: T
    page 26

28. The world's strong dependence on oil will continue to be a factor in limiting economic growth.

ANS: T
page 29

29. World energy consumption is predicted to increase by 50% by 2025.

ANS: T
page 30

MULTIPLE CHOICE

1. In 1997, the electric power industry was deregulated. This meant, that in certain states (Wisconsin is not one of them), people would have choices of where to buy electricity. Which below is the best answer?
   a. This allowed consumers to buy based on cost.
   b. Cost was not the only consideration, buying "green power" also became available.
   c. All of these

ANS: C
page 2

2. Which area of our lives does energy not play a part in?
   a. economics
   b. housing
   c. transportation
   d. recreation
   e. computers
   f. furniture
   g. food
   h. none of these

ANS: H
page 2

3. The use of fossil fuel energy resources has not:
   a. increased carbon dioxide concentrations in the atmosphere dramatically
   b. had no impact on the environment
   c. increased the earth's temperature

ANS: B
page 4

4. Generally speaking, how much more garbage is generated in American per person than in Europe?

a. 1
b. 2
c. 5
d. 9

ANS: B
page 4

5. Which is a reason to burn garbage for industrial purposes or to generate electricity?
a. air pollution
b. water pollution
c. thermal pollution
d. minimizes land fill waste

ANS: D
page 6

6. Overall global demand for energy might increase by how much in the next 30 years?
a. 2x's
b. 3x's
c. 4x's
d. 5x's

ANS: A
page 7

7. Today, roughly 80% of the world energy supply comes from fossil fuels. Which is not a fossil fuel?
a. Coal
b. Oil
c. Natural Gas
d. Renewable

ANS: D
page 9: Actually, renewable, Hydro, and Nuclear are not fossil fuels.

8. What was the United States peak production rate of oil? MBPD=million barrels per day
a. 2 million barrels per day
b. 8 million barrels per day
c. 11 million barrels per day
d. 15 million barrels per day

ANS: C
page 10 11 MBPD which occurred in 1970

9. Oil imports cost the US roughly $300 billion a year which makes up what percentage of the US trade deficit?
a. 10%
b. 25%
c. 5%
d. 30%

ANS: B
page 10

10. Which is not a renewable energy source:
    a. hydroelectric
    b. biomass
    c. wind
    d. photovoltaic
    e. radiant solar
    f. nuclear

ANS: F
page 10

11. Which fuel currently is used the most in the United States to meet our energy needs (and has been for many decades)?
    a. Wood
    b. Hydropower
    c. Nuclear
    d. Petroleum
    e. Natural Gas
    f. Coal

ANS: D
Figure 1.9 on page 11

12. Which two sectors use almost 60% of the energy consumed in the US?
    a. commercial & Residential
    b. Commercial and Industrial
    c. Industrial and Transportation
    d. Transportation and commercial
    e. Residential and Industrial
    f. Residential and Transportation

ANS: C
Figure 1.12 on page 12, Industrial is 29.8% and Transportation is 28.7% for a combined percentage of 58.5%

13. To understand energy, you must understand energy resources, their limitations, and their uses. Not only that but how large is the source and how long will it last? What are some assumptions one has to make to start to get a understanding of this?
    a. future technologies to extract the fuel
    b. future prices of that commodity
    c. what the consumption rates in the future will be
    d. all of these

ANS: D
page 12

14. Part of the definition of a reserve is:
    a. it is a static quantity of a resource,
    c. technology can impact a reserve

such as oil
b. they only decrease
quantity
d. it is not related to cost of extraction

ANS: C
page 14 “Reserves are not a static quantity—they are being added to every year through discovery and improved methods of economically extracting the particular resource”.

15. Which does not define a BTU?
    a. amount of energy needed to raise the temperature of 1kg of water by 1 degree Fahrenheit
    b. approximately the amount of energy released by burning a wooden kitchen match
    c. British thermal unit

ANS: A
page 14

16. Energy Conservation has two approaches. Which below is not one of those approaches?
    a. doing the same task with less fuel - e.g. more efficiently.
    b. not letting any energy enter or leave a process
    c. using less fuel by a behavior or lifestyle change

ANS: B
page 24:
1) Technical fix. T is consists of using fuel more efficiently to perform the same task, such as driving a car with a more efficient engine (reducing the energy required for that activity).
2) Lifestyle change. This means consciously using less fuel by such behaviors as turning down the thermostat or driving fewer miles (thereby reducing the frequency of the activity).

MULTIPLE RESPONSE

1. Which are facts about China and it’s energy use (select all that apply)
    a. consumes about 27% of the worlds total energy consumption.
    b. it uses more energy than the United States
    c. it is the worlds\ largest emitter of green house gases
    d. it imports about 45% of the oil it consumes
    e. they have 4.5 million digesters that convert animal waste to gas for cooking and lighting.

ANS: A, B, C, D, E
page 15-16

2. Energy policy should be concerned with (select all that apply)
   a. finding new sources
   b. impacts on our lives
   c. technology impacts
   d. reducing energy consumption

ANS: A, B, C, D
page 26
Energy policy should be concerned not only with finding new sources and reducing energy consumption, but also with weighing the effects of technologies and energy-related lifestyles on our lives and on our planet.

YES/NO

1. Are energy supplies intimately tied to our economy? For example, will higher energy prices or restricted supply hinder economic growth? Can a significant restriction of energy sources cause severe damage to our economic system?

   ANS: Y
   page 2

2. Is the equation below a simplified method for determining how long it will take to double a given quantity at a given rate?

   Doubling rime ~ 70 years / % growth rate

   ANS: Y
   page 18

MATCHING

For the given resource, match the typical unit of measure associated with it.
   a. tons
   b. barrels (bbl)
   c. trillion cubic feet (tcf)

1. natural gas
2. coal
3. oil
1. ANS: C
2. ANS: A
3. ANS: B

BEST Center Curricula, Resources & Recordings

Academic Programs
Georgia Piedmont Technical College - Building Automation Systems
Milwaukee Area Technical College - Sustainable Facilities Operations
Laney College - Commercial HVAC Systems
City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos
National Institutes
Building Automation Systems Instructor Workshops
Webinars (e.g., BEST Talks)

Faculty Profile Videos
Reports & Case Studies
Marketing Resources

BEST
Building Efficiency for a Sustainable Tomorrow

NSF National Science Foundation