Chapter 1

Introduction

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Director of EMU Energy Research Centre
Primary objectives of Energy Management

- Improving energy efficiency, reducing energy use, reducing costs
- Cultivating good communications on energy matters
- Effective monitoring, reporting and management strategies for wise energy usage
- Finding new and better ways to increase returns from energy investments
- Developing interest in energy programs from all employees
- Reducing the impacts of any interruption in energy supplies
The Need for Energy Management

- Economics
- National interests
  - Using resources efficiently
    - Economics
    - Competitiveness
  - Increasing national security
- Reducing emissions
  - Acid rains (*caused by sulfur dioxide*)
  - Global warming (*caused by carbon dioxide*)
  - Depletion of ozone layer (*caused by CFC’s and NOx*)
History of world supply of primary energy: Continuous growth.

Energy supply grew 20-fold between 1850 and 2000. Fossil fuels supplied 80% of the world’s energy in 2000.

From Holdren

Hydro+ means hydropower plus other renewables besides biomass.
...and that growth will continue

Figure 7. World Marketed Energy Consumption, 1980-2030

World energy reserves

Petroleum and Natural gas

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**World conventional crude oil production and forecast for an ultimate of 2.1 Tb (no demand constraint)**

- **World**: 930 Gb
- **model**:
- **Non-OPEC**: 560 Gb
- **non-opec - 2004-end**: 500 Gb
- **OPEC**: 370 Gb
- **opec - 2004-end**: 700 Gb


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**IPCC extreme scenarios on natural gas consumption and modeling 2000-2300**

- **A1G message**
- **A1G AIM**
- **BI image**
- **Laherrere**
  - 2000-2300=175 000 EJ
  - 2000-2300=165 000 EJ
  - 2000-2300=19 000 EJ
  - 2000-2300=9 000 EJ
- **data**

Grandfather Energy Report - [http://mwhodges.home.att.net/energy/energy.htm](http://mwhodges.home.att.net/energy/energy.htm)
Problems with business as usual (BAU)

- The problem with this path is not only that we won’t have enough energy to meet projected demand.
- The problem is the irreparable harm to the global environment that will result from current energy use patterns...
- …and the increased tensions between states as they compete for energy resources.
Problems with business as usual (BAU)

- Energy use can be the source of most indoor and outdoor air pollution.
- Energy use can be the source of most of the human-caused emissions of greenhouse gases that are altering the global climate.
- Energy use can be the source of most radioactive waste.
Problems with business as usual (BAU)

- Energy use can be the source of much of the hydrocarbon and trace-metal pollution of soil and ground water.
- Energy use can be the source of many international and internal conflicts (Iraq war; Nigerian unrest; source of funds for terrorist activities, to name but a few)
Greenhouse effect and global warming

$CO_2$ and $H_2O$
Global Warming

Figure 66. World Carbon Dioxide Emissions by Fuel Type, 1980-2030

Billion Metric Tons

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Oil</th>
<th>Natural Gas</th>
</tr>
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<td>10</td>
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<td>2000</td>
<td>30</td>
<td>30</td>
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</tr>
<tr>
<td>2030</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

The earth is getting warmer

Global Land-Ocean Temperature Anomaly (°C)

Global annual surface temperatures relative to 1951-1980 mean temperatures

Source: J. Hansen et al., PNAS 103: 14288-293 (26 Sept 2006)
Sea level is rising; snow cover is falling

Source: IPCC 2007
Snow is melting in northern hemisphere

Since 1979, more than 20% of the Polar Ice Cap has melted away.
Melting glaciers and temperature rise

- If global warming is causing ice glaciers to melt faster, the reduced ice cover over earth in turn is causing temperatures to rise further. Ice glaciers deflect almost 80% of the heat from the sun and absorb about 20% of the heat. When an ice glacier vanishes and exposes the earth below, 80% of the heat from the sun is absorbed by the earth, and only about 20% of this heat is deflected back.

Increase in sea level...

- Heat absorbed by the earth increases the temperature of the earth, which increases the temperature of sea water. Sea water expands with an increase in water temperature and causes sea levels to rise. Melting water from glaciers will finally empty into the sea, causing a further increase in sea levels. All low-lying areas near the sea will go under water and humans living here will be displaced. At the rate at which sea levels are rising, it is estimated that many South American and Asian countries will be the first to suffer from this effect.

There are many more effects that rapidly melting glaciers cause. While some areas will witness unprecedented floods, other areas will witness severe drought. In both cases, agriculture will be severely hit, causing scarcity of food grains. Nations depending on hydroelectricity will have to switch over to other sources to generate their electricity, in effect further polluting the atmosphere. Forest fires will happen more frequently (they already are in Australia and the US) causing great stress to humans living in the vicinity. The bad effects of rapidly melting ice glaciers are limitless.
Global warming impact on Boston

This rendering depicts coastal flooding by the end of the century resulting from the combined effects of a sea level rise and a storm surge. Data from the EPA study assumes a 2- to 3-foot rise in the sea level combined with the coastal surge from a storm. The flooding plotted along the Charles River occurs because the surge pushes seawater over the dam.

Existing water levels  Coastal flooding likely by 2100

**Source:** Applied Science Associates, Inc

**Graphic:** Globe Staff Graphic/Joan Mclaughlin

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**Image Description:**
- A map of Boston showing the current water levels and projected flooding by 2100.
- The map highlights areas such as Back Bay, Beacon Hill, North End, Museum of Science, and Back Bay Common.
- A message at the top right reads: **The Day Is Today**
- A question below the message: **What Will You Do?**
- A website link: **Visit www.thedayaftertomorrow.com**

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**Caption:**
- Water levels rising
What should we do?

- Energy Management
  - Energy efficiency
  - Rational use of energy
  - Energy Conservation

- Energy Utilization
  - Exploration of clean energy sources
  - Utilization of innovative technologies

- New Energy Policies
MENG 547 Grading Policy

- Mid-Term (20%)
- Assignment-I (10%)*
- Assignment-II (30%)**
- Final (40%)

*Short presentation on the selected seminar topic (10 - 15 mins)

**Submission of the report on the seminar topic (use format of Solar Energy – ISSN: 0038-092X)
Report Format
The report should have the following possible sections. A suitable title should be chosen for each section. The text of the report should be 12pt Times New Roman.

Title of Report (16 pt Times New Roman, Bold, Centred)
AUTHOR NAME (Capital, 12pt Times New Roman, centred)

Abstract
1. Introduction (with a literature review)
2. Description of the technologies available (Title can be different)
   a. What are they?
   b. How do they work?
3. Energy calculations (Comparison should be made with conventional technologies in terms of energy, economics and carbon emissions)
3. Recent Developments with discussion (Title can be different)
4. Conclusions
References
Appendices
Suggestions for seminar titles for students

1. Lighting: Efficient lamps, applications and daylighting
2. Combustion processes and the use of industrial wastes
3. Energy management with control systems and computers
4. Utility demand-side management
5. Energy systems maintenance
6. Industrial cogeneration
7. Power circuits and electrical machinery
8. Distributed generation
9. Cooling storage systems and their application
10. Energy utilization technologies: Clean hydrogen energy
11. Solar energy utilization technologies: Active solar heating systems
12. Solar energy utilization technologies: Solar thermal power plants
14. Hydro-electric power
15. Electric cars