Lecture #1

Environmentally Responsible Design and Manufacturing

Prof. John W. Sutherland

Jan. 12, 2004
Contact Details

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Course Objectives

Acquaint students with the environmental issues surrounding product and process design decisions.

Identify/develop strategies, techniques, and methods that can be used to make more environmentally responsible decisions.

Understand the “systems” nature of environmental challenges.
Course Topics

Introduction
- Environmental measures (Global -- Local)
- Sustainability
- Laws & Regulations
- Control vs. ?
- Motivators

Product Design
- Life Cycles
- Materials
- Assembly & Disassembly
- QFD
- DFX
More Course Topics

Process Design
  Types & Wastes
  Process Impacts and how to measure them
Plant Issues
Input-Output Analysis
Supply Chain Issues

System Issues & Industrial Ecology
  System Modeling
  Life Cycle Analysis
  Risk Assessment and Management
  Decision Making
  Future Steps
Readings

Text

Other
- Plus handouts and website links posted on the course webpage.
Grading

Basis (graduate student breakdown in parentheses)
- 30% Homework (20%)
- 30% Midterm Exam (25%)
- 40% Final (35%)
- Graduate Project (20%)

Grade Breakdown
- Class GPA: approx. 3.0
- Graduate students graded separately
Web Site

- The course web site can be accessed from: http://www.me.mtu.edu/~jwsuther

- At the web-site, the following materials may be retrieved:
  - Course notes
  - Homeworks
  - Listing of assignment results for both on- and off-campus students
  - Other

- For listing of assignment results we need a 3 digit codeword -- btw, because we may need to have classes at other times -- need your schedule
Assignment

- Read Chapter 1 & Material Through Chap. 2 in WTEC EBM Report

- Problems:

  Due next Monday (Jan. 19, 2004)
Why Focus on the Environment??

Can the earth continue to support an ever-increasing population??

Environmentally Responsible Design & Manufacturing (MEEM 4685/5685)
Dept. of Mechanical Engineering - Engineering Mechanics
Michigan Technological University

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Population Breakdown

But, maybe population isn’t the whole story.....
What About Spending? (GDP/Capita)
Energy Proportional to GDP/capita

- World: 344.90 GJ per capita, 342.91 PJ total energy consumption
- Africa: 60.97 GJ per capita, 12.15 PJ total energy consumption
- Asia and the Pacific: 92.41 GJ per capita, 28.56 PJ total energy consumption
- Europe and Central Asia: 131.89 GJ per capita, 114.14 PJ total energy consumption
- Latin America and the Caribbean: 41.76 GJ per capita, 19.85 PJ total energy consumption
- North America: 101.68 GJ per capita, 101.68 PJ total energy consumption
- West Asia: 99.89 GJ per capita, 8.31 PJ total energy consumption

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Energy Efficiency of US Economy

The U.S. has become more efficient over time... Is it enough??
### The Global Picture

<table>
<thead>
<tr>
<th>Rank</th>
<th>GDP per capita (1999 World Factbook)</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Luxembourg $32,700</td>
<td>5.7%</td>
</tr>
<tr>
<td>2.</td>
<td>United States $31,500</td>
<td>5.0%</td>
</tr>
<tr>
<td>3.</td>
<td>Bermuda $30,000</td>
<td>1.5%</td>
</tr>
<tr>
<td>4.</td>
<td>Switzerland $26,400</td>
<td>3.0%</td>
</tr>
<tr>
<td>5.</td>
<td>Singapore $26,300</td>
<td>10.10%</td>
</tr>
<tr>
<td>6.</td>
<td>Hong Kong $25,100</td>
<td>10.0%</td>
</tr>
<tr>
<td>7.</td>
<td>Monaco $25,000</td>
<td>N.A.</td>
</tr>
<tr>
<td>8.</td>
<td>Norway $24,700</td>
<td>2.7%</td>
</tr>
<tr>
<td>81.</td>
<td>Russia $4,000</td>
<td>6.3%</td>
</tr>
<tr>
<td>84.</td>
<td>China $3,600</td>
<td>6.0%</td>
</tr>
<tr>
<td>106.</td>
<td>India $1,720</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

What are the consequences if developing countries follow same path as U.S.??
What About Emissions
As energy consumption increases, so do carbon emissions.
The Future

Maybe we can manage increased energy demands & carbon emissions?? What about energy sources??

![Graph showing oil production trends](image-url)
As engineers, what should we be doing about all of this??