



Cornell University

## ENERGY ECONOMICS & ENGINEERING

### Cornell Master of Chemical Engineering concentration

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#### Why a new concentration in energy?

We need energy engineers who not only have skills in their BS discipline but are aware of the “big picture” of energy issues

#### How will a Master’s degree in energy engineering be useful to my career?

It’s a great pathway to many job opportunities. You will be a valued employee in organizations ranging from major energy companies, to consultants, to energy start-ups.

#### Who can qualify for admission?

Any graduate, typically from engineering or the physical sciences, with the requisite level of knowledge in thermodynamics and relevant coursework (details given in the “Course Offerings” section of the web page)



# ENERGY ECONOMICS AND ENGINEERING: Talk Outline

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- Value of an M. Eng. degree
- Unique value of an M. Eng. in Energy Economics and Engineering
- Program outline
- Details on the core course sequence
- Q&A



# ENERGY ECONOMICS AND ENGINEERING:

## Value of an M. Eng. degree

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### Advantages:

- Greater, earlier responsibility at work
- Life time earnings potential
- Gain extra breadth or depth
- Gain maturity and attractiveness to employers
- Improve GPA

### Financial aid:

- Limited but possible



# ENERGY ECONOMICS AND ENGINEERING: Value of an M. Eng. (ChE) degree

## Advantages:

- High starting salary (2004-5 mean ~\$60,000)
- **Unique** program in energy economics and engineering sets you apart
- Only comparable programs are in Europe

## Aspirations:

You could be Secretary of Energy  
some day, like Dr. Samuel Bodman  
(Cornell BS ChE '60)



# ENERGY ECONOMICS AND ENGINEERING:

## Motivation for the new program

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- Energy needs of the world are increasing rapidly
- New “game-changing” technologies and techniques needed to transform our energy infrastructure
- Orderly transition needed from current fossil fuel based energy system to one that assures secure, sufficient energy sources and supply networks that mitigate addition of greenhouse gases to the atmosphere.
- New primary energy sources needed, built from new materials and integrated into a new system of networks.
- Energy demand sectors can no longer be considered independent: Transportation integrated with electricity, electricity with communications, etc.
- Daunting challenge and lack of a clear path toward the replacement of existing infrastructure.
- A portfolio of primary energy sources and downstream technologies will be involved, but its unclear which possibilities will ultimately be important
- Picking winners and losers now is risky

# ENERGY ECONOMICS AND ENGINEERING:

## Objectives of the new program

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### Overall Program Objective

- Create a new breed of engineer with the ability to thoughtfully contribute to designing future energy landscapes and portfolios

### Tasks

- Examine **economics and technology** of renewable and non-renewable energy systems
- Study **theory and economics** of coal, oil, gas, hydropower, nuclear, solar, wind and geothermal
- Focus on **novel solutions**; *not* a survey of current technologies. Ex: Gasification project in Montana. How would you advise the Governor of Montana to proceed?

# ENERGY ECONOMICS AND ENGINEERING:

## Outcomes of the new program

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- Familiarity with techniques used to record and project future energy use on a national and global scale.
- Appreciate how environmental issues, safety, policy and public opinion impact different approaches for energy creation
- Understand how to evaluate energy combinations: For instance, a coal mine powered by wind or solar power? Heat engines powered by cold Northeast winters?
- First-hand experience through a variety of simulation projects with growing complexity

# ENERGY ECONOMICS AND ENGINEERING:

## Program Outline

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### Course Requirements:

- One MS/PhD core graduate course (3 credits)  
*Choose from ChE 711 Thermodynamics; ChE 731 Fluid Mechanics and Heat Transfer, ChE 751 Mathematical Methods; new ChE 7xx kinetics course*
- **Two-semester core course sequence in Energy Economics and Engineering** (6 credits)
- Sustainable business or societal impact course (3 credits)
- Environmental impact course: Pollution abatement or conservation (incl. air pollution, solid waste and water supplies) or climate control (3 credits)
- Energy Technology courses: Study traditional and/or alternative energy sources (6 credits)
- Energy-related Project (3-6 credits)
- Free electives (3-6 credits)

# ENERGY ECONOMICS AND ENGINEERING: Core course sequence

Keystone of the program is a new two-semester course in “Energy Engineering and Economics”

## Objectives

- First semester: energy statistics and energy processes
- Second semester:
  - energy efficiency
  - energy projects



# ENERGY ECONOMICS AND ENGINEERING:

## Core course details

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- Highly interactive lecture/seminar format
- Teams on a variety of energy projects and simulations throughout the year
- Grades based on presentations. No formal exams.
  
- Instructors with long experience in energy industries and consulting
  - Andrew Hunter
  - Al Center
  - Mike Duncan



# ENERGY ECONOMICS AND ENGINEERING:

## Core course details

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- Course meets M and W 2:55pm to 4:10pm
  - Examples of first semester projects
    - Energy audit of a campus building
    - Projected U.S. gasoline demand in 2008
    - Turn Iowa into a source of biomass-derived energy?
  - Examples of second semester projects
    - Coal mine with solar-powered facilities
    - Nuclear plant with H<sub>2</sub> storage
    - Solar thermal systems and compressed air storage
- Other projects as arise through student interest



# ENERGY ECONOMICS AND ENGINEERING:

## Detailed course list

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See list under “course offerings” on the web site. This summarizes

- The program and pre-requisites
- A typical fall and spring schedule of courses (30 credit hours)
- Acceptable courses in
  - traditional and alternative energy sources
  - sustainable business
  - pollution abatement and climate control

# ENERGY ECONOMICS AND ENGINEERING:

## Pre-requisite background

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- Undergraduate course in thermodynamics
- Undergraduate courses in **two** of these three areas (a) fluid mechanics (b) reaction kinetics or (c) heat transfer.

BS graduates with from programs in Bioengineering, Chemical Engr., Electrical Engr., Environmental Engr., Mechanical Engr., and Materials Science, should have no difficulty meeting these requirements.

Other students interested in this program, but unsure of their background, should contact Professors A. M. Center ([ac222@cornell.edu](mailto:ac222@cornell.edu)) or A. Hunter ([ah363@cornell.edu](mailto:ah363@cornell.edu))

### Acceptable Cornell classes:

- Thermodynamics: BEE 222, CHEME 313 (summer, fall), MAE 221, MSE 303
- Fluid mechanics: CHEME 323, MAE 323, CEE 331
- Heat transfer: BEE 350, CHEME 324 (summer, fall), MAE 324
- Reaction Kinetics: CHEME 390, MSE 304

# ENERGY ECONOMICS AND ENGINEERING:

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Questions ????? Want to know more?

Contact: Professor A.M. Center, [ac222@cornell.edu](mailto:ac222@cornell.edu) or  
Professor A. Hunter, [ah363@cornell.edu](mailto:ah363@cornell.edu)

Olin Hall: Home of the School of  
Chemical & Biomolecular Engineering  
at Cornell

