Teaching
Institutional Decarbonization Economics

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Spring 2016 Economics Courses:

ECON 370 Special Topics
Applied Economics of the UMass Boston Climate Action Plan

ECON 697 Special Topics, Applied Economics Practicum:
Optimizing the UMass Boston Decarbonization Plan

Course Structure:
1. Climate change economics in general
   GDAE module: The Economics of Global Climate Change
2. Renewable energy economics
   GDAE module: The Economics of Renewable Energy
3. University climate action plans
   Simpson: Cool Campus! A How-To Guide
   for College and University Climate Action Planning
   Timmons: Institutional decarbonization, working paper
[4. Graduate course: constrained optimization and more journal articles]
Approach: conservation heat pump, solar PV.
UMB Climate Action Plan: electricity

Metrics:
- Levelized Cost of Energy (LCOE, $/kWh)
- Cost of Conserved Energy (CCE, $/kWh)
UMB Climate Action Plan: electricity

First draft results for UMB Climate Action Plan

-生产
-减缓
-购买
-基础电费

$/kWh

- 水平轴：kWh
- 垂直轴：$/kWh

- 风力涡轮机
- 太阳能光伏地面
- 太阳能光伏屋顶
- 太阳能光伏停车
- 太阳能光伏车库
- 风力发电

- 生产
- 减缓
- 购买
- 基础电费
Electricity Decarbonization: solar and wind
Electricity Decarbonization: solar and wind
UMB Climate Action Plan: electricity

First draft results for UMB Climate Action Plan

- roof insulation, cooling
- double glazing, cooling
- demand ventilation, cooling
- heat recovery, cooling
- lighting control, CC doors cooling
- motor control
- LED lighting

Costs per kWh:
- Production
- Conservation
- Purchased
- Base electric cost

$kWh$ vs. Cost per kWh
UMB Climate Action Plan: electricity

First draft results for UMB Climate Action Plan

MA Clss I REC ≈ $0.06/kWh
UMB Climate Action Plan: electricity costs

First draft results for UMB Climate Action Plan

- Production
- Conservation
- Purchased
- Base electric cost

KWh vs. $/kWh graph showing the savings and costs associated with the UMB Climate Action Plan.
Institutional Decarbonization

Natural Gas

Price

0

$q_1$

$q_2$

Quantity

$MC_{\text{conservation}}$

$MC_{\text{heat pump +renewable}}$

$q_2$
Central Heating Plant:
Ball State University
Muncie, Indiana

(4) Heat Pump Chillers:
R134A Refrigerant

Heating:
150 F   Hot Water
38,000,000 BTU/Hour

Cooling:
42 F   Chilled Water
2,500 tons
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Lessons Learned:
• Approach was very productive for instructor research.
• Should have collected institutional data before start of course.
• Course needed more engineering content.
• Projects should have had earlier and more submissions ($\geq 3$).
• Considerable work remains to finish Climate Action Plan.

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