

Teaching Institutional Decarbonization Economics

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University of Massachusetts Boston
ISEE Conference, Washington DC, June 29, 2016



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]

~~Transform Your House Into A~~ **Zero Energy Home In Just Two Weeks**

campus

Advertisement
in
Green Energy
Times
April, 2016

Approach:
conservation
heat pump
solar PV

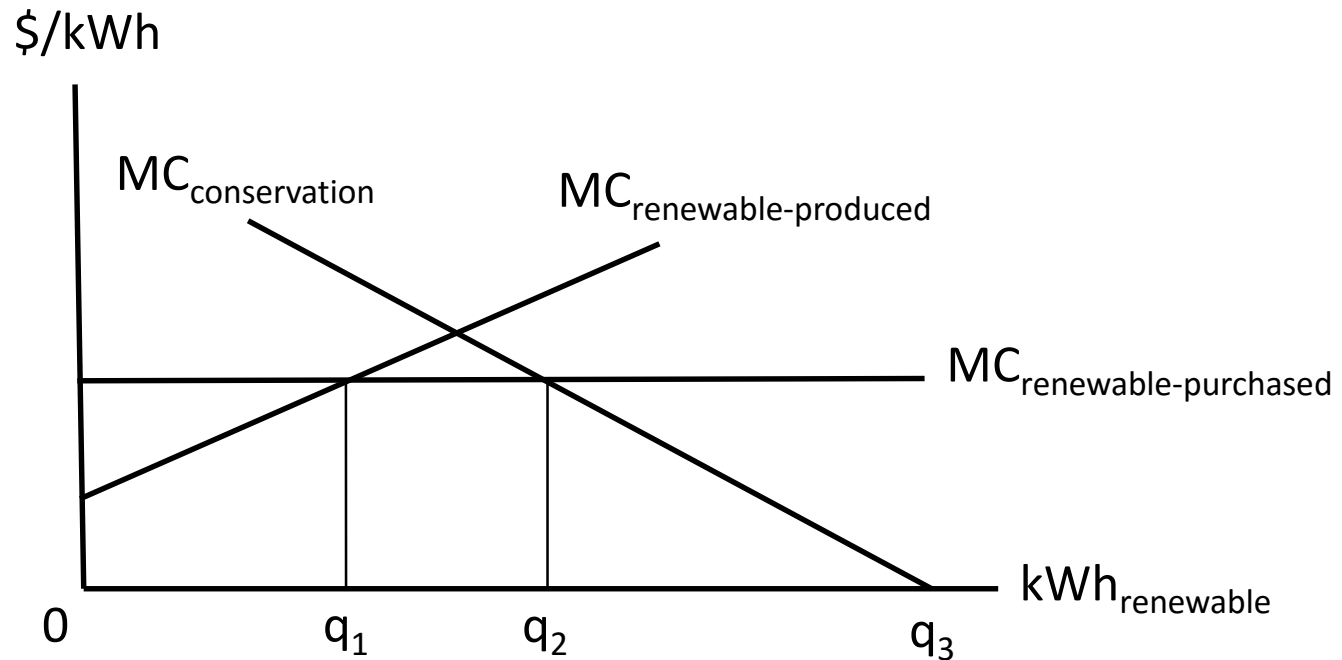
Zero Energy Now! is a new comprehensive home energy improvement program. By combining energy efficiency upgrades, renewable energy heating options, and solar photovoltaics, we can virtually eliminate your monthly energy costs.



Low-cost financing is available. Use the savings from energy costs to pay off the loan, and move your home toward using zero energy at little or no cost to you.

For more information, visit our website at zen-vt.com, call us at **802-477-5249** or email info@zen-vt.com.

UMB Climate Action Plan: electricity



Metrics: Levelized Cost of Energy (LCOE, \$/kWh)
Cost of Conserved Energy (CCE, \$/kWh)

UMB Climate Action Plan: electricity

\$/kWh

\$0.18
\$0.16
\$0.14
\$0.12
\$0.10
\$0.08
\$0.06
\$0.04
\$0.02
\$0.00

0 10,000,000 20,000,000 30,000,000 40,000,000 50,000,000 60,000,000 kWh

First draft results for
UMB Climate Action Plan

solar PV garage

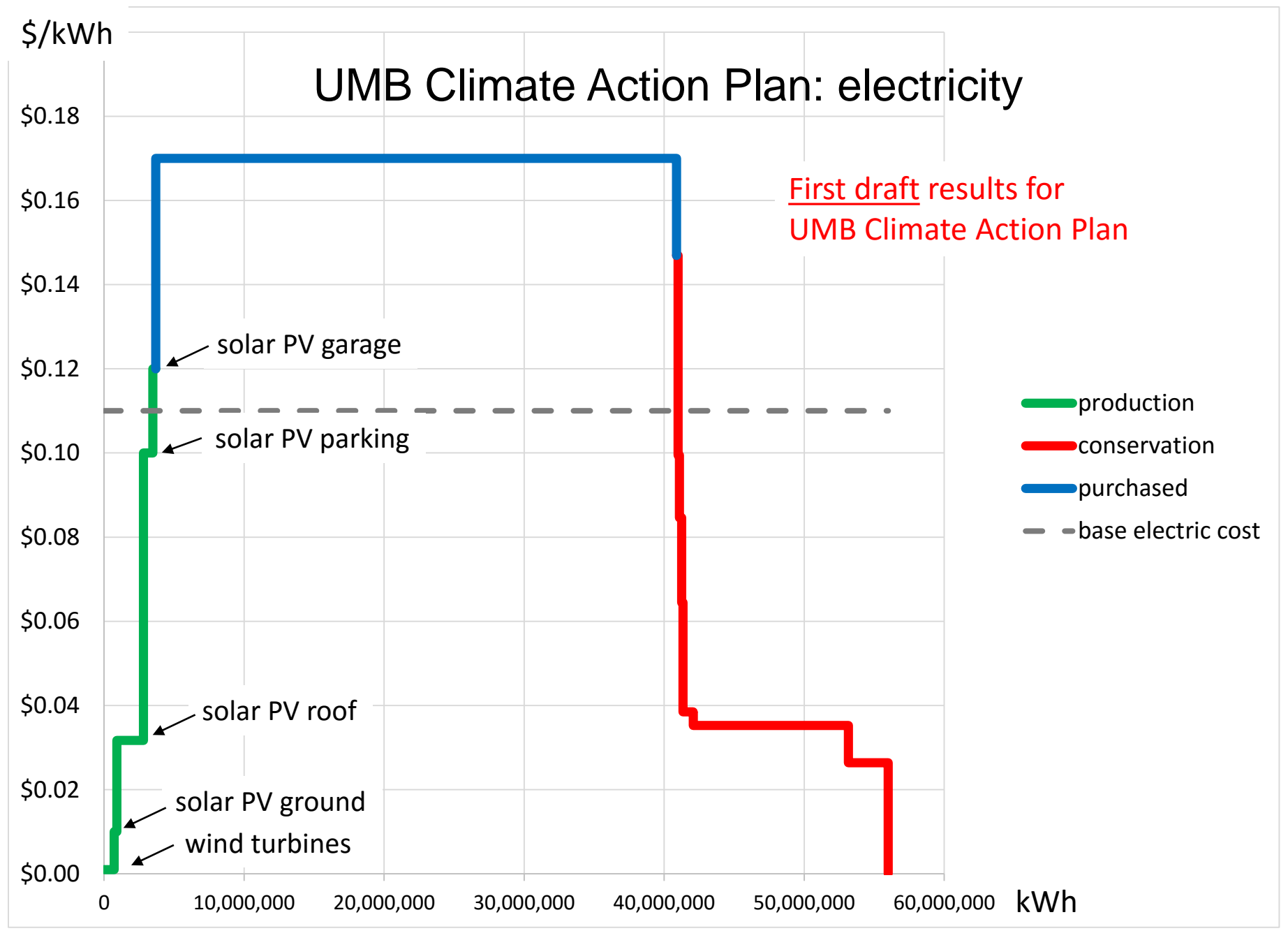
solar PV parking

solar PV roof

solar PV ground

wind turbines

- production
- conservation
- purchased
- base electric cost



Electricity Decarbonization: solar and wind



Electricity Decarbonization: solar and wind



MunichRE 2.5 MW
Princeton, NJ

UMB Climate Action Plan: electricity

\$/kWh

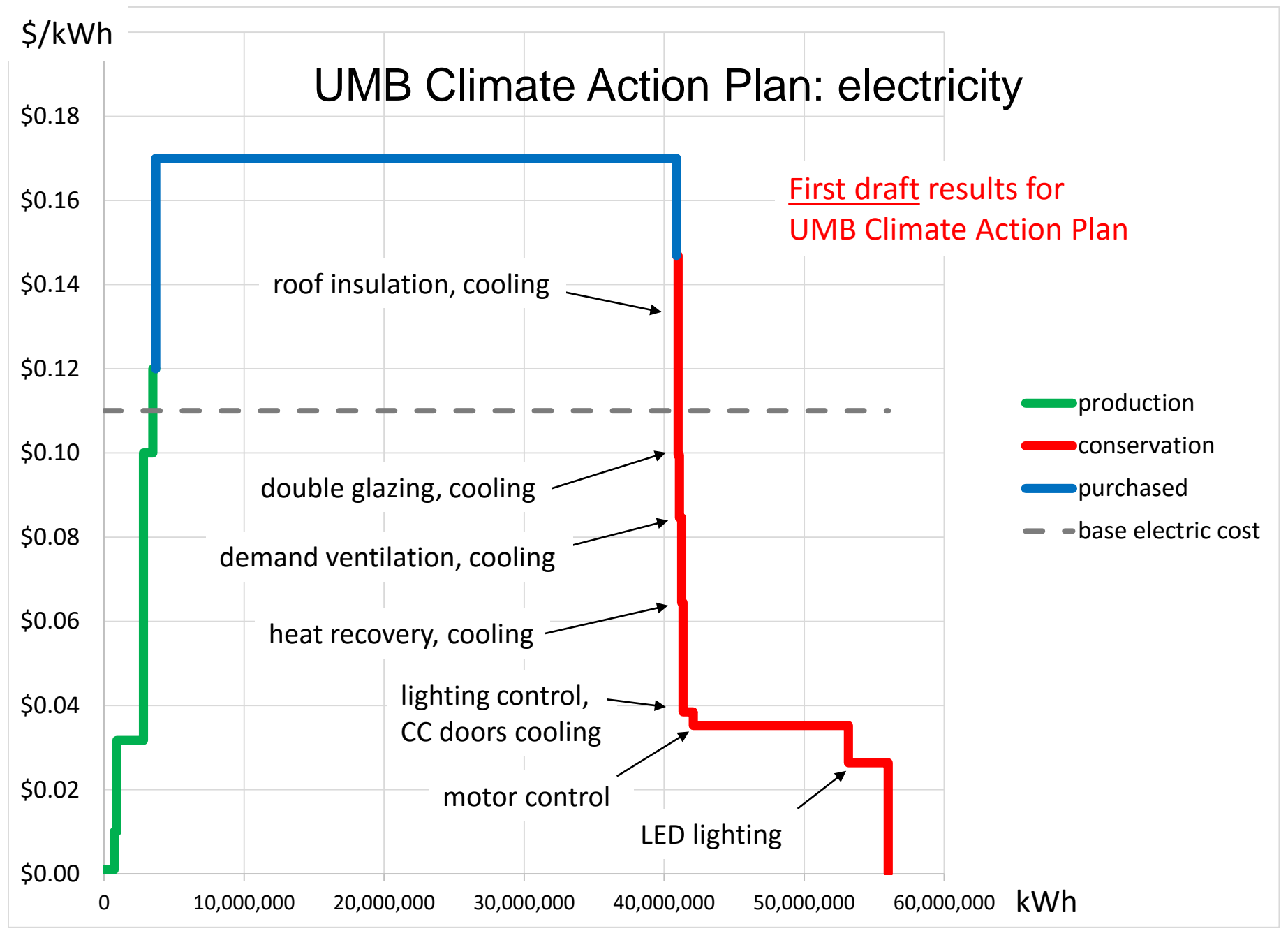
\$0.18
\$0.16
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\$0.02
\$0.00

0 10,000,000 20,000,000 30,000,000 40,000,000 50,000,000 60,000,000 kWh

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

- production
- conservation
- purchased
- base electric cost



UMB Climate Action Plan: electricity

\$/kWh

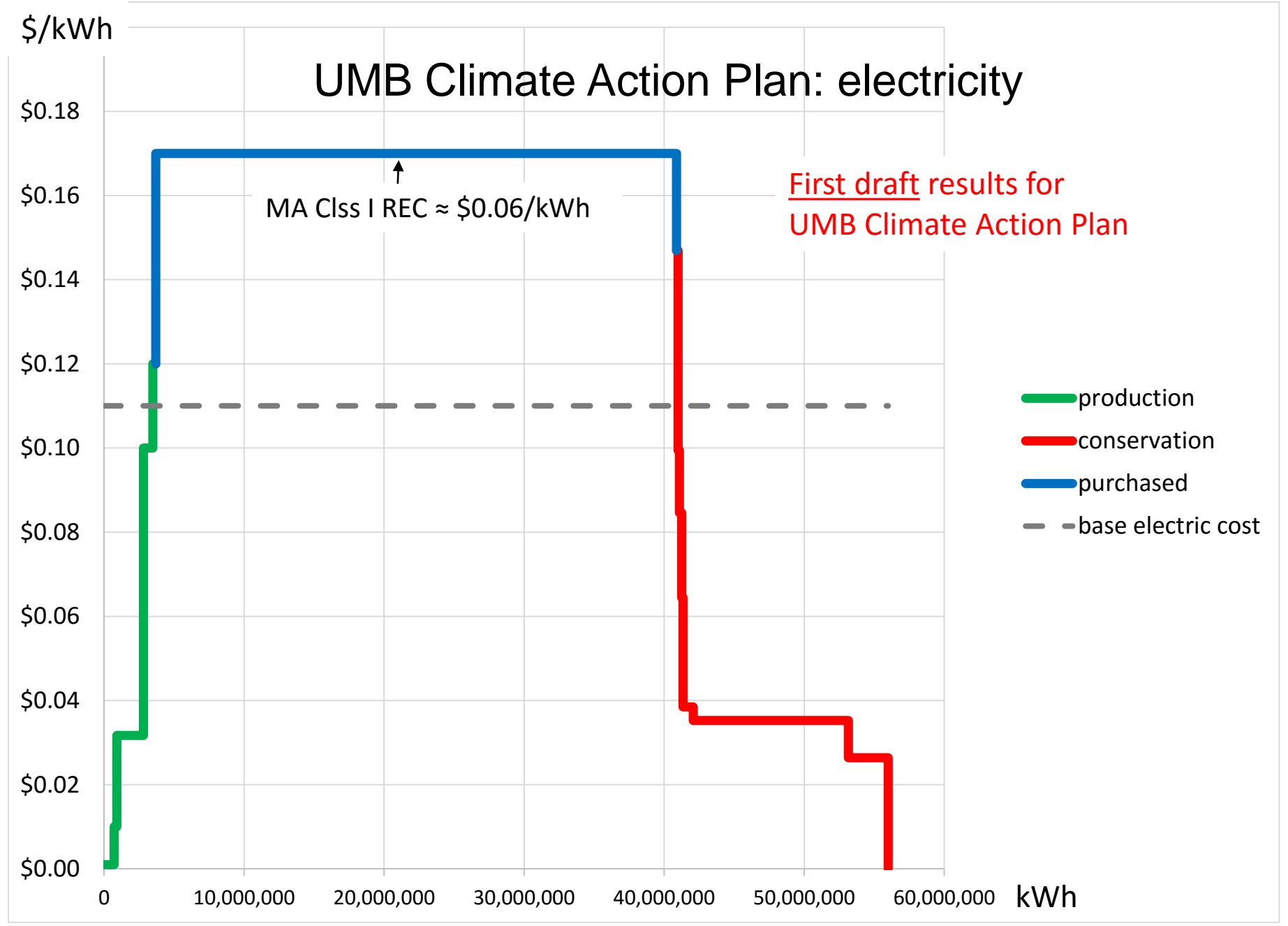
\$0.18
\$0.16
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\$0.10
\$0.08
\$0.06
\$0.04
\$0.02
\$0.00

0 10,000,000 20,000,000 30,000,000 40,000,000 50,000,000 60,000,000 kWh

↑
MA Class I REC ≈ \$0.06/kWh

First draft results for
UMB Climate Action Plan

- production
- conservation
- purchased
- base electric cost



UMB Climate Action Plan: electricity

\$/kWh

\$0.18
\$0.16
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\$0.02
\$0.00

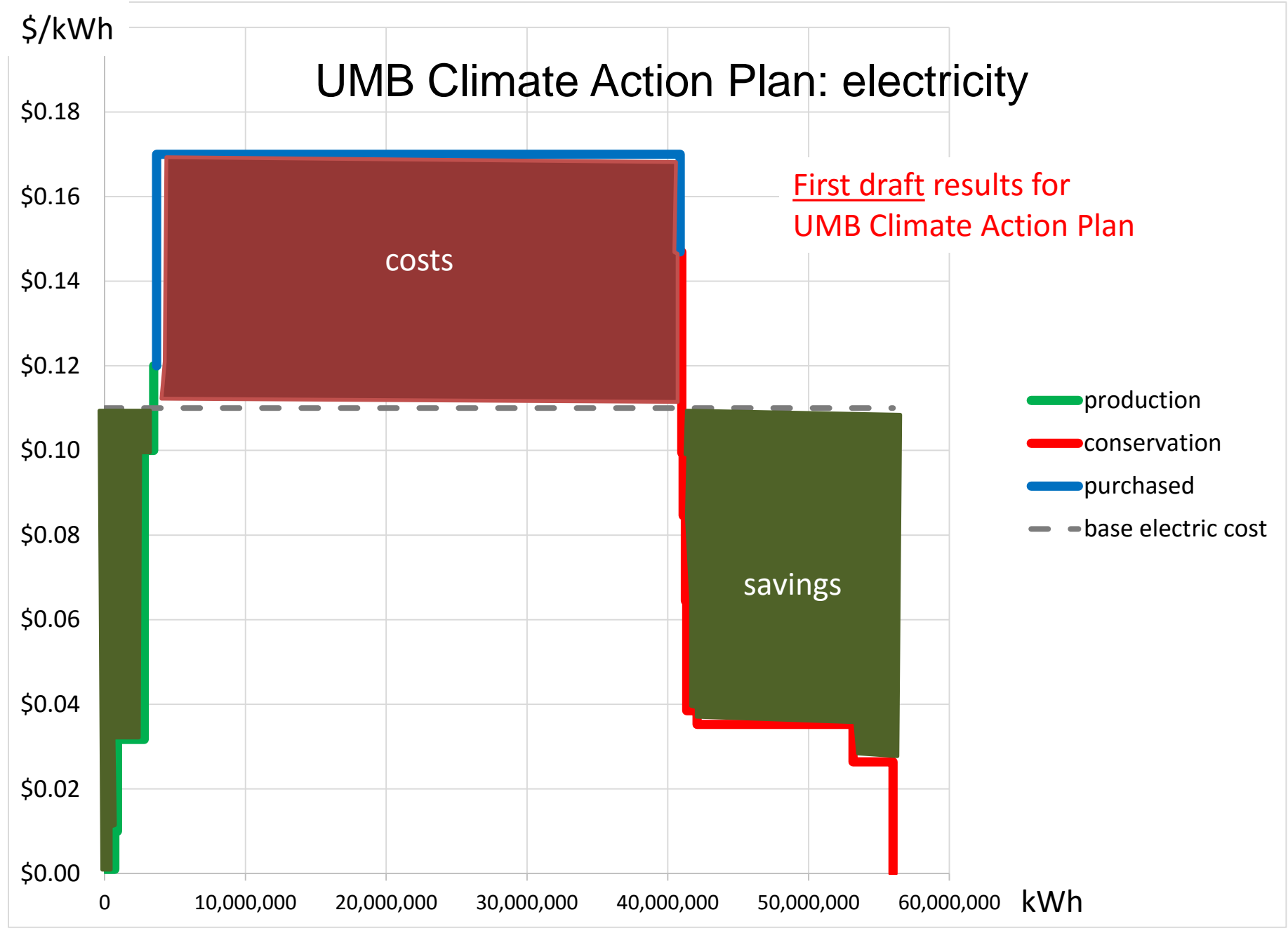
First draft results for
UMB Climate Action Plan

costs

savings

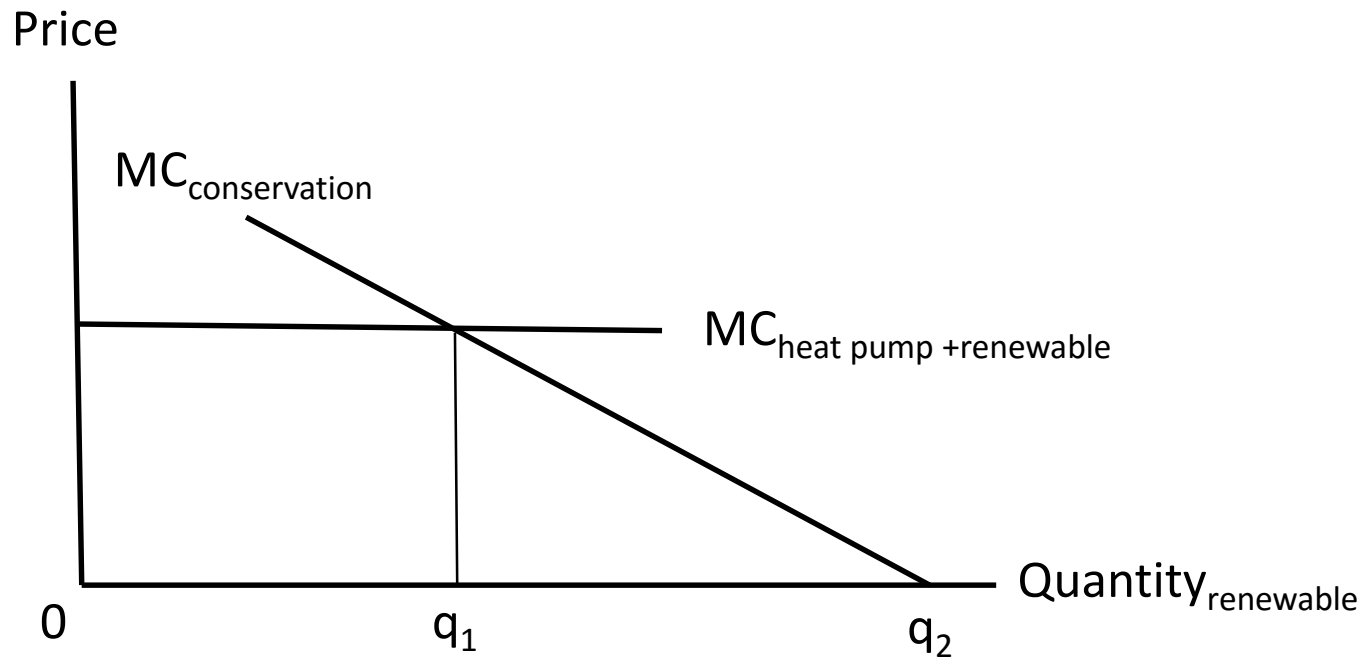
- production
- conservation
- purchased
- base electric cost

0 10,000,000 20,000,000 30,000,000 40,000,000 50,000,000 60,000,000 kWh



Institutional Decarbonization

Natural Gas



District Energy Station North

(4) Heat Pump Chillers:
R134A Refrigerant

Heating:

150 F Hot Water

38,000,000 BTU/Hour

Cooling:

42 F Chilled Water

2,500 tons



**Central Heating Plant:
Ball State University
Muncie, Indiana**



Teaching Institutional Decarbonization Economics

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 (≥ 3).
- Considerable work remains to finish Climate Action Plan.

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