

# IPRO 349: Solid Fuel from Biomass for Cogeneration



## Problem

To determine the **feasibility** of using corn stover as a combined heat and power source for **rural community colleges**



## Objectives

- Survey the **potential** for CHP application using modified EPA guidelines
- Scale up from single to **multiple farm system** for corn stover conversion to CHP
- Identify **future** stover CHP options
- Investigate creation of an **online database**

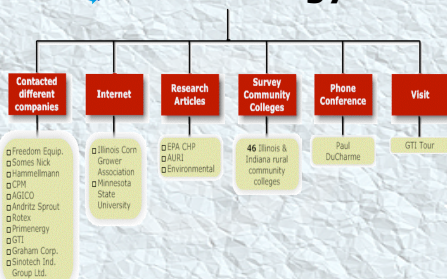


## Importance

- The U.S. is moving towards **sustainability**
- Biomass is becoming popular, but the use of solid biomass as a direct energy source is **relatively unexplored**
- There is an **increase in demand** and a decline in production of natural gas
- Potential energy** from stover is greater than that of natural gas, propane, and heating oil
- Places energy value on stover which was once considered waste

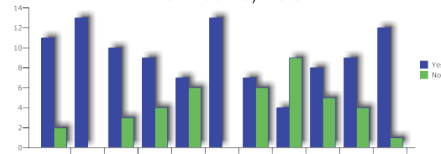


## Methodology



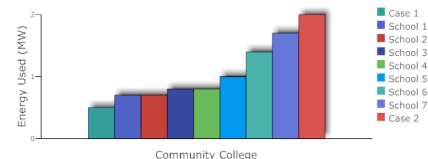
## Results

CHP Survey Data

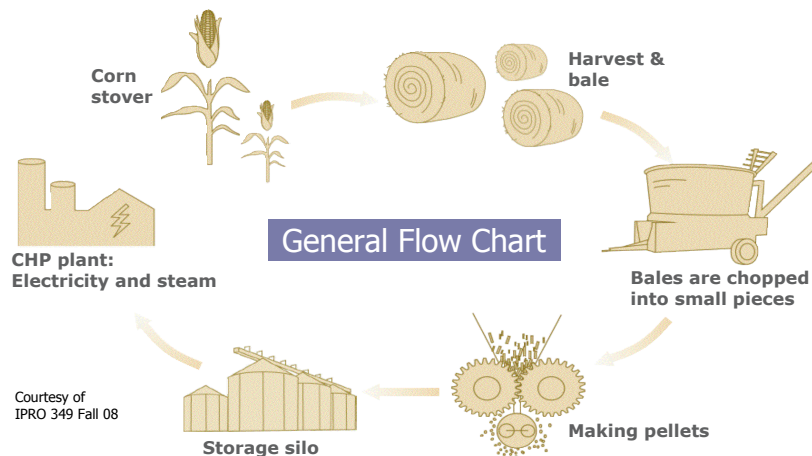


- More than \$.07/kWh electricity usage
- Concern about impact of current/future energy cost
- Given facility in a deregulated electricity market
- Concern about power reliability
- Operate more than 5,000 hours/year
- Thermal loads throughout the year
- Existing central plant
- Expectation to replace/upgrade central plant in <5 years
- Anticipation of facility expansion in <5 years
- Implementation of energy efficiency measure
- Interest in reducing facility's impact on the environment

Community College Energy Usage

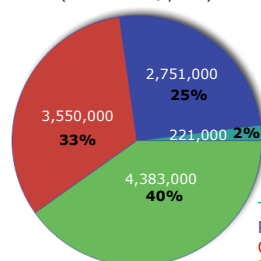


0.5MW case	2MW case
12 farms/yr with 40% pick up of corn stover	51 farms/yr with 40% pick up of corn stover
10,400,000lb stover/yr	45,600,000lb stover/yr
4,800 tons pellets/yr	21,100 tons pellets/yr
1 ton pellets/hr if pelletizing system runs 6.75 months/yr	5 ton pellets/hr if pelletizing system runs 6 months/yr

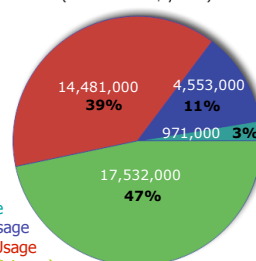


Courtesy of IPRO 349 Fall 08

Energy Chart 0.5MW  
(Unit: kWh/year)

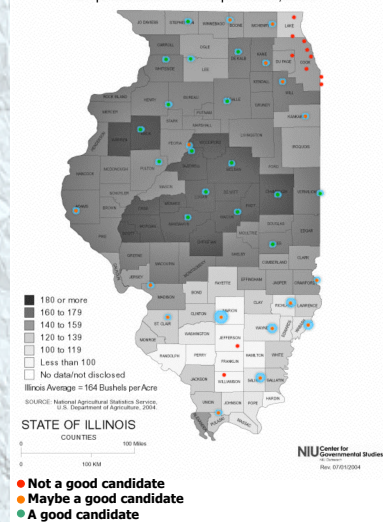


Energy Chart 2MW  
(Unit: kWh/year)



## Illinois Potential

Illinois Corn Production by County  
Crop Yield in Bushels per Acre, 2003



## Recommendations

- Cost effectiveness/payback analysis
  - Specific case study-surrounding land and CHP specifications
- Stirling engine
  - Look into **modular system**
- Investigate energy effective farming/diversity
  - Look into **international humanitarian** applications
- Internet database (**more user friendly**)



## Conclusion

- CHP is **feasible** for the researched:
  - Heat & power requirement
  - Stover production and storage
- 75% of farmers surveyed would be willing to participate in a CHP project
- 100% of schools which responded would be good candidates for CHP (EPA guidelines)
- Current **gas turbine** options **not fit** for this scale