



Large Scale GSHP as Alternative Energy for American Farmers

Shawn Yunsheng Xu
University of Missouri
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- Timeline:

Start: June 1, 2010, End: May 31, 2014

Part of business development and technical improvement work may be extended to the end of 2014 without budget of DOE

- Budget:

DOE share: \$2.47 M, Awardees' share: \$2.62 M

Funding received in FY2010: \$0

- Partners:

On-campus: College of Engineering, Agriculture School, and University Extension

Off-campus: Holliday Investment (Poultry farm), Cargill Poultry Production, Missouri Poultry Federation

- Barriers in Poultry Farming:
 - High utility cost in rural area and usage in peak seasons
 - Business risk caused by unpredictable fuel rate
 - Low weight gain and high mortality resulted from heat stress
 - High initial cost of renewable energy system
- Technical Challenges:
 - GSHP system with lower initial cost
 - Distribution and climate control inside barns
 - High efficient and affordable solar collector
 - Appropriate and optimized control system

- 100% replacement of on-site fossil fuel in the poultry farm
- Reduce heating cost by 70% through bar efficiency improvement, GSHP and solar applications
- Reduce 4% of mortality through cooling effect of GSHP in summer (Average mortality in confined barns is range in 5-18%)
- Increase weight gain by 14% (It shows there will be over 25% of more weight gain for male broilers at the room temperature of 24C, in comparison with 30C. This weigh gain benefit can be more than 30% for female broilers).
- Develop new business model to use third party investment to promote solar assisted GSHP application without tax rebate or other government incentives

- Agriculture represents an undeveloped market for GSHP technology. There are about 6,000 turkey barns, and 8,000 chicken barns in Missouri. A typical farm with 4 barns will use 3,000-5,000 gallon of propane in a winter season.
- Within 5 years it is anticipated to have 10% of barns installed with proposed GSHP system, which will result \$700 millions of energy saving annually in Missouri State. National wide, this translates to \$30-50 billions of utility saving.

- Remove American poultry farmers' risk in energy and help their competitiveness in international market (17% of U.S. poultry products are exported)
- Through education and business development to create job opportunity in engineering, installation, and equipment manufacturing.

- Improvement of thermal insulation and ventilation of confined poultry barns
- Solar assisted GSHP system to reduce underground loops size, and then reduce initial installation cost
- Over sized, high efficient and low cost solar collector for barn space heating and charging (storage) of underground loop
- Efficient delivery system and terminal units for difference type of birds in different growing stage.

- Micro Green Utility (MGU) with floating rate or fix rate based on metering or production
- Project evaluation and economic analysis tool
- Partnership with poultry companies, financing institutes, or government agencies.
- Training, education and public awareness

- FY10: Collect all necessary data from poultry companies and partner farms to conduct feasibility study and engineering design. One project evaluation tool will be developed.
- Develop and demonstrate solar assisted GSHP system and optimize its operation
- Prototyping and commercialization of a high efficient and low cost solar collector for rural application. One patent is expected.
- Develop a new utility business model, provide basic document in engineering, business, and marketing
- Provide education program to involve 500 farmers and engineers in Missouri.

- FY10: Project planning, team organizing; Project information collection; Environmental permit application; Economic analysis and feasibility study; Site survey, soil thermal property test; Energy auditing and load estimation; Barn insulation and other improvement; Configuration and engineering design
- FY11-12: Purchase of underground pipe/fittings; Purchase of commercial solar collectors; Purchase of M/E equipments and parts; Purchase of small GSHPs/large chillers; Installation of underground loop; Installation of solar heating system; Installation of heat pumps/indoor equip; Installation of data acquisition system; System inspection and commissioning

- FY12-13: Test of commercial solar collector; Solar collector improvement; Performance analysis and optimization; MGU business model development; MGU feasibility analysis tool develop; MGU Partnership with poultry company; MGU Financial partner identification
- FY13-14: Operation manual and instruction; Training for operation/data collection; Data collection and data processing; Marketing information and publication; On-site visiting and technical seminar; MGU financing program design; Tech/business support program; Documentation and Reporting U.S. DOE

- Involvement of the research faculty and graduate students in the College of Engineering, Agriculture School at the University of Missouri, MU's connection with Missouri farmers through the University Extension
- Support of poultry company (Cargill and others) in providing internal data in energy usage and energy efficiency, impact of climate control on weight gain and mortality, advice in system design and business model development. Possible business partner in development of utility model.
- Assistance of the Missouri Poultry Federation assistance in promotion of the technology and business to its members in Missouri and other states.

- Further energy source to built zero-energy poultry farm
- Extend the system to other farms and processing facility
- Start utility business to bring the technology to rural agriculture market

- Solar assisted GSHP will be used to provide heating in winter as replacement of fossil fuel, and provide cooling in summer
- Demonstrate project will help to reduce energy cost of farmers and increase its production.
- High efficient and low cost of solar collector will be developed through this demonstration
- New business model will be developed to speed up the application of the demonstrated technology.
- Successful of the project will result significant impact in energy saving in rural agriculture business. It will help to remove US farmer's business risk in energy, and help their export to international market.

- US Department of Energy, International demonstration project through International Utility Efficiency Partnership (IUEP) and Beijing City Government in China, 2004
- US Department of Agriculture, Thermal energy storage, 2005
- US Department of Commerce, Energy Technology Office in China, 2006
- US Department of Labor, Workforce preparation in renewable energy, 2010

- Wenhua Garden, 75kw, 12,000sft, 2001
- Ningbo Free Trade Zone, 1200kw, 110,000sft, 2004
- Beijing Huaxia Plaza, 2600kw, 300,000sft, 2004
- Olympic Forest Park, 4000kw, 500,000sft, 2005
- Bogart Factory, 1100kw, 90,000sft, 2005
- Concordia School, 4250kw, 370,000sft, 2009
- Coca-Cola/SWIRE Bottling Plant, 2200kw, 2010
- TESCO Cold Storage Facility, 400kw (to be started in July, 2010)