Improving Access to Clean Energy in Rural Central America Using On-site Solar-Biopower Generation

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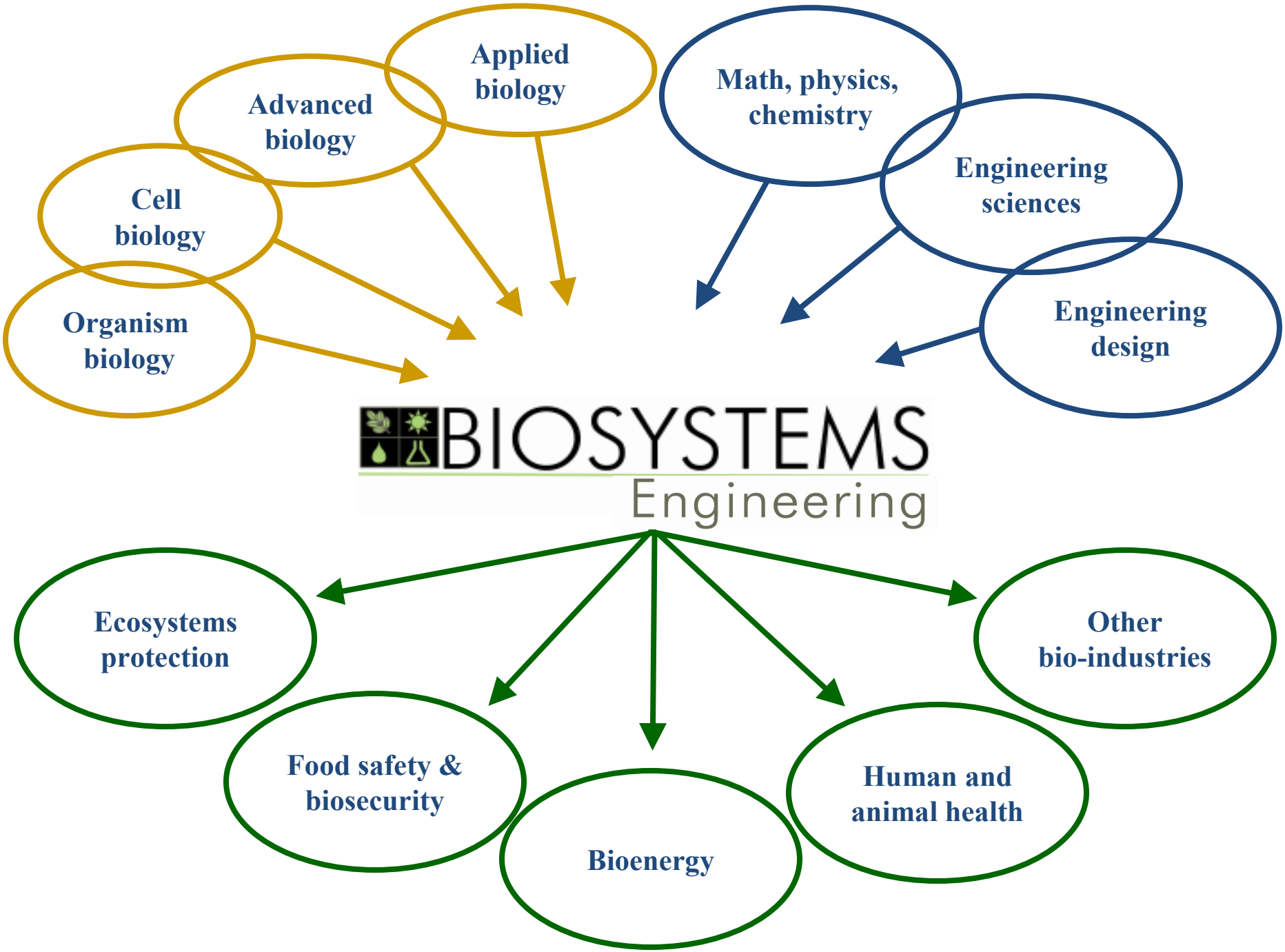
Applied biology
Advanced biology
Cell biology
Organism biology
Math, physics, chemistry
Engineering sciences
Engineering design
BIOSYSTEMS Engineering
Ecosystems protection
Food safety & biosecurity
Bioenergy
Human and animal health
Other bio-industries

Concentrations (Optional)

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Ecosystems Engineering

Food Engineering

Bioenergy Engineering

Biomedical Engineering

Project Partners

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- Lead Institutes:
  - Michigan State University (MSU), U.S.
  - University of Costa Rica (UCR), Costa Rica
- Participating Institutes:
  - Universidad Autonoma de Chiriqui (UNACHI), Panama
  - Universidad Nacional Autonoma de Nicaragua (UNAN), Nicaragua

MSU-UCR Partnership

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- Activities
  - Summer 2009 - Ing. Jose Francisco Aguilar, Director, Ag. Engineering, UCR visit to MSU
  - Dec. 2010 - Dr. Ajit Srivastava, Chair, MSU BAE visit to UCR
  - May 2011 - Eight MSU faculty and graduate student visit to UCR
- Outcomes
  - Dec. 2010 - Letter of Intent (LOI) signed
  - Summer 2011
    - UCR Ag. Engineering department changed to Biosystems Engr.
    - UCR Ag. Engineering degree changed to Biosystems and Agri. Engr.
  - Fall 2011 - 2 UCR students completed summer internships at MSU
  - Sept. 2011 - ECPA Project funded ($1 million)
  - Oct. 2011 - Collaborative research in post-harvest technology
  - Dec. 2011 - Partners workshop at MSU
  - Jan. 2012 - 1 UCR PhD student began at MSU in food safety

Facts

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- Central America is a region with significant unequal distribution of income.
- Continuous economic growth will improve the quality of life for people in rural Central America (about 19 million people, approximately 50% of the population), the demand on energy and other resources are predicted to be increased accordingly
- High price of fossil fuels and heavy investment of new coal/hydropower plants are a significant burden on Central American countries.
- On the other hand, the agriculture sector, as the second largest industry in Central America, has contributed to an average of 20% of total GDP in the past several decades.
- The agricultural and agro-industrial activities generate a vast amount of organic wastes that have high caloric values for potential clean energy generation at small-medium rural communities.

Goal

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Develop and deploy an integrated small-scale self-sustained waste-to-clean energy generation system co-producing value-added by-products such as fertilizers for local farming applications and reclaiming water

A solar-biopower concept

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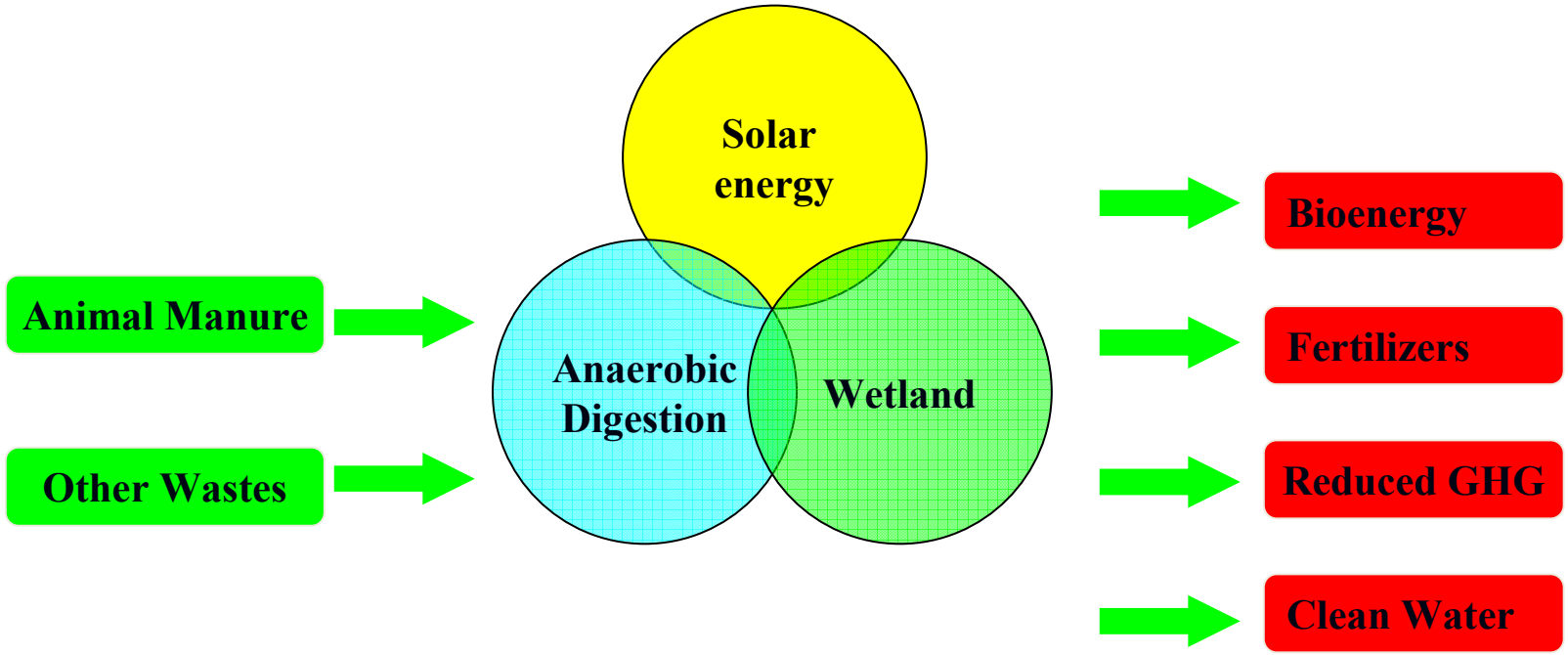
Integrating wastes utilization with solar and biological technologies will create a novel self-sustainable clean energy generations system for small-medium scale operations



Objectives

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- Optimize local thermophilic anaerobic microbial consortia on mixed waste streams
- Design and implement the integrated portable solar-biopower generation system on mixed waste streams at UCR
- Evaluate technical and economic performance of the system for various rural scenarios in Central America
- Establish an outreach program in Central America to include technology transfer, business development, and workforce training

Expected Results

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- A small-scale environmental-sound energy solution that utilizes available agricultural wastes to generate clean energy for rural communities in Central America.
- Overall system efficiency (energy generation efficiency) will be doubled considering both solar thermal and anaerobic digestion.
- A business model will be completed to predict technical and economic impacts of the proposed technology at different rural scenarios in Central America.
- Short courses, workshops and seminars will be held for participating parties to continuously train professionals, educate general public, and extend applications of the proposed technology in Central America.
- Study Abroad program(s) will be developed.

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