

Overview of An Analysis Project for Renewable Biogas / Fuel Cell Technologies



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***Renewable Biogas:
An Opportunity for
Commercialization of
Fuel Cells***

A Panel Discussion at
2009 Fuel Cell Seminar

Palm Springs, CA

November 19, 2009

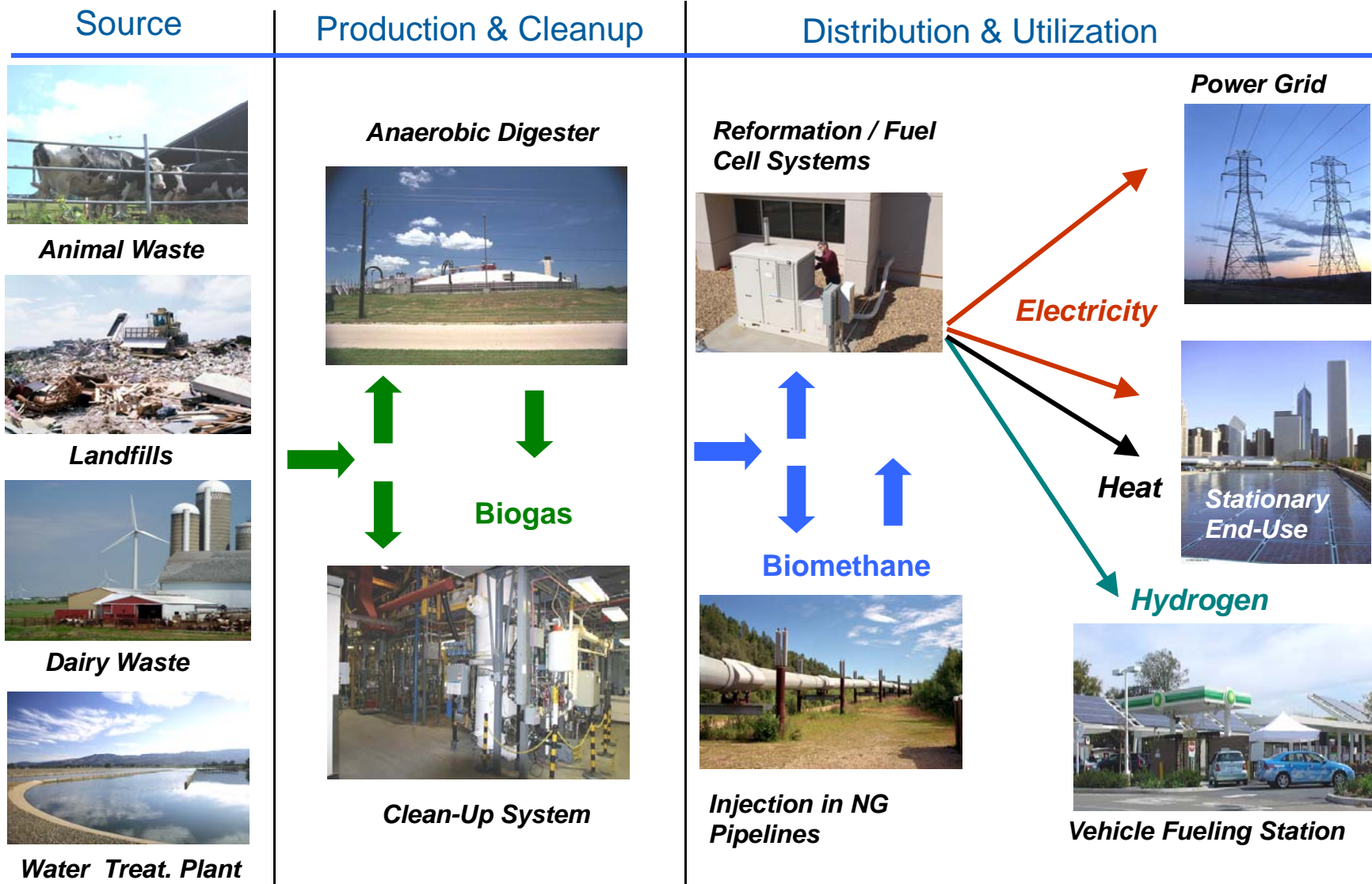
Objectives of Analysis Project

- Geospatial evaluation of sources of biogas, distribution infrastructure, and demand centers.
- Analysis of various scenarios for biomethane production and distribution for fuel cell technologies in stand-alone and CHP modes from economic, energy, and environmental standpoints.
- Assessment of the market potential for renewable biogas/fuel cells in conjunction with the available financial incentives.

Fuel cells operating with renewable biogas can play a critical role in mitigating energy and environmental issues.

Biogas Systems Integration

Project Concept



Approach

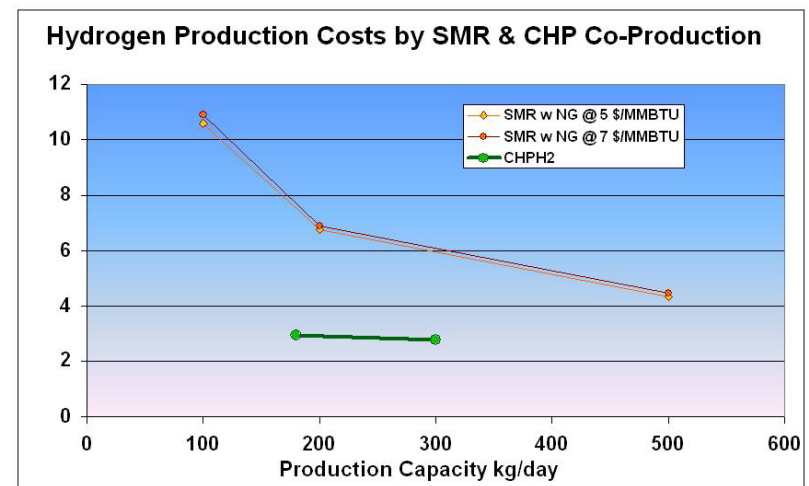
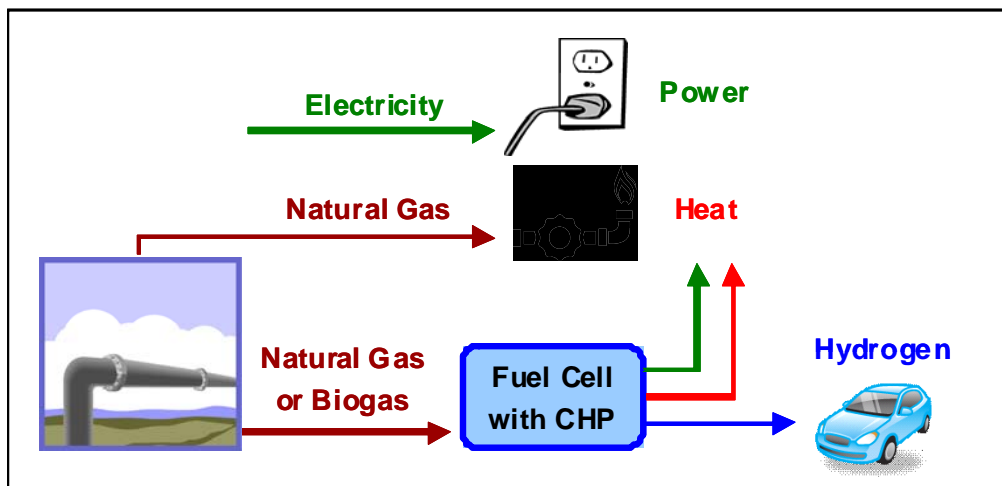
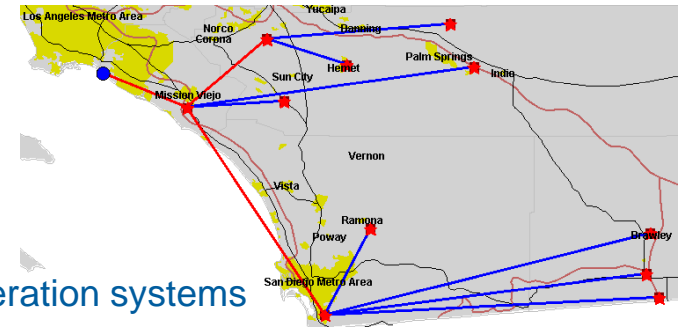
- Gather data on sources of biogas, costs of biogas production, clean-up, and fuel cell technologies.
- Evaluate technical and economic feasibility of injecting biomethane into NG pipelines.
- Use NREL GIS capabilities to map stranded biogas resources in select states / regions and overlay infrastructure information for analysis of deployment scenarios
- Identify critical technical and cost parameters for various scenarios, including central and distributed models.
- Identify relevant federal and state incentives and integrate into cost analysis.

Providing valuable information to the stakeholders, including municipalities, industry, and policy makers, is an important consideration in the project.

Analysis Tools

- **Fuel Cell Power Model***: Cost analysis of Combined Heat, Hydrogen, and Power (CHHP) Systems.
- **H2A Production**: Cost analysis of hydrogen production technologies
- **SERA**: An optimization tool for hydrogen infrastructure

* The *Fuel Cell Power Model* can also be used for FC power generation systems without heat recovery and CHP systems without hydrogen production.

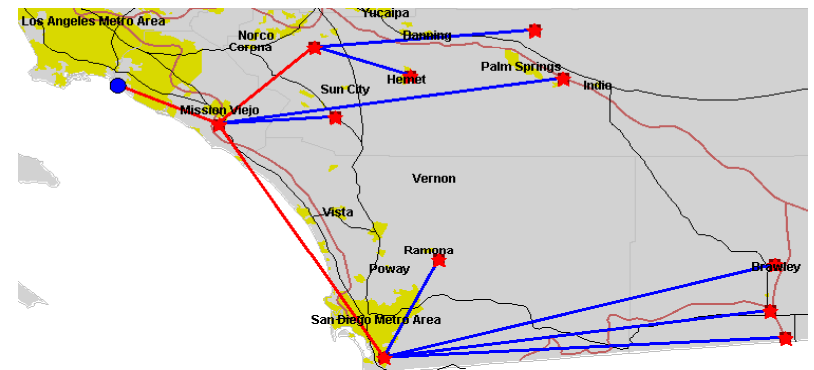


SERA—Scenario Evaluation, Regionalization & Analysis

Optimization of Hydrogen Infrastructure

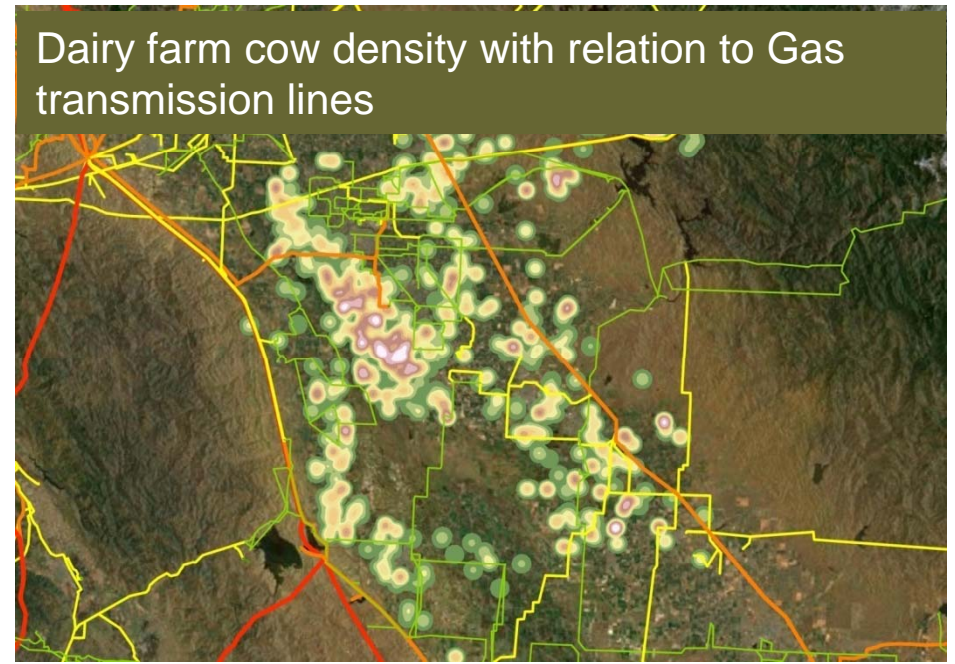
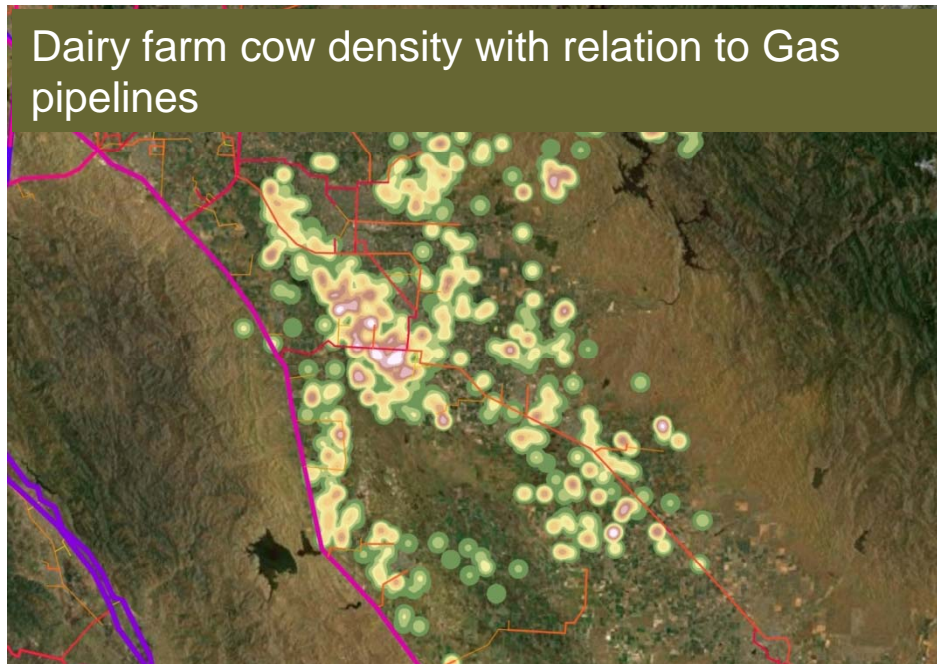
Features:

- Treatment of production, transmission, and distribution
 - Easy to add new technologies
 - Consistent physical and economic computations
- Cost, cash flow, and price estimates
- Spatial & temporal resolution of hydrogen infrastructure networks
- Regional specificity
- Exogenous, urban H₂ demands

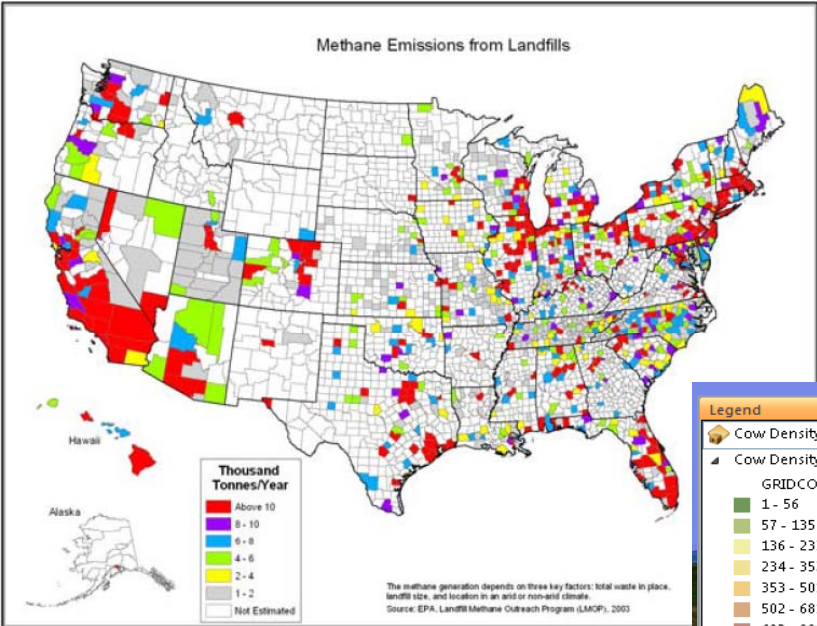


Initial GIS Analyses

- **Data Analysis:** Distances to distribution infrastructure, load centers, ...
- **Data Visualization:** Regional and detailed maps

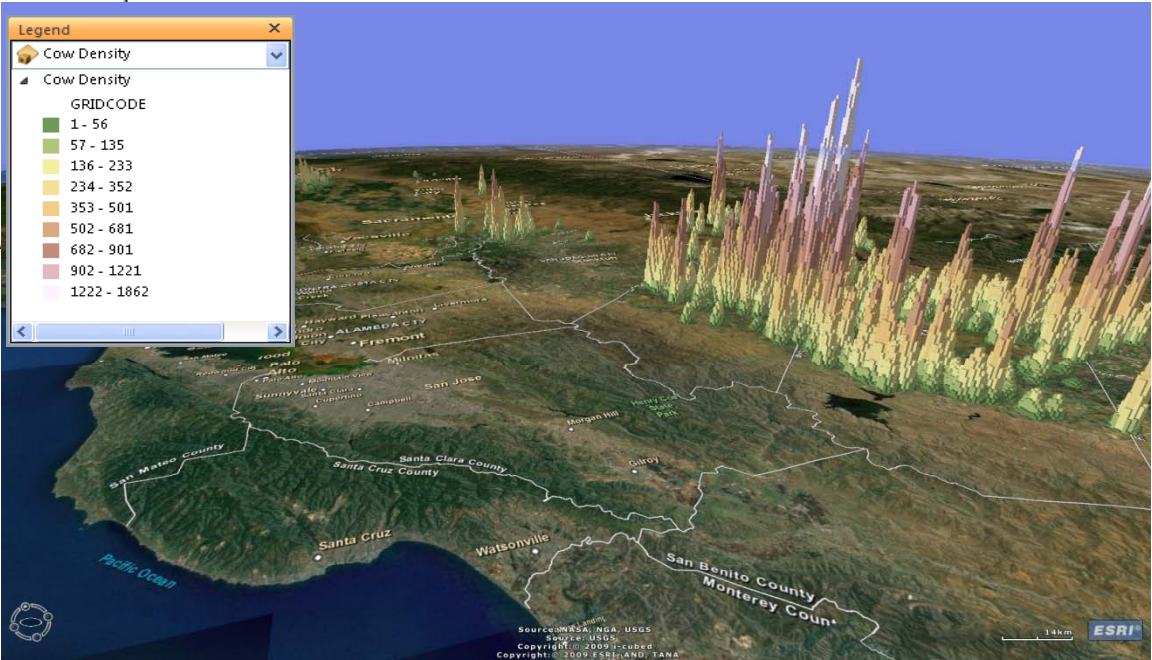


Initial GIS Analyses (cont.)



← Methane emissions from landfills

Dairy farm cow density 3D visualization →



International Perspectives

- Unlike incineration, anaerobic digestion (AD) coupled with clean-up process can lend itself to both transportation and stationary applications.
 - Biogas market in parts of Europe (e.g., Germany) is rapidly expanding.
 - Biogas plants can be quite profitable in Europe (depending on factors such as climate, financial incentives, availability of energy crops, etc.)
 - Gasification is environmentally friendly and can take a wide range of waste materials (e.g., MSW and MBT residues) but is still viewed as an emerging technology.
 - Energy from waste still plays a small role in governments' commitments to energy and environmental solutions.
 - Biomethane has a potential to drastically reduce Europe's dependence on conventional natural gas (with waste-to-energy conversion and energy crop).
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International Perspectives (cont.)

- Forecasting waste availability must be an important consideration in the planning and design phase due to the evolving waste minimization initiatives and increase in recycling.
- Promoting waste-to-energy must not diminish the importance of waste minimization and cost-effective recycling.
- Minimizing stranded investment is imperative for profitability and financing of waste-to-energy facilities, necessitating consideration of various factors such as seasonality and energy demand dynamics.

Emphasis on principle-based strategies is critical to resolving the energy and environmental issues.

Remarks

- The analysis is complex and requires feedbacks from the stakeholders for simplification / prioritization.
 - Participation of the stakeholders (e.g., industry, utilities, and municipalities) in providing system performance / cost data and regulatory constraints is critical to the success of this analysis project.
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Questions / Comments ?

Thank you!

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