Local Initiatives
Moderated by: Todd Campbell, USDA, F2F2 Co-Lead
Vicki Walker,  
State Director of Rural Development – Oregon, USDA
“Farm to Fly” Connecticut

Presentation to CAAFI General Meeting

Washington DC
January 28-29, 2014
Discussion Topics

1. Information about CCAT & State of Connecticut
2. USDA Rural Business Enterprise Grant (RBEG) Project in Connecticut
3. DLA Energy Alternative Fuels Program
4. Creating / Leveraging Opportunities via RBEG and DLA programs

Disclaimer: All of the facts and opinions expressed in this presentation are solely those of the Connecticut Center for Advanced Technology and are not endorsed or approved by the USDA, Defense Logistics Agency or other organizations listed in this presentation.
1. Information about CCAT

Not-for-profit economic development organization that combines expertise in cutting-edge technology with specialized centers of excellence in manufacturing, education, training, entrepreneurialism energy and alternative fuels.

Advanced Manufacturing and Energy Technologies in East Hartford, CT
1. Information about State of CT

Demand for:
- Jet Fuel, Diesel/Gasoline,
- Home Heating Oil
- Natural Gas (NG)

No Fossil Reserves
- Some NG pipelines;
- Pipeline expansion ongoing

Decent Solar Insolation

Limited Wind Resource

No Active Landfills

Nuclear Power

Significant Resources:
- Large, focused MSW supplies
- “Environmental Culture”
2. USDA Rural Business Enterprise Grant

The CT RBEG supports many beneficial activities that may boost the economy of the region, create jobs and could open the door for other ventures\(^{(1)}\).

In CT BDL, New England’s 2\(^{nd}\) largest airport, is located in rural land and qualified for RBEG grant to develop jobs and economic opportunity in Rural Connecticut.

\(^{(1)}\)Please see [www.rurdev.usda.gov/BCP_rbeg.html](http://www.rurdev.usda.gov/BCP_rbeg.html) for detailed information
Connecticut (CCAT) Project

Objective
Determine the feasibility of constructing a renewable fuel production facility in rural North Central Connecticut

- Production of jet fuel, diesel fuel, and heating oil is of interest
- Feedstocks: Municipal Solid Waste supplemented by biomass from farms, nurseries and other green waste streams

Benefits
If results are favorable, the proposed fuel production facility will boost the economy of the region, create jobs and could open the door for other ventures
2. USDA Rural Business Enterprise Grant

Project Team and Supporting Organizations


This team shares support for our national goals of environmental stewardship and energy independence. And this commitment also includes the implementation of programs and incentives to help American farmers produce feedstocks that can be converted into affordable and sustainable aviation biofuels

(1) C. Kimball is our USDA RBEG Project Manager, Amherst, MA
2. USDA Rural Business Enterprise Grant

Feedstocks

Municipal Solid Waste
- Central CT waste collection greater than 800,000 tons/year
- Supply of MSW – from over 70 towns; more towns possible (one of our RBEG project partners serves 26 CT towns)
- Landfill no longer an option!

Supplemental Biomass
- Forest thinnings
- Wood and wood waste
- Agricultural crops and residue
- Nursery wastes
CCAT and Arcadis U.S. are executing a project under leadership of DLA Energy to consider full range of gasification technologies for:

- Diverse Feedstocks-to-Liquid Fuel – main focus
- Diverse Feedstocks-to-Electricity

Test and evaluate technologies to advance commercial viability and comply with EISA 2007 Title V, Section 526

( L. Hicks and J. Maniwang are the DLA Energy project leads)
3. DLA Energy Alternative Fuels Program

Collaborative effort among DoD-DOE (NETL) and leverages existing U.S. capabilities

<table>
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<tr>
<th>Existing Test Facilities</th>
<th>Technologies</th>
<th>Feedstocks Tested</th>
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<tbody>
<tr>
<td>EERC¹</td>
<td>Entrained Flow and Trnspt. Gasifiers Transport Gasifier Plasma Reactor Reformer</td>
<td>Raw Biomass Torrefied Biomass MSW Algae Nuisance Plants Used Railroad Ties Coal (Mixtures of the above)</td>
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(1) Energy & Environmental Research Center, Grand Forks, ND
(2) National Carbon Capture Center (DOE/Southern Co.), Wilsonville, AL
(3) Westinghouse Plasma Corp., Madison, PA
(4) Laramie, WY
4. Creating / Leveraging Opportunities

Connecticut Resources Recovery Authority (CRRA)

Strong interest in USDA RBEG Program and DLA Energy Program for exploring liquid fuels production from renewable domestic feedstocks

CRRA
Mission is to develop and implement environmentally sound solutions and best practices for solid waste disposal and recycling management

CRRA manages ~80 member towns’ solid waste through three CT trash-to-energy systems (Hartford, Bridgeport, Preston)
4. Creating / Leveraging Opportunities

CRRA Hartford Facility

REFUSE-DERIVED FUEL (RDF) TRASH-TO-ENERGY FACILITY

- Trash collected from ~50 towns
- Towns pay CRRA for MSW collection
- MSW processed to RDF at Hartford facility
- CRRA burns RDF to generate/sell electricity

May now consider MSW/RDF-to-Liquid Fuels
- MSW collection and processing system already in place
- Real estate available for additional equipment
- Location in proximity to jet fuel pipeline

Hartford trash-to-energy plant
4. Creating / Leveraging Opportunities

USDA RBEG (commercial) and DLA Energy (military) projects are complementary and benefit the overall aviation supply chain.

USDA RBEG connecting fuel suppliers with feedstock owners locally best way to identify and communicate opportunities rapidly.

Multiple biofuel end customers (jet, diesel, home heating oil) optimizes efficiency – enhances commercial business opportunity.

Immediate opportunity to determine feasibility of MSW/biomass to aviation fuel, diesel fuel, and home heating oil to serve north rural CT and western MA.
Acknowledgements

Connecticut Center for Advanced Technology, Inc. (CCAT):
A. Foysol, B. Karasik, T. Maloney, J. Rinebold, J. Smith,
W. Sumple, M. Wadden, A. Willhide

Arcadis U.S.: M. Barmasse, A. Danzig

Alternative Fuel Producer Contributors to RBEG:
Solena, Fiberight, CAAFI (R. Altman), Paine’s Inc.

USDA:
Programmatic and Technical Project Leadership: C. Kimball

DLA Energy:
Programmatic and Technical Project Leadership: L. Hicks, J. Maniwang

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THANK YOU!

Tom Maloney, tmaloney@ccat.us

“Farm to Fly” Connecticut

Presentation to CAAFI General Meeting

Washington DC
January 28-29, 2014
Anju Dahiya,
Project Director, General Systems Research
COST EFFICIENT ALGAL BIOFUEL PRODUCTION IN VERMONT

Jan. 28 - 29, 2014
2014 CAAFI General Meeting
Washington, DC

Anju Dahiya
GSR SOLUTIONS LLC
COST EFFECTIVE ALGAE PRODUCTION IN NORTHEAST / NEW-ENGLAND

- ALGAE IN NORTHEAST / NEW ENGLAND
- GSR SOLUTIONS VERMONT FOCUS/RESUME
- VERMONT RBEG PROJECT
  - PROJECT COMPONENTS
  - SPECIFIC GOALS
  - PROCESS DESIGN APPROACH
  - BENCHMARKS FOR SUCCESS
- ADDED BENEFITS OF PROJECT
  - A PATHWAY TO COMMERCIAL DEMONSTRATION/DEVELOPMENT
From a small 1950s MIT rooftop bioreactor
To a two decades of ASP DoE NREL Algae Species program (1978-1996)

ASP Recommendation: Integrate with wastewater treatment to grow algae cost effectively.

GreenFuel Corp MA USA
CO2 mitigation & algoil raised over $19 million
Vermont “Bottoms-Up” Developments & Targeting Algal Biofuel Technology Scale-Up

- Led by GSR SOLUTIONS LLC (GSR)
- Airlines (CAAFI) and Home Heating Oil Customer focus (VFDA)
- Focus on Vermont Feedstocks Dairy farm effluents & Cellulosic non-food crops/waste
- Industrial Waste Streams
- Projects supported: USDA (RBEG) Dept. of Energy, VT Sustainable Jobs Fund NSF, VT EPSCoR
Vermont/GSR Resume

- Bioprospecting/Isolation of microalgal & related organisms for waste-grown biomass production for fuel
- Algae culture collection facility hosting oleaginous algal strains tested for waste treatment potential
- Algal mass culturing for fuel utilizing auto-mixotrophic and heterotrophic modes & related systems
- Rapid screening methods for algal isolation, lipid and nutrients testing
- Advanced technologies for algal biomass harvesting, its conversion to oil and other valued byproducts
- Fertilizer and animal feed production.
- Data management and data analysis infrastructure to inform larger scale systems.

PILOT / DEMONSTRATION FACILITY TO "SCALE UP" PROCESS IN RURAL COUNTY
Farm to Fly 2.0: USDA RBEG supported project

- **PROJECT COMPONENTS**
  - Oil-rich indigenously isolated algal strains & related microbes
  - Scalable algal biomass production systems
  - Integrate with local waste-based throughput feedstocks
Nordic Farm: 300 milking cows

Farm puts around 200 tons of urea as fertilizer per acre only for grass grown

Picture source: Nordicfarms.com

Farm spent $75000 in fuel costs & invested $500,000 in the digester

Farm is located on the truck route and other businesses including local beer brewery
GSR System Process Model for Integration of Algal Biomass Production for Oil with Waste Treatment
VERMONT RBEG
- BENCHMARK FOR SUCCESS

• Process candidate identified with positive energy return on investment at market rate

• Cost of biofuel per gallon competitive with oil

• Fuel standard including the Sulfur content:
  • projected to meet EPA RFS 2 standards as an advanced biofuel

• Sustainable & Scalable:
  1) continuous supply of throughput feedstocks,
  2) acceptable business case;
  3) nutrients recovery from the wastewater to meet with the state/EPA regulations;
  4) none or positive land use change at the farm.
Benefits of ongoing VT RBEG project

- **Integrating the supply chain**
  - with the suppliers of throughput feedstock sources for algae production (farm, brewery, other potential suppliers), and
  - with technology end users:
    - Fuel & Fertilizer – Farms, and other businesses in the area (greenhouses, vegetable growers etc.)
    - Jet Fuel - CAAFI & Burlington-based aerospace industry
    - Home heating oil – VT Fuel dealers Association

- **Adding valued by-product - fertilizer**
  - the farm runoff nutrients captured by algae to produce granular fertilizer and rerouted to farm for enriching soils for crop production.

- **Harmonizing With State Environmental/Economic goals**
  - next step – demonstration in rural county
Acknowledgements

We are grateful to our funders, partners & supporters

- USDA
  United States Department of Agriculture
  Rural Development
- U.S. Department of Energy
- Vermont Sustainable Jobs Fund
- Vermont EPSCoR
- National Science Foundation
  WHERE DISCOVERIES BEGIN
- NASA EPSCoR
- Vermont Chamber of Commerce
- Farm Bureau
- The UNIVERSITY of VERMONT
- EPA
- National Aeronautics and Space Administration (NASA)
- CAAFI®
  Vermont Fuel Dealers Association
- VFDA
- Renewable Energy Vermont
- John Todd Ecological Design
- Solutions

We are inviting partnerships and investment from private sector
Thank You

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Note: White paper for follow up plan available
Chris Cassidy,
Renewable Energy Advisor, USDA
CAAFI General Meeting
January 29, 2014
Washington DC
# Alternative Jet Fuels Supply Chain – Agency Effort Summary

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<th>Feedstock Production</th>
<th>Feedstock Logistics</th>
<th>Fuel Conversion</th>
<th>Conversion Process Scale-up/Integration</th>
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USDA Areas of Focus in Alternative Fuels - Summary

High level description of agency effort:

- Develop sustainable feedstock production systems and reduce supply chain transaction costs
- Assess environmental and social impacts of biofuel deployment
- Help enable commercial feedstock and biofuel production
Path to Commercialization - Overview

Approach/Strategy
- R&D
- Deployment
- Pilot + Demonstration
- First-of-a-Kind Commercial Scale Commercial replication

Partners
- (Federal) USDA, DOE, DOT, FAA, DOD, DOC, DOI, EPA, State
- State Departments: Ag Energy, Ecology
- Labs: National, State, Private
- Industry: Academia, Associations (CAAFI, A4A)
- Stakeholders: Farmers, Ranchers, Foresters, Fishers, Businesses

Other Agencies Involved
- Rural Development (RBS & RUS)
- NRCS
- FSA
- NIFA
- ARS
- FAS

Initiatives
- Farm Bill 2002, 2007 and 2014
- BioPreferred Program
- EISA
- RFS & Modifications
- Copenhagen
- Farm to Fly 1 & 2.0
- Farm to Fleet
- Bio Economy

Feedstock
- Oilseeds, perennial grasses, algae biomass, wood lots & plantations, agriculture waste & residue, forest waste & residue, municipal solid waste

Conversion Technologies
- Biological
- Bio-Chemical
- Thermo-Chemical
- Hybrid

Leveraging
- Private
- Federal
- State/Local

Biofuels & Bio Products

Certifications
- ASTM, Military, Euro/International Industry standard

Sustainability
- Social, Environmental, Economic

Manufacturing
- Co-generation
- Co-products

RD Programs
- RBOG, RBEG, VAPG, SSDPG, RCDG, RCDI, REDLG, B&I
- FB 9000 Series: 9008, 9006, 9011, 9004, 9003, 9007, 9005
Path to Commercialization with Example Partners + Funding Sources

R&D
• DOE, USDA (ARS, NIFA), DOT, Academia, private partners
• 9008, NARA, AHB

Deployment
• Technical Assistance, Regional Planning
• DOE grant, RBEG, RBOG, Cooperative Development

Pilot + Demonstration
• ARS Regional Centers, DOE, DOT, DOD, Industry, Academia

First-of-a-kind Commercial Scale Up:
• Section 9003 Biorefinery Guarantee, Lenders, Venture Capital, Mezzanine, Angel, etc.

Commercial Replication
• USDA B&I and REAP guarantee
• Private Investment
• Commercial Lenders

ZeaChem positioned to move into Commercial Scale-Up phase
Path to Commercialization – Critical Role of Loan Guarantees in Advanced Biofuels to Market

Technology Phase: R&D, Deployment, Pilot, Demonstration

Driving Initiatives: Farm Bill, BioPreferred, EISA, RFS 1+2, Copenhagen, MOU

Development: Feedstock + Conversion Technology Platforms

Funding Partners: Federal, State, Industry, Academia, VC, Private

Certifications: ASTM, Military, European/International Standards

First-of-a-kind Commercial Scale Biorefinery

ZeaChem Private Investment (~$200MM)

B&I and/or REAP/9007 Guarantee – Commercial Scale Replication

AHB $40MM, NARA $40MM, DOE $20MM, FAA $40MM over 10 years

9003 Guarantee ($198MM) – Commercial Scale-Up

Commercial Technology Replication

Commercial Lenders

Manufacturing + Jobs

Bioeconomy Expansion

Sustainability: Social, Economic, Environmental
Take Off Recommendation

- USDA Summit to include:
  - ARS Regional Centers
  - FAA
  - NIFA Advanced Hardwood Biofuels (AHB) + NW Advanced Renewable Alliance (NARA)
  - FAA Center of Excellence
  - DOT, VOLPE
  - CAAFI
  - A4A (Airlines for America)
  - Academia
  - National Labs
  - Industry Partners (Boeing, GE, etc.)
  - DOE Tribal Program
  - 1890 Institutions
Strategy

- Research and Development: feedstocks, technology conversions, biofuels and bioproducts
- Pilot and Demonstration
- First of kind Commercial
- Commercial Replication
Resources

- Energy Investment Map

- Energy Matrix
- Renewable Energy Tool
USDA Energy Investments Map

The USDA Energy Investments web map contains information regarding USDA programs that provide assistance to renewable energy and energy efficiency projects. The map displays investment location, type of energy investment, amount of assistance provided and the administering USDA program. The energy investment data is also summarized by state, county and congressional districts to display total number of investments and total dollar amounts obligated by USDA.

Click here to view the Renewable Energy Special Projects Report.
Requirements

- Feasibility study
- Technical report
- Business plan
- Environmental report
- Agreements
Programs

- Rural Business Enterprise Grant
- Rural Business Opportunity Grant
- Cooperative Development Grant & Technical Assistance
- Business & Industry Loan Guarantee
Farm Bill 2014

- Clear Priorities
  - Energy, Nutrition, Jobs
- Targeted investments
Farm Bill 2014

• Rural Energy for America Program REAP
  – Feasibility Studies
  – Renewable Development Assistance
  – Renewable Energy Systems
Farm Bill 2014

- Biomass Research & Development Initiative
- Biomass Crop Assistance Program
- Value Added Producer Grant Program
- Biorefinery Assistance Program
- Bioenergy Program for Advanced Biofuels
Algae
Algae
Feedstock Diversification
Feedstock Diversification
Feedstock Diversification
Feedstock Densification
Advanced Aviation Biofuels
Advanced Aviation Biofuels
Advanced Aviation Biofuels
Thank You

• Chris.Cassidy@wdc.usda.gov
• 202 841 6097
Rich Altman,
Executive Director Emeritus, CAAFI
“Farm to Fly” State/Local Initiatives Success Model Lessons .... Building Future Projects
“Farm to Fly” State/Local Progression

* Key Lessons from initial “Farm to Fly” Initiatives (Vermont, Connecticut, Oregon)

* South Carolina – RBEG Proposals... case study for new initiative formation

* Key take away..... “Farm to Fly” can work in your state / province ... success formula available and effective.
“Farm to Fly” Key Lessons from States

- All projects are local/unique
- “Experience Templates” applicable to new projects
- Focus on full supply chain... start build up from feedstocks... incorporate customer stakeholders
- Strong Local private leadership with supply chain knowledge/access essential
- Lead fuel company engagement /exposure with “limited bandwidth” major goal/benefit
- Rural Development “Tool Kit” enables progression
- USDA State Director / CAAFI lead consult is first step

Relationship Build is Top Outcome!
All Projects are Unique / Local

- Vermont... High Sugar content waste streams feed “Dark Algae” fed fuel... granular Fertilizer co-product.

- Connecticut ... Building a global future for BDL, viable MSW to Energy in Northeast Corridor

- Oregon.... SAFN focus contributed to Zeachem Boardman Initiative
Feedstock Focused Supply chain

- Vermont... Dairy and Beer Brewery Waste streams enable dark algae growth

- Connecticut ... MSW base strong and centralized public / private capture

- Oregon.... Creative Woody Biomass productivity and capture
Strong Local Team Leadership
South Carolina “Farm to Fly” Next

- Building from Well Defined Feedstock base
- Strong Local private supply chain
- Diverse (mil./comm.) customers engaged
- Early Engagement with USDA S.C. Office
- Strong State and Local Community Participation
- RBEG Experience Template (from CT)
- Path for lead Fuel company engagement addressing requirement/benefits set
South Carolina – New Initiatives

- **Strong Feedstock Potential** (ref. USDA/SCRA 2012 report) e.g. Algae, Woody Biomass
- Diverse aviation fuel proven process potential: FT, HEFA, Thermochemical, Alcohol to Jet
- Real CAAFI customer / fuel stakeholder interest
- I-95 Corridor has need / Assets

**RBEG Proposals**
- Clarendon (Woody)
- Colleton (Algae)
Strong SC Team Leading, Supporting

Feedstock Centric Private Leadership

Public Advocacy and Support
SC Aviation Demand Strong
200M+ usg with Growth and Supply Security Needs

- Beaufort – Navy/Marine Air
- Charleston - Commercial Air / Boeing
- Charleston - C17 Maintenance
- Columbia – Air National Guard
- Charlotte - U.S Airways Hub
- Savannah - Gulfstream production
- Cherry Point - Navy/Marine Air
- Charleston – Commercial Marine
- Package Freight – Air / Ground
SC RBEG Goals / Pathways Set

- SCRA report... USDA/DOC EDA I-95 corridor study
  - “Sustainable biomass energy crops ... projected $25 - $30 ton”.... Woody biomass for starters
  - “resources to be a prominent player in algae production

- CAAFI / Navy Markets Identified 2011 - 2013
  - ACI focused CAAFI began with Charleston growth
  - Navy identified base needs

- CAAFI/Navy/ Biomass Council /USDA set plan 9/13

- SCCEBA selected leads submitting proposal 2/14
  - county engagement set
  - two fuel companies each proposal
  - company benefits /requirements identified
Farm to Fly in your State / Province?

Consult with the “Farm to Fly 2.0” Team

CAAFI:  Steve Csonka (Csonka.caafi.ed@gmail.com)
        Rich Altman (rcbaltman@gmail.com)
        www.caafi.org

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        Tony Logan (tony.logan@oh.usda.gov)
        Todd.Campbell (todd.Campbell@osec.usda.gov)

Put F2F2 Model To Work for You!