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CAAFI 2014 General Meeting & Expo

Local Initiatives

Moderated by: Todd Campbell, USDA, F2F2 Co-Lead

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Vicki Walker,

State Director of Rural Development – Oregon, USDA

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Director, Technology, Research & Applications, CT Center for Adv. Tech.

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“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

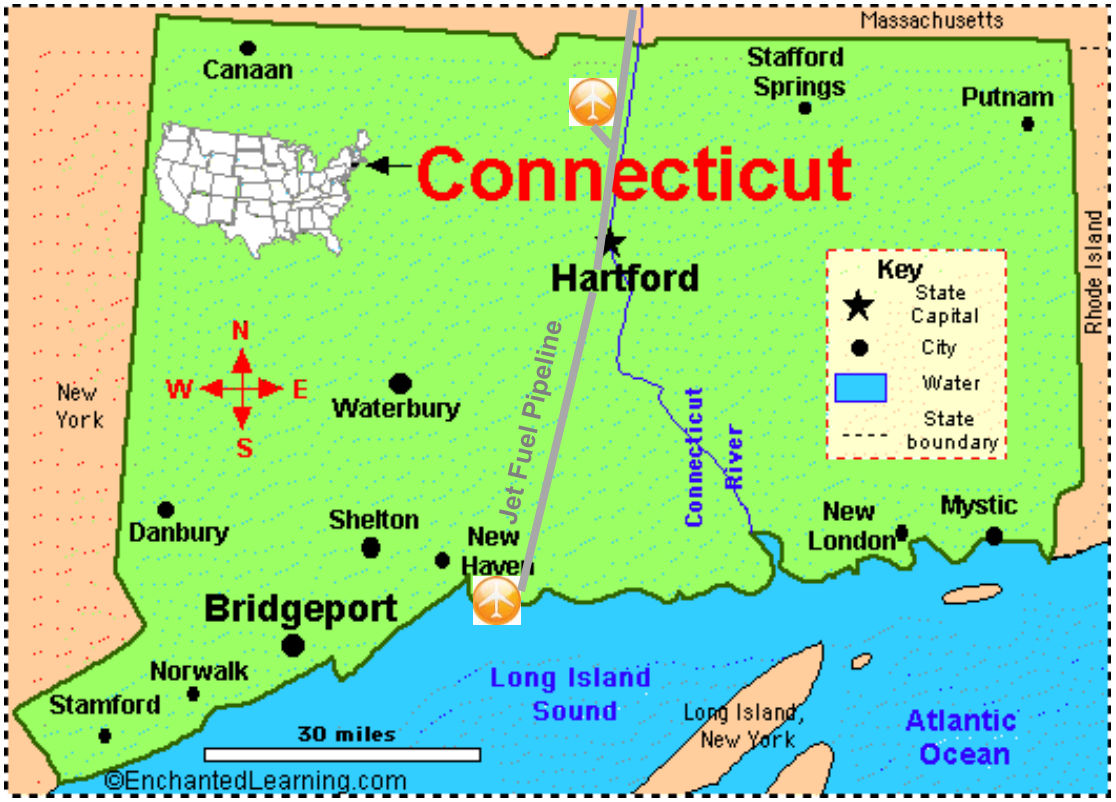
Disclaimer: All of the facts and opinions expressed in this presentation are solely those of the Connecticut Center for Advanced Technology and are not endorsed or approved by the USDA, Defense Logistics Agency or other organizations listed in this presentation.

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 2nd largest airport, is located in rural land and qualified for RBEG grant to develop jobs and economic opportunity in Rural Connecticut.

Bradley International Airport in Windsor Locks, CT

(1)Please see www.rurdev.usda.gov/BCP_rbeg.html for detailed information

2. USDA Rural Business Enterprise Grant

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

CCAT, CT Towns of East Granby, Granby, Suffield, Windsor Locks, Fiberight, Paine's Inc., Solena Fuels, Altman Assocs., Bradley International Airport, Airlines for America, USDA Southern New England Jurisdiction(1)

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

3. DLA Energy Alternative Fuels Program

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)

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Infrastructure · Water · Environment · Buildings

3. DLA Energy Alternative Fuels Program

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

Existing Test Facilities	Technologies	Feedstocks Tested
EERC[1]	Entrained Flow and Trnspt. Gasifiers	Raw Biomass
NCCC[2]	Transport Gasifier	Torrefied Biomass
Alter NRG[3]	Plasma Reactor	MSW
Emery Energy[4]	Reformer	Algae
Other TBD		Nuisance Plants
		Used Railroad Ties
		Coal
		(Mixtures of the above)

(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

ARCADIS
Infrastructure · Water · Environment · Buildings

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

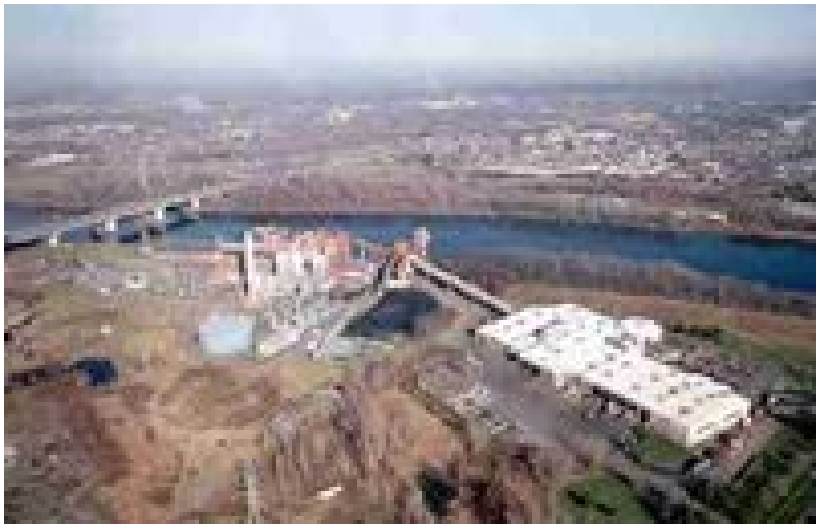
CRRA manages ~80 member towns' solid waste through three CT trash-to-energy systems (Hartford, Bridgeport, Preston)

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



Hartford trash-to-energy plant

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

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

THANK YOU !

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“Farm to Fly” Connecticut

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Anju Dahiya,

Project Director, General Systems Research

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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

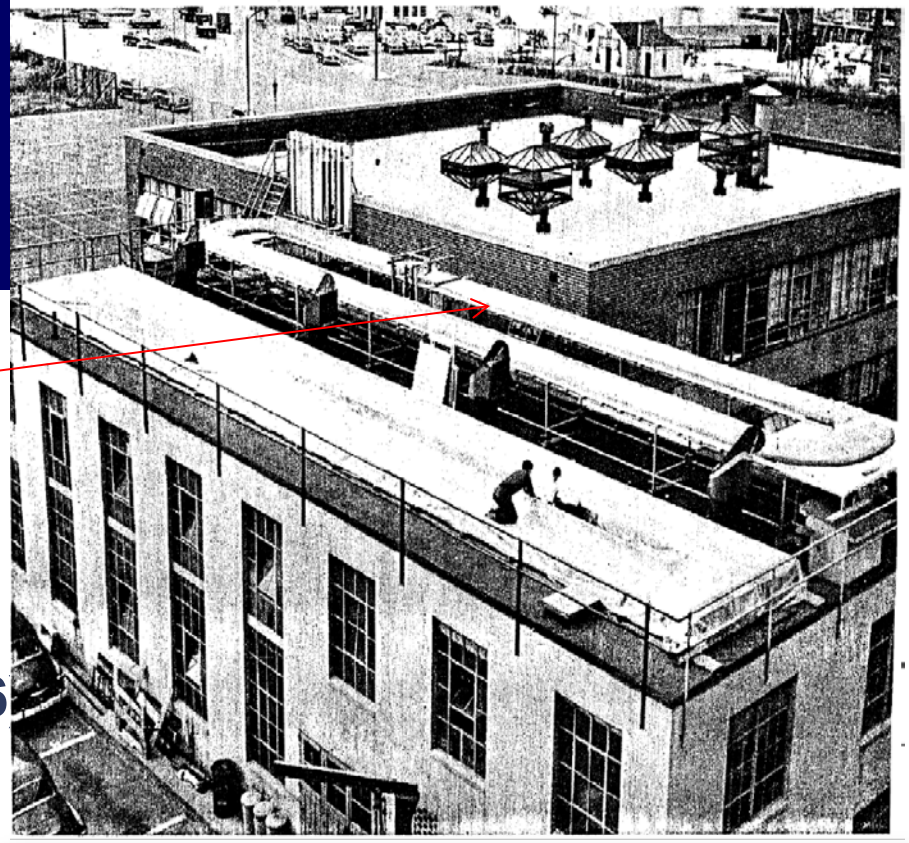
- ALGAE IN NORTHEAST / NEW ENGLAND
- GSR SOLUTIONS VERMONT FOCUS/RESUME
- VERMONT RBEG PROJECT
  - PROJECT COMPONENTS
  - SPECIFIC GOALS
  - PROCESS DESIGN APPROACH
  - BENCHMARKS FOR SUCCESS
- ADDED BENEFITS OF PROJECT
  - A PATHWAY TO COMMERCIAL DEMONSTRATION/ DEVELOPMENT

GSR SOLUTIONS

ALGAE in Northeast NOT NEW?

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.

GSR SOLUTIONS

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

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VFDA
Vermont Fuel Dealers Association

VERMONT FARM BUREAU

BREWERS Vermont ASSOCIATION

U.S. DEPARTMENT OF ENERGY

USDA
United States Department of Agriculture
Rural Development

Vermont Sustainable Jobs Fund

VERMONT EPSCoR

NSF National Science Foundation
WHERE DISCOVERIES BEGIN

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

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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**

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Nordic Farm: 300 milking cows

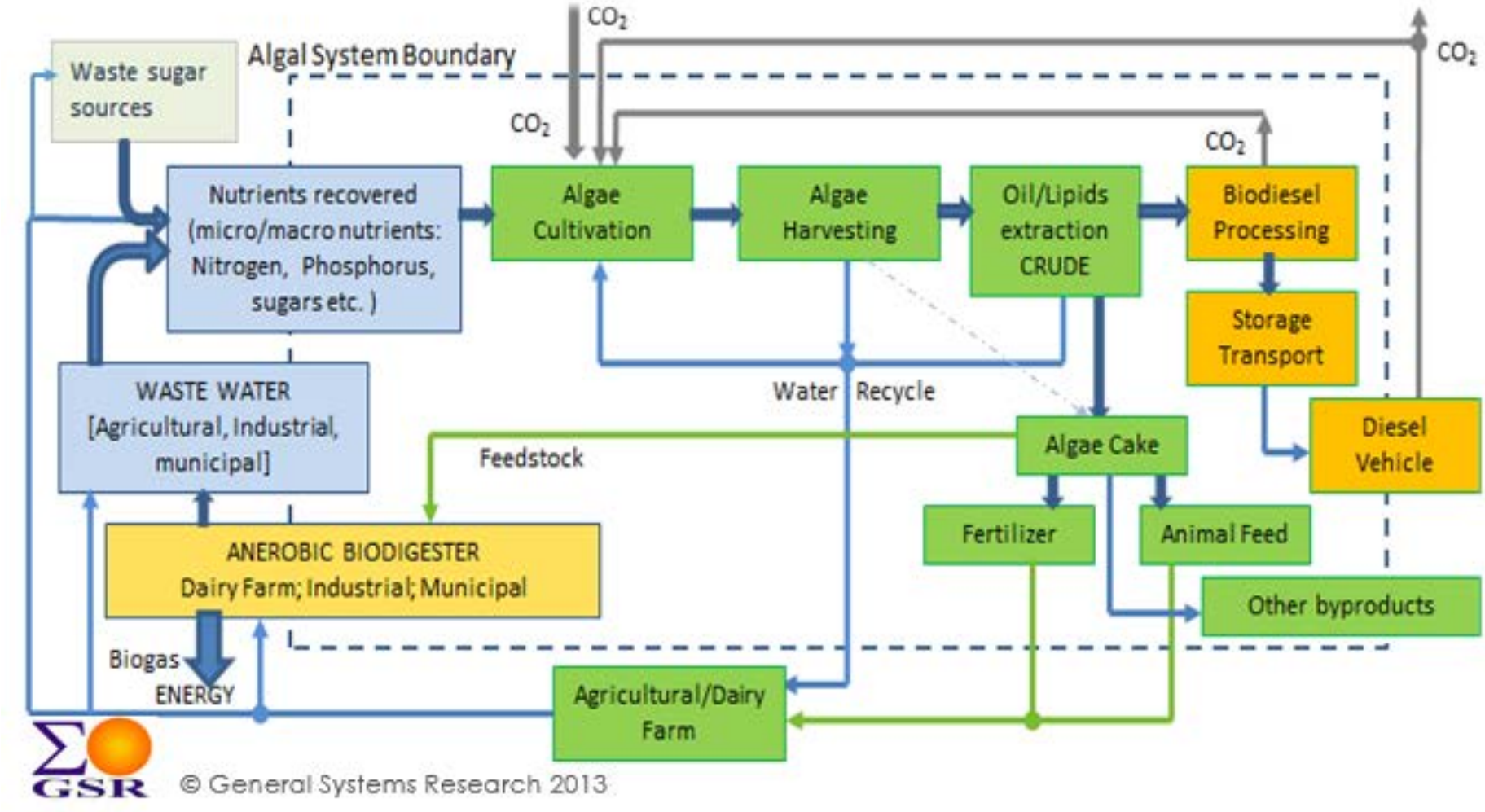
Farm puts around 200 tons of urea as fertilizer per acre only for grass grown

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.

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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

GSR SOLUTIONS

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

EPA

NASA National Aeronautics and Space Administration (NASA)

VERMONT FARM BUREAU

VERMONT Chamber of Commerce

The UNIVERSITY of VERMONT

CAAFI

VFDA Vermont Fuel Dealers Association

Renewable Energy Vermont

John Todd Ecological Design www.toddecological.com

GSR SOLUTIONS

We are inviting partnerships and investment from private sector

Thank You

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www.GenSysResearch.com

Note: White paper for follow up plan available

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Renewable Energy Advisor, USDA

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CAAFI General Meeting

January 29, 2014

Washington DC

Alternative Jet Fuels Supply Chain – Agency Effort Summary

	Feedstock Production	Feedstock Logistics	Fuel Conversion	Conversion Process Scale-up/Integration	Fuel Testing/Approval: Fuel Performance	Fuel Testing/Approval: Environment Assmt	Enable Production	End User/ Buyer
USDA	✓	✓	✓	✓	---	---	✓	---
DOC	✓	---	✓	✓	✓	✓	---	✓
DOE	✓	✓	✓	✓	---	✓	✓	---
DOD	---	---	---	---	✓	✓	---	✓
EPA	---	---	---	---	---	✓	✓	---
FAA	---	✓	---	✓	✓	✓	---	✓
NASA	---	---	---	---	✓	✓	---	---
NSF	✓	✓	✓	---	---	---	---	---

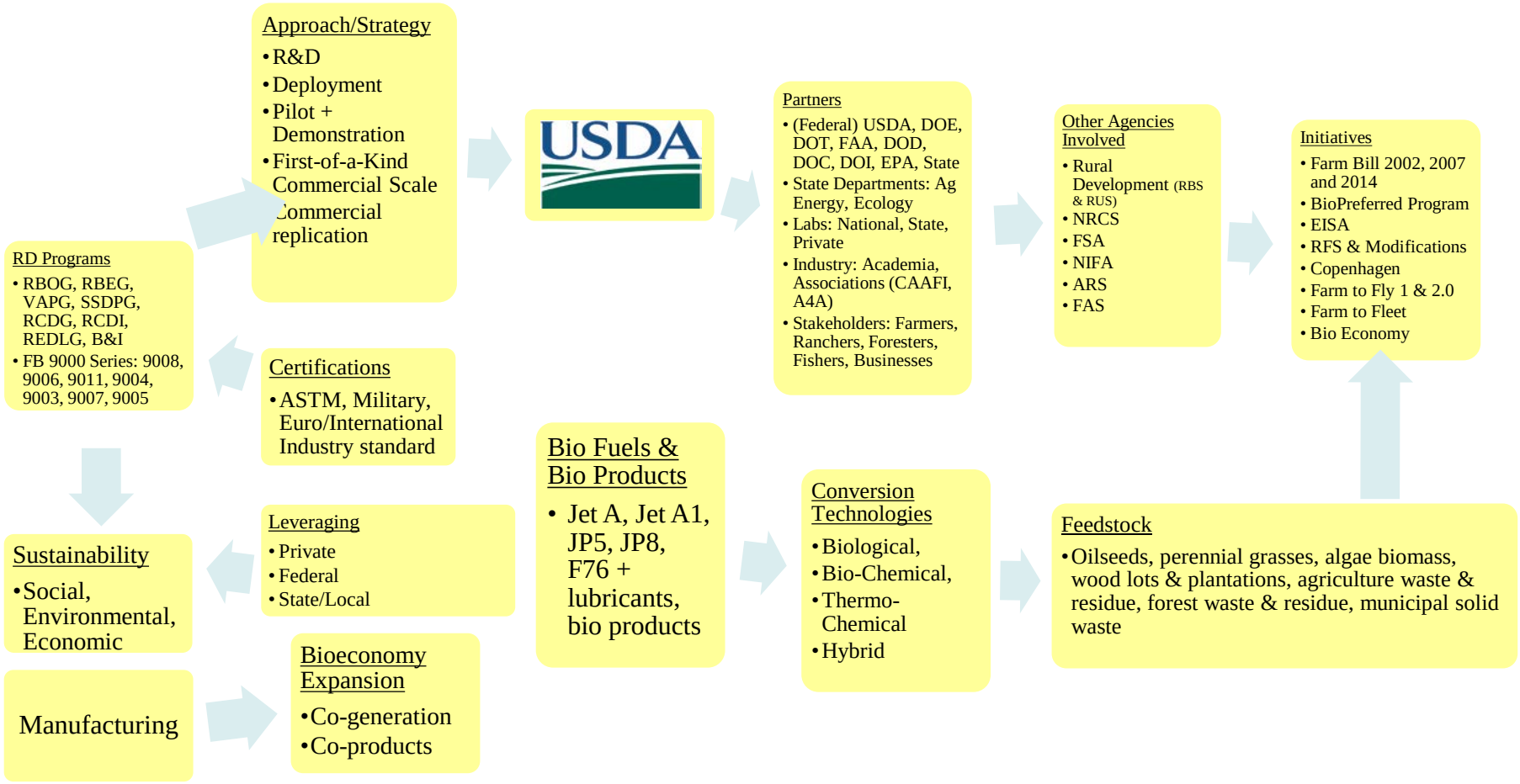
USDA Areas of Focus in Alternative Fuels - Summary

	Feedstock Production	Feedstock Logistics	Fuel Conversion	Conversion Process Scale-up/Integration	Fuel Testing/Approval: Fuel Performance	Fuel Testing/Approval: Environment Assmt	Enable Production	End User/ Buyer
USDA	✓	✓	✓	✓	---	---	✓	---

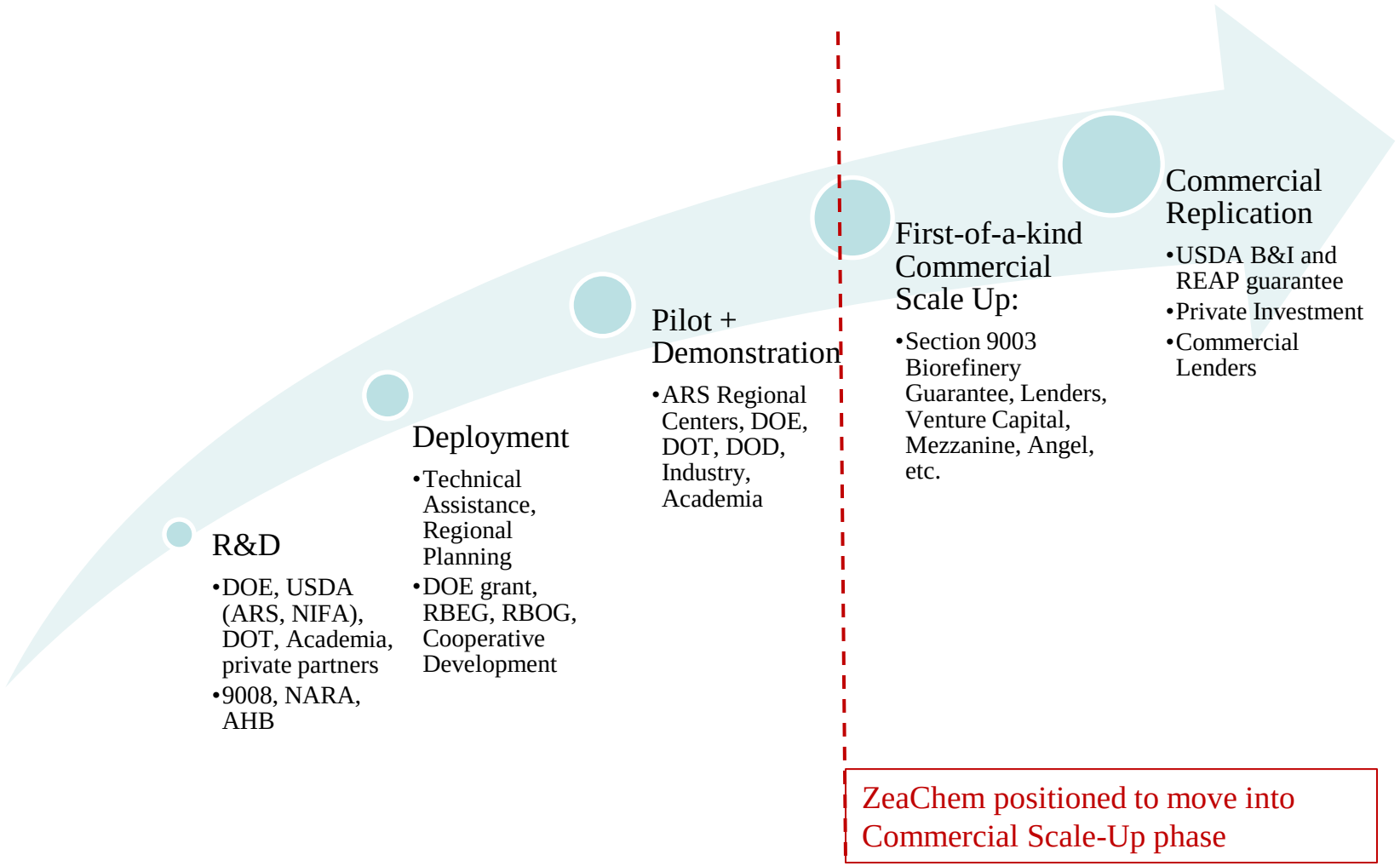
High level description of agency effort:

- 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



Path to Commercialization with Example Partners + Funding Sources



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)

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

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

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

- 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
- http://www.usda.gov/energy/maps/maps/Investment.html

- 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.

Legend | Data

Anaerobic Investments
Anaerobic

Hydroelectric Investments
Hydroelectric

Solar Investments
Solar

Hydrogen Investments
Hydrogen

Biomass Investments
Biomass

Wind Investments
Wind

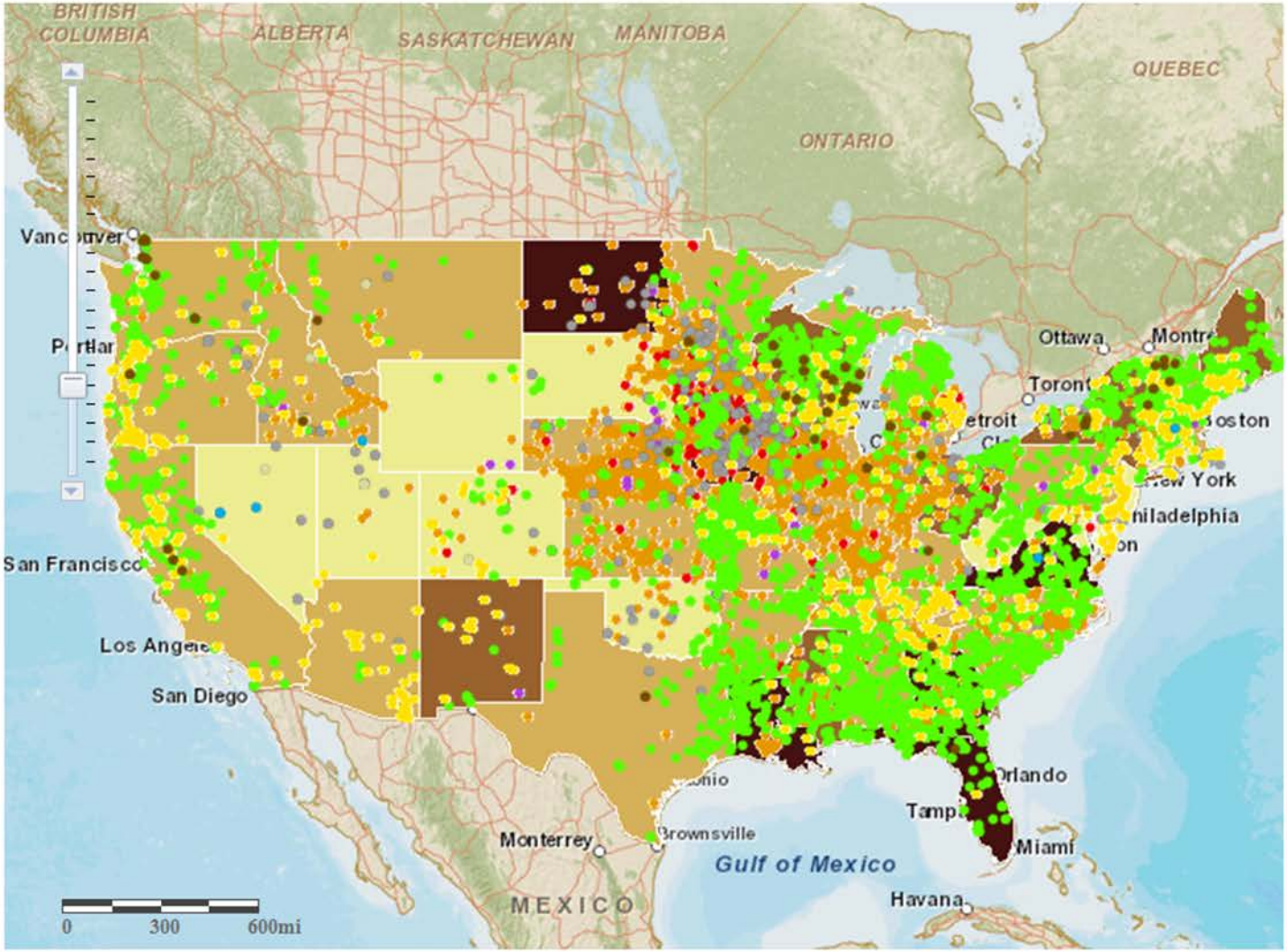
Geothermal Investments
Geothermal

Other Investments
Other

Energy Efficiency Investments
Energy Efficiency

Investment Totals by State & County
Total Investments by State (in millions of Dollars)

- <= 10
- 11 - 50
- 51 - 100
- 101 - 450



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


H.I.
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Thank You

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Rich Altman,

Executive Director Emeritus, CAAFI

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"Farm to Fly" State/Local Initiatives Success Model Lessons …. Building Future Projects

CAAFI Biannual General Meeting
January 29, 2014
Washington, D.C.

Rich Altman, Executive Director Emeritus
Commercial Aviation Alternative Fuels Initiative (CAAFI)

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COMMERCIAL AVIATION
ALTERNATIVE FUELS INITIATIVE

“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!

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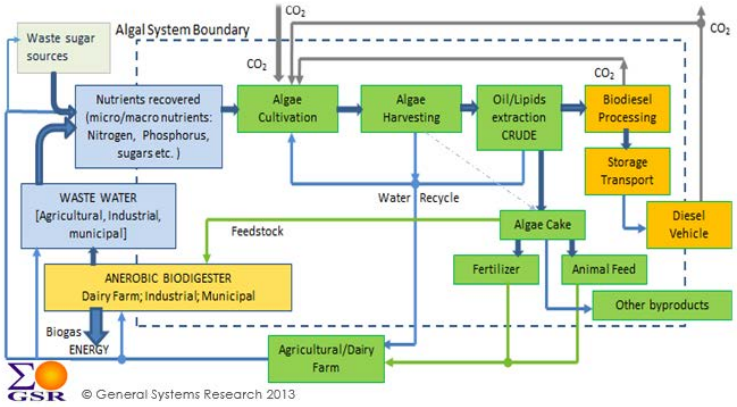
All Projects are Unique / Local



BRADLEY INTERNATIONAL

* 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

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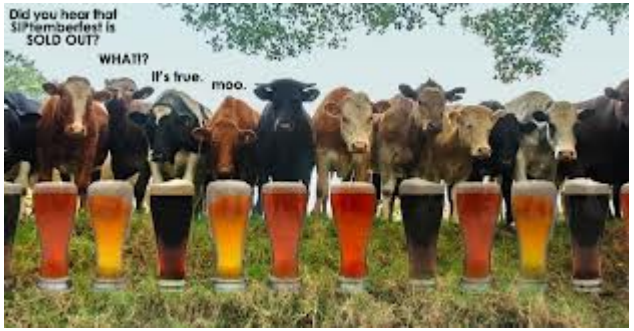
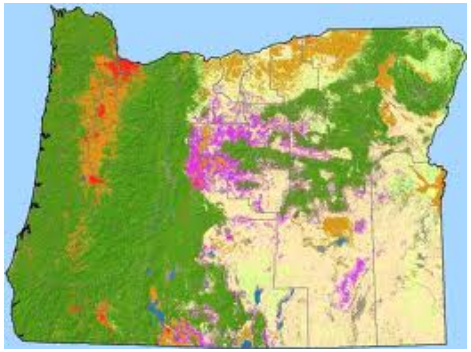
Feedstock Focused Supply chain



* **Vermont… Dairy and Beer Brewery Waste streams enable dark algae growth**

TRASH MUSEUM
REDUCE. REUSE. RECYCLE.
RECOVER. RETHINK.
www.crra.org

* **Connecticut … MSW base strong and centralized public / private capture**



* **Oregon…. Creative Woody Biomass productivity and capture**

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Strong Local Team Leadership

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VFDA
Vermont Fuel Dealers Association

VERMONT FARM BUREAU

Brewers Association Vermont

Connecticut Center for Advanced Technology, Inc.

Metro Hartford Alliance

BRADLEY INTERNATIONAL

SOLENA FUELS

Fiberight

USDA RURAL DEVELOPMENT OREGON

Alaska Airlines

BOEING

Climate Solutions
PRACTICAL SOLUTIONS TO GLOBAL WARMING

PORT OF PORTLAND

Port of Seattle

Spokane International Airport
GEG – GENERATING ECONOMIC GROWTH

WASHINGTON STATE UNIVERSITY

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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

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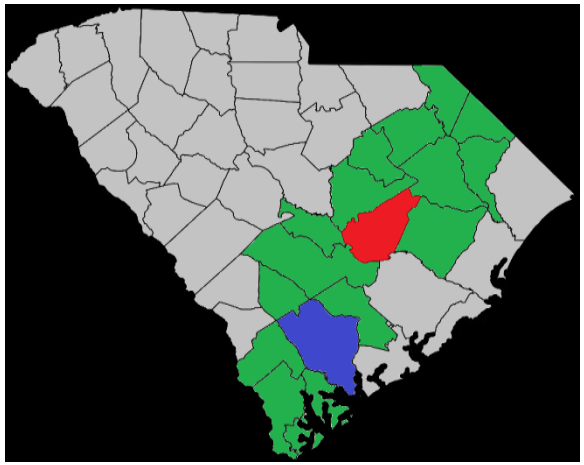
South Carolina – New Initiatives

* **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)

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Strong SC Team Leading, Supporting

Feedstock Centric Private Leadership

SCRA

SC Clean Energy Business Alliance

South Carolina Biomass Council

Public Advocacy and Support

South Carolina Department of Commerce

USDA Rural Development

Committed to the future of rural communities.

Certified SC Grown

Colleton County South Carolina

Clarendon County

CAAFI®

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 - Gulfsteam production
* Cherry Point - Navy/Marine Air
* Charleston – Commercial Marine
* Package Freight – Air / Ground

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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

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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

USDA: Chris Cassidy (chris.Cassidy@wdc.usda.gov)
Vicki Walker (Vicki.walker@or.usda.gov)
Tony Logan (tony.logan@oh.usda.gov)
Todd.Campbell (todd.Campbell@osec.usda,gov)

Put F2F2 Model To Work for You!

CAAFI®