

**THE BIOMASS/BIOENERGY INDUSTRY
IN VIRGINIA
A COMMENT FOR THE JOINT
COMMISSION FOR ENERGY AND
TECHNOLOGY.**

Oct 2, 2012

Dr Liam Leightley, Executive Director,
The Institute for Advanced Learning and Research, Danville,
Virginia.

WHY REPLACE FOSSIL FUELS WITH BIOMASS BASED RENEWABLES?

- National Security
- Protection of the Environment
- Prosperity for Rural America

UTILIZATION OF BIOMASS FOR THE PRODUCTION OF ENERGY AND CHEMICALS

- Combustion - heat, steam generation
- Combustion - power (electricity)
- Wood Pellets - domestic, commercial, CHP
- Liquid Fuels - Biooil, Ethanol
- Chemicals

HOW MANY GALLONS IN A BARREL OF OIL?

HOW MANY GALLONS IN A BARREL OF OIL?

42 GALLONS

**HOW MANY GALLONS IN
A BARREL OF OIL ARE
REFINED TO GASOLINE?**

**HOW MANY GALLONS IN A
BARREL OF OIL ARE
REFINED TO GASOLINE?**

19.5 GALLONS

WHAT COMES OUT OF THE 42 GALLONS IN A BARREL OF OIL?

END USE	GALLONS
Chemical Feedstock	1.2
Refinery Gas	1.9
Gasoline	19.5
Kerosene	4.1
Diesel Fuel	9.2
Lubricants	0.5
Fuel Oil	4.1
Bitumen	1.3

SOME OF THE CHEMICAL FEEDSTOCK USAGE

20th Century: The Hydrocarbon Era



Simmons and Company International

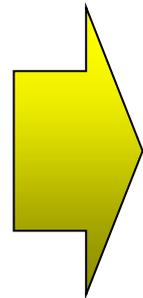
WHAT COMES OUT OF THE 42 GALLONS IN A BARREL OF OIL?

END USE	GALLONS
Chemical Feedstock	1.2
Refinery Gas	1.9
Gasoline	19.5
Kerosene	4.1
Diesel Fuel	9.2
Lubricants	0.5
Fuel Oil	4.1
Bitumen	1.3

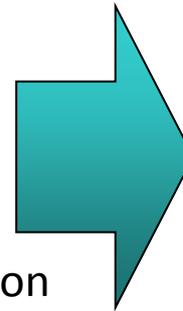
Feedstocks - Conversion-Uses



BIOMASS FEEDSTOCK



Conversion Processes



- Enzymatic Fermentation
- Gas/liquid Fermentation
- Hydrolysis to Oil
- Gasification
- Combustion
- Co-firing

USES

Fuels:

- Ethanol
- Renewable Diesel

Power:

- Electricity
- Heat

Chemicals

- Plastics
- Solvents
- Adhesives
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents

Food and Feed

Trees
Agricultural Crops
Forest residues

ALTERNATIVE FUEL SUPPLY

To meet the Renewable Fuel Standard, 250, 60 million gal / year facilities will need to be built in the US, targeted primarily in the south eastern United States.

Each facility will cost approximately \$200 million to build and will require 75 people for 2 years

Will require 2 years to build supplying much needed construction jobs for highly skilled welders, pipefitters, etc.

Each plant will employ approximately 50 people

For each employee of a biorefinery, the US department of labor estimates there are 4.3 indirect support jobs, or approximately 200 additional jobs

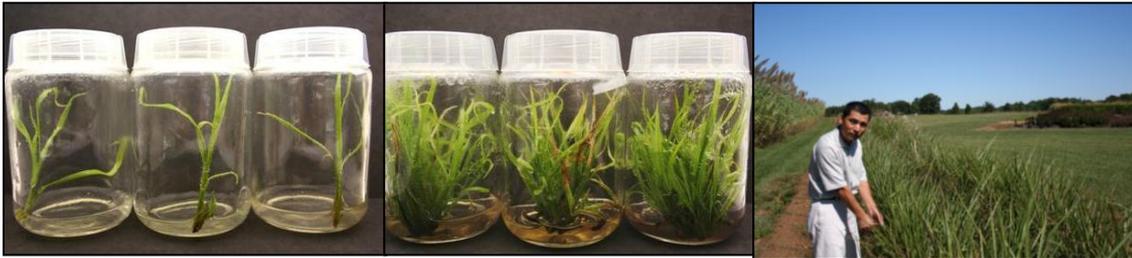
Each facility of this size will target 50,000 acres of crops to be cultivated, (compared to 120,000 acres for corn ethanol) .

PLANT BIOLOGY RESEARCH IN VIRGINIA AT THE IALR

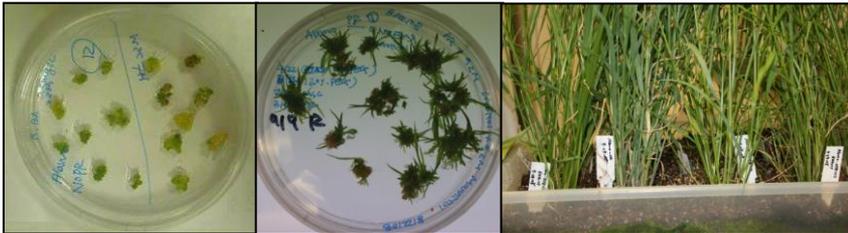


- Use of strategic research, advanced learning programs, advanced networking and community outreach
- The agricultural/plant biology research center is The Institute for sustainable and Renewable Resources (ISRR). Partnering with VT.
- Expertise in plant tissue culture, plant molecular biology, functional genomics, molecular breeding and developing Intellectual Property
- In-house expertise to carry plant propagation and plant improvement research
- Spun-off a commercial tissue culture plant production facility from in-house technology

ENERGY GRASSES IN VIRGINIA



MISCANTHUS



SWITCHGRASS



ARUNDO

CHEMTEX – IALR PROJECT

1. *Crop Improvement and Crop Development*

- Use targeted molecular breeding techniques to increase further the yields, survival rate and performance of *Arundo donax*

2. *Feedstock Identification and Crop Tests*

- Confirm the potential in the Virginia area with desired performance metrics including high productivity (ton/acre), low water and nutrient requirements, and favourable processing characteristics
- Assess harvesting systems that will be compatible with *Arundo donax* and the proposed biorefinery
- Identify suitable land and growers and develop the basis for the required logistic infrastructure for delivering cellulosic biomass to a future facility producing 50 million gal of drop in fuels and 50,000 tons of bio-based chemical annually



IMPACT OF THE IALR - CHEMTEX PROJECT COLLABORATION

- Immediate job creation in research, plant propagation, contract growing and associated economic impacts
- Development of economically attractive propagation protocols for *Arundo donax*, reducing expected cost per acre and enhancing plantlet survival rate
- Enhanced yield and profit potential through better performing *Arundo* plant material
- These all provide the due diligence required to attract a leading biomass processing leader



ECONOMIC CONSIDERATIONS FOR ARUNDO

	units	Miscanthus	Arundo
Soil Preparation (no till)	\$/acre	-	\$6
fertilizer	\$/acre	-	
herbicide	\$/acre	\$6	\$6
Total Establishment cost*	\$/acre	\$24 (one time \$480)	\$11 (one time \$219)
Land Rent	\$/acre	\$45	\$45
Cost Fresh chopping	\$/acre	\$100	\$100
Cost baling	\$/acre	\$293	\$477
Transportation **	\$/acre	\$78	\$76
Eradication (spray application, rhizome removal)	\$/acre	\$7 (one time \$140)	\$7(one time \$140)
Production Cost	\$/acre	\$338 (40% baled)	\$326 (20% baled)
Yield	Ton/acre	28	16
Total acreage necessary	acres	25,000	15,000
Total annual cultivation cost	\$/year	\$703,500	\$240,000
Cost per ton	\$/Ton	\$28	\$16

- Does not include taxes

** Transportation based on 13 miles, 12 ton wet load or 34 large bales load for Miscanthus

Transportation based on 13 miles, 21 wet ton load or 34 large bales load for Arundo due to bulk density differences.

Agricultural cost summary target price for biomass for THE CHEMTEX process is \$30 - \$50 per dry ton.



Project Benefits and Impacts

- Farmer familiarity and interest in larger scale production of *Arundo donax*
- Increased opportunities for farmers to utilize marginal land for income generation
- Inexpensive biomass for local companies seeking biomass resources, such as Piedmont Geriatric Hospital
- Optimized feedstock for our region to generate higher biomass than non-improved feedstock, providing attractive opportunities for processing companies
- Building a partnership with Chemtex International, with a goal of a facility in the region requiring large scale biomass growing and large benefits to the farmers and the region. CHEMTEX has invested \$150M in Arundo.

