Eucalypt Plantations in Florida USA: Economic Analysis of Current and Potential Uses

Dr. Jeff Wright





ArborGen Confidential

SARA

- Sustainable
- Affordable
- Reliable
- Available

- J. Lane, BioFuels Digest April 13, 2012

EU 27 Bio-energy Demand by 2020

- Renewable Energy Directive
  - 20% reduction in GHG from 1990 levels
  - 20% energy efficiency improvements
  - 20% energy from renewable sources
  - 10% increase in biofuels usage

- Source: Biorefining Magazine, February 2011.

Life Cycle Emissions Including Production

Fuel	CO2 emissions kg/GJ	CO2 emissions kg/MWh
Hard coal	134	484
Oil	97	350
Natural gas	75	270
Wood chips @ 25% MC	7	25
Wood pellets @10% MC	9	33

- Source: Biomass Power & Thermal October 2011

UK Renewable Energy 2020 Targets

- 20% of energy needs from renewable sources
- 75% of renewables as wind, solar…
- 25% of renewables as biomass
- 50,000,000 dry tonnes biomass total
- 30,000,000 dry tonnes biomass imported
  - 22 million tonnes wood pellets
  - 24-36 wood pellet facilities (1/3 in US South?)
- 20,000,000 dry tonnes biomass-domestic
  - UK Forestry Commission says 2 million tonnes by 2020 in bio-energy forest plantations

Wood Bio-energy South
Projected Annual Wood Demand 2022
www.forisk.com June 30, 2012

State	Projects	New Tons*	Current PW Tons*	Harvest Residues**
AL	8	4,947,460	22,319,461	5,100,000
AR	7	1,820,000	8,599,960	
FL	18	10,574,125	8,810,364	4,700,00
GA	36	18,167,578	24,910,968	
LA	4	3,300,000	13,202,538	
MS	8	3,183,239	9,756,782	3,320,000
NC	13	2,796,000	6,516,913	3,617,000
SC	11	2,939,800	11,754,290	3,700,000
TN	6	3,150,000	N/A	
TX	9	2,862,440	8,828,168	
VA	15	2,207,300	N/A	
Total	**145**	**62,813,654**	**125,294,759**	

- *Green tons
- **Green tons estimated as available by state agency or USFS

Post Harvest Residue
Gadsen Co. Florida

Whole Tree Chipped

Conventional Tree Length Harvest

Bio-energy Availability = Zero on Many Logged Sites

Bio-energy Resources (?)

Urban waste **Logging site waste**

Florida Harvest and Utilization Study, 2008 Resource Bulletin SRS-162

- Average total harvest 68 tons/acre (15 ton/acre residual)
- 331,000 acres harvested (191,000 acres/year clearcut)

- Softwood 85% utilized 15% residual
  - Residual 3.2 million tons (1.0 million tons stem wood, 2.2 million tons tops and limbs)
- Hardwood 74% utilized 26% residual
  - Residual 1.5 million tons (0.7 million tons stem wood, 0.8 million tons tops and limbs)

Residual at 15 tons/acre, 50% recoverable is 7.5 tons/acre

Need recoverable residuals from 80,000 acres clearcut for 50MW (600,000 tons/year)

Eastern US Hardwood Forest Plantation Opportunities

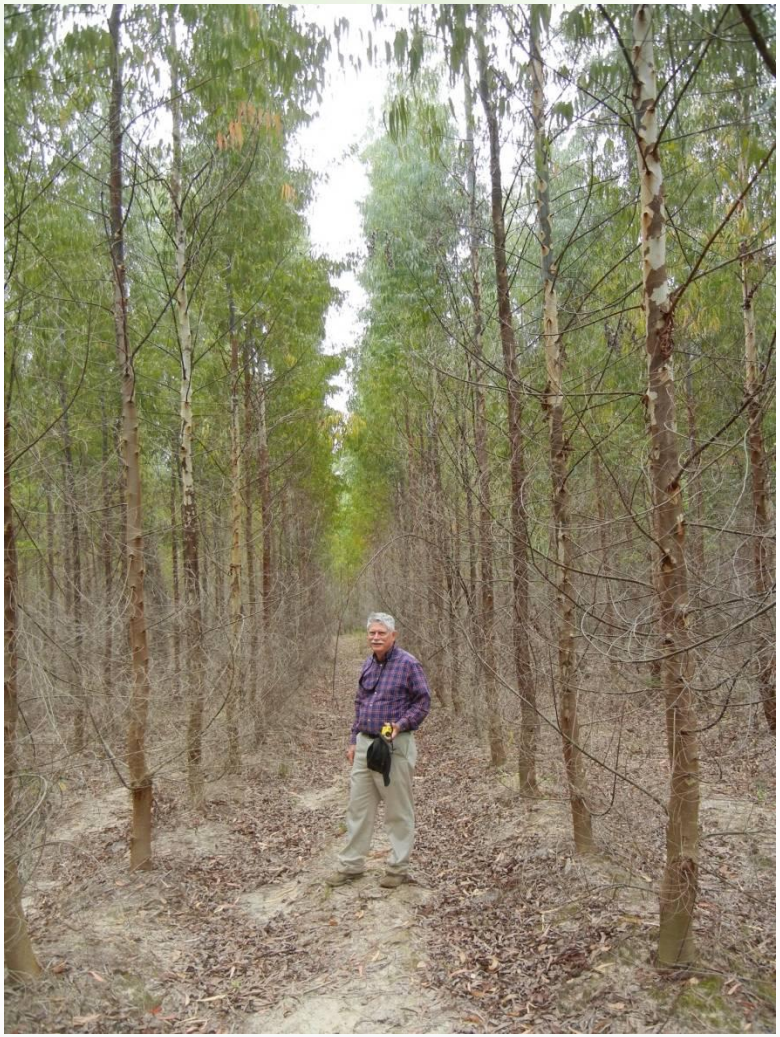
Conventional Eucalyptus

- **Uses**: Mulch, Hardwood Pulp & Biomass for energy
- **Species**: Eucalyptus benthamii
- **Sites**: Lower latitudes in the SE USA
- **Soils**: Somewhat poorly with good internal drainage to well drained soils
- **Silviculture**: Good understanding but will improve
  - Establishment cost > than pine
  - Coppice for additional rotations < than pine
- **Risk**: Freeze damage- Unknown pest
- **Productivity range**: 9-16 Gtons/ac/yr pulp wood rotation 7-8 yrs. Specific gravity 0.46 to 0.52.
- **Improvement activities**: Seed source testing, NCSU FPC screening

Eben – age 12 years

Eucalyptus benthamii (Eben)

- Most cold tolerant eucalyptus we have tested
- Current planting stock are seed collections from multiple sources which produce good but variable performance
- Large effort in US seed production



3-yr-old Eben planted near Jackson, AL

Eben seed production

Bellamy clonal orchard

Age one year – will be Seedling Seed Orchard

Native Eucalypts to Plantations

Species Introductions

E. benthamii South Carolina USA
Age 6 years

Pawns to Clones

E. camalduensis, Age three years

Selected Ecam, Age Two Years

EH1 South Florida

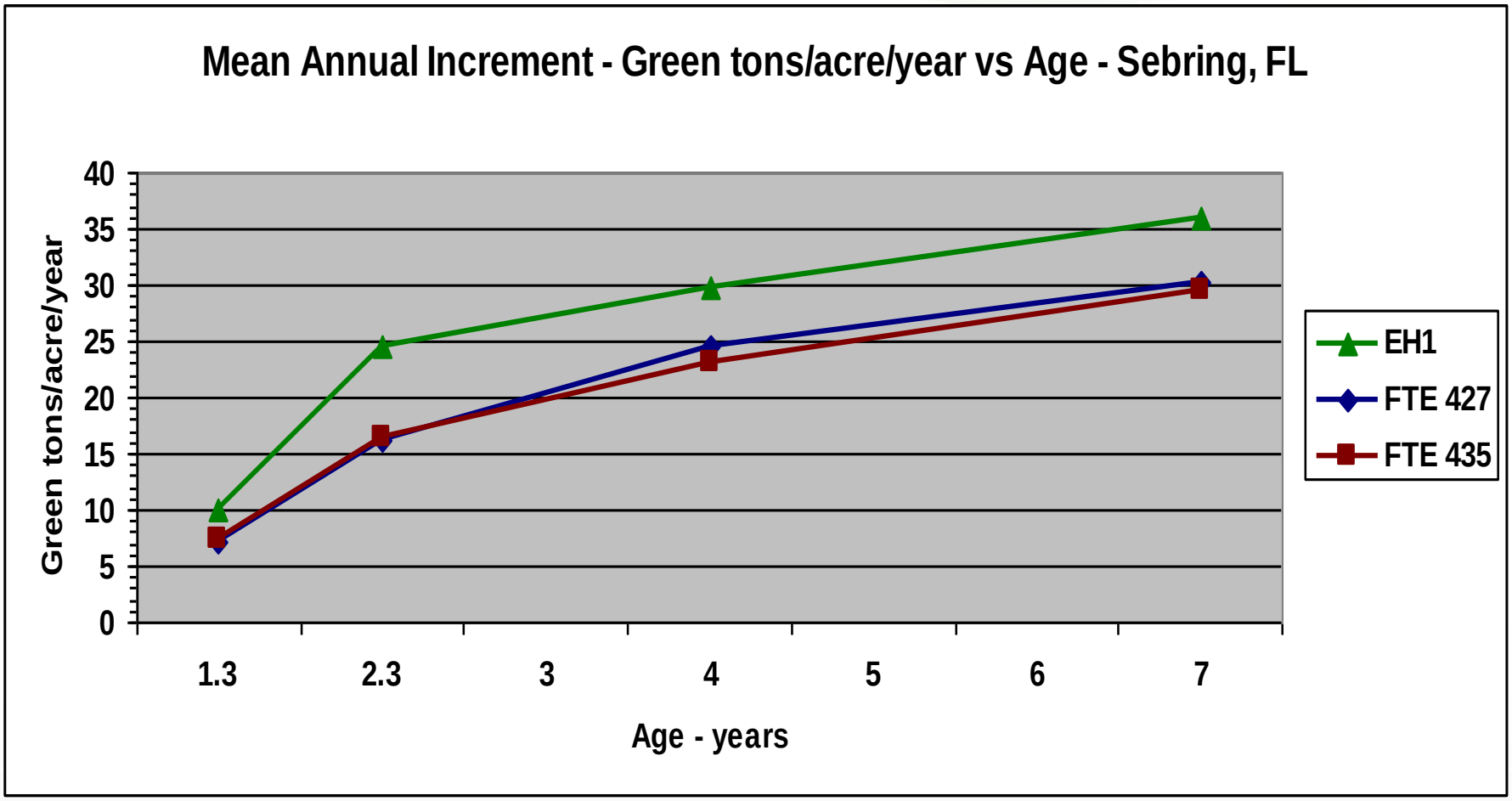
Age 12 months

Age 4 months

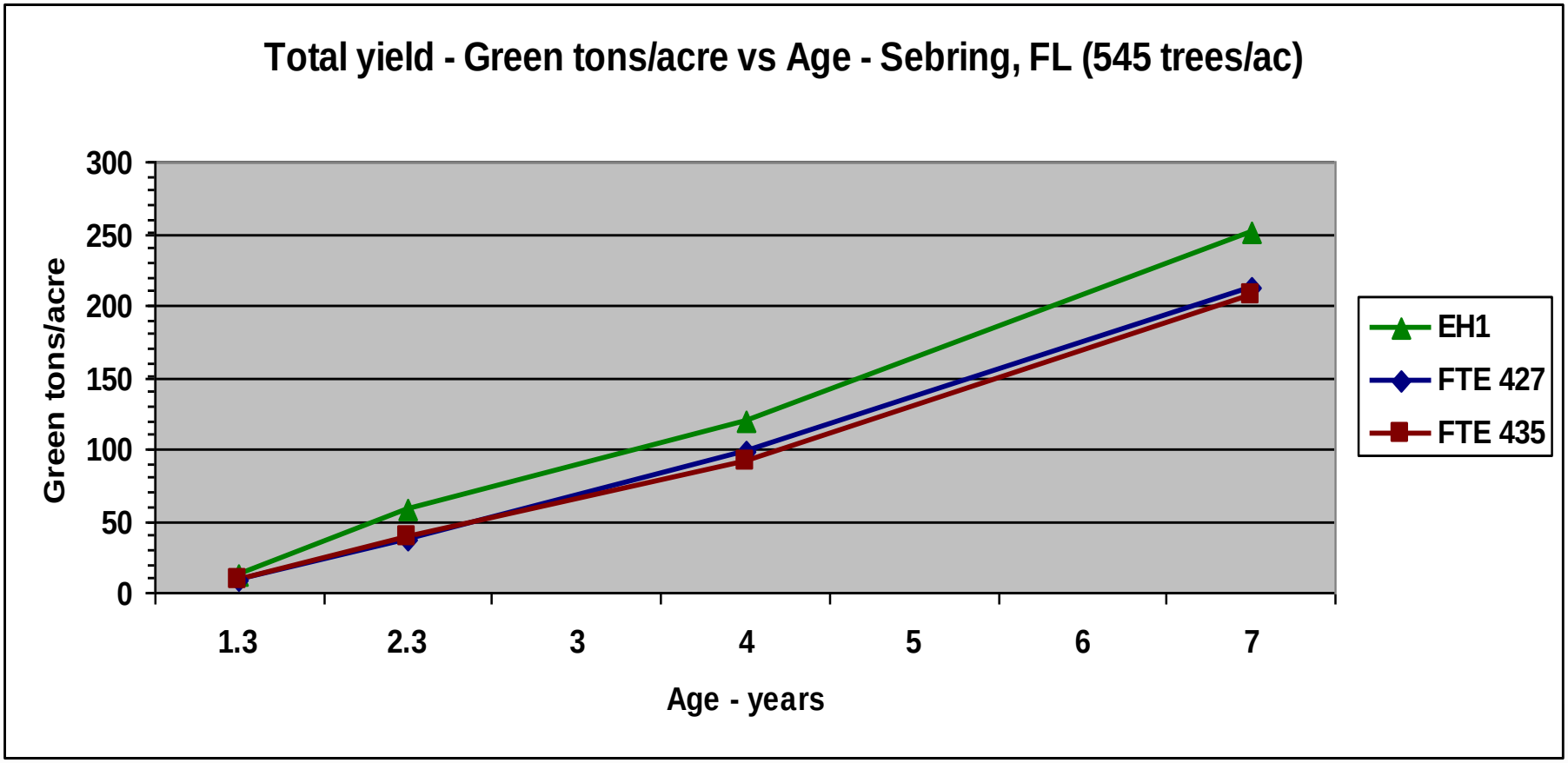
EH1 Sebring Florida.Age Four Years.

14 dry short tons/acre/year

Annual Yield Sebring FL



Total Yield Sebring FL



Eucalypt Coppice Management

Coppice 3 months

Coppice 18 months

E. urograndis at Age two years

40’ tall

4.5” DBH

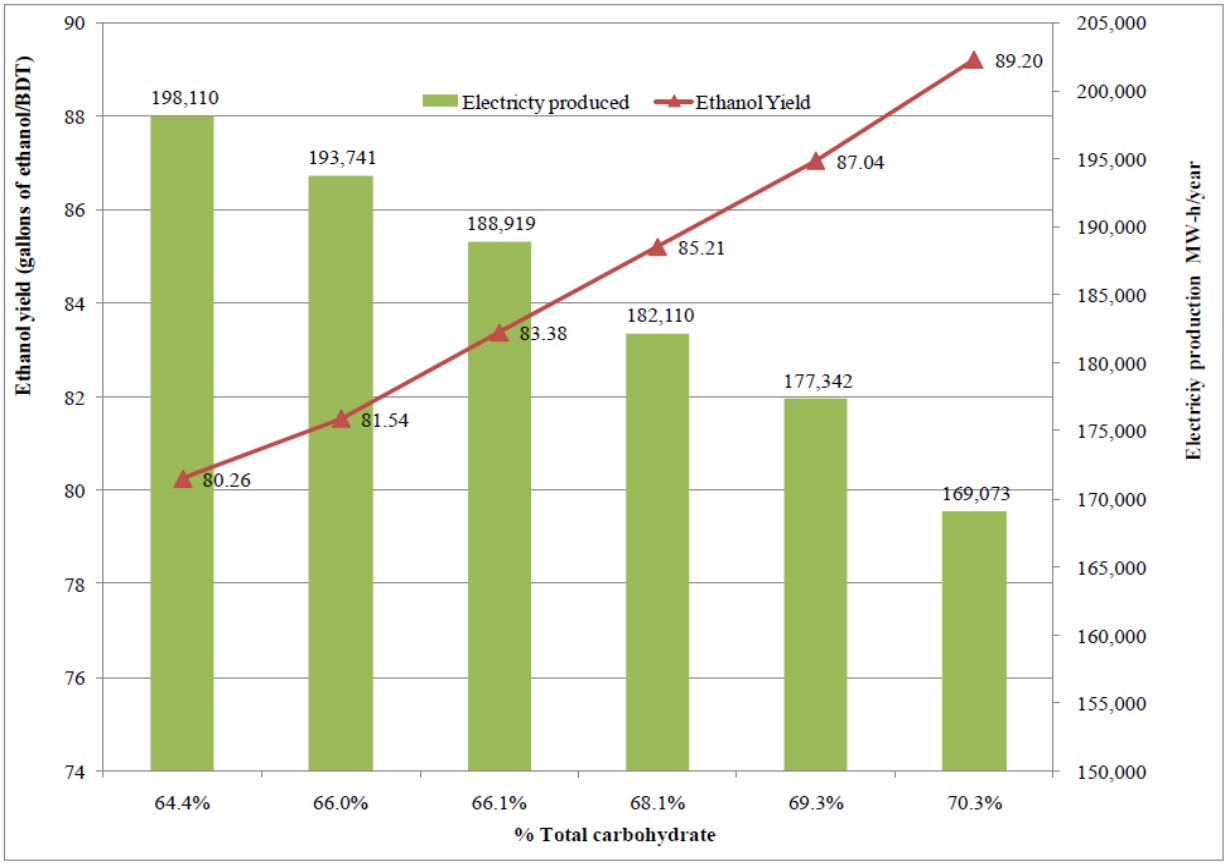
Eucalypt for Mulch Production

Bio-energy Analysis

Field Crew – Brute Force

Lab Crew – Intelligent Force

Eucalypt potential for cellulosic ethanol



Gonzalez R, Treasure T, Jameel H, Saloni D, Phillips R, Abt R, and Wright J. Converting Eucalyptus Biomass Into Ethanol: Financial And Sensitivity Analysis In A Co-Current Dilute Acid Process. Part II. Biomass and Bioenergy 2010.

Eucalypts for solid bio-energy production

Bio-energy such as wood pellets and briquettes can be effectively manufactured from Eucalyptus

PIRRAGLIA, ADRIAN; GONZALEZ, RONALDS; DENIG, JOSEPH; SALONI, DANIEL and WRIGHT, JEFF (2012).Assessment of the most adequate pre-treatments and woody biomass sources intended for direct co-firing in the US. BioResources 7(4)4817-4842.

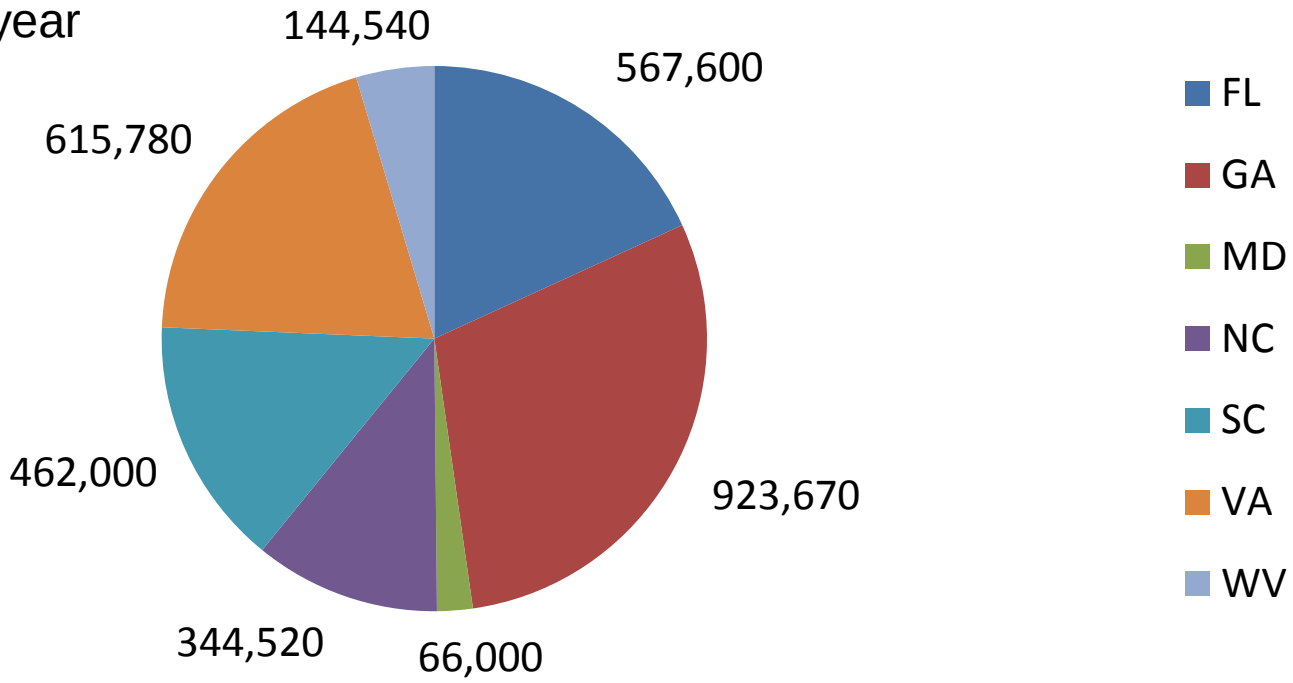
PIRRAGLIA, ADRIAN; GONZALEZ, RONALDS; SALONI, DANIEL; WRIGHT, JEFF and DENIG, JOSEPH. (2011). Fuel properties and suitability of *Eucalyptus benthamii* and *Eucalyptus macarthurii* for torrefied wood and pellets. BioResources 7(1):217-235.

PIRRAGLIA, ADRIAN; GONZALEZ, RONALDS; SALONI, DANIEL and WRIGHT, JEFF. (2010). Wood pellets: An expanding market opportunity. Biomass Magazine 6:68-75.

Wood Pellets: NCSU Dr. Daniel Saloni July 2012

Current Production by State (Tons/year)

Total
3,124,110 tons/year



Georgia is the largest producer with second fewest pellet plants

Wood Pellet Shipping Cost for the EU (1)

- SE US to EU US$36
- Brasil to EU US$44
- BC Canada to EU US$67

- (1) Dr. Daniel Saloni, NCSU, Department of Biomaterials

Global Pellet Production and Demand
(millions metric tonnes)

	Demand		Production	
	2010	2020	2010	2020
• EU	10.8	23.8	7.7	13.0
• China	0.6	10.0	0.6	10.0
• Japan/Korea	0.2	5.5	0.1	1.1
• North America	3.4	5.6	4.9	11.0
• Total	15.0	44.9	13.3	35.1

- (Pellet Mill Magazine, Fall 2011)

Stem Size Matters

Eucalypt Bio-energy Harvest

Plantation age 18 months

Harvesting Systems – Whole Tree Biomass

Bales at roadside $9.25/green ton

Whole tree chips at roadside $10.42/green ton

D. Mitchell, USFS, October 2012

Eucalypt Harvesting Systems

Eucalypt Bio-energy Systems

Tree length chipping

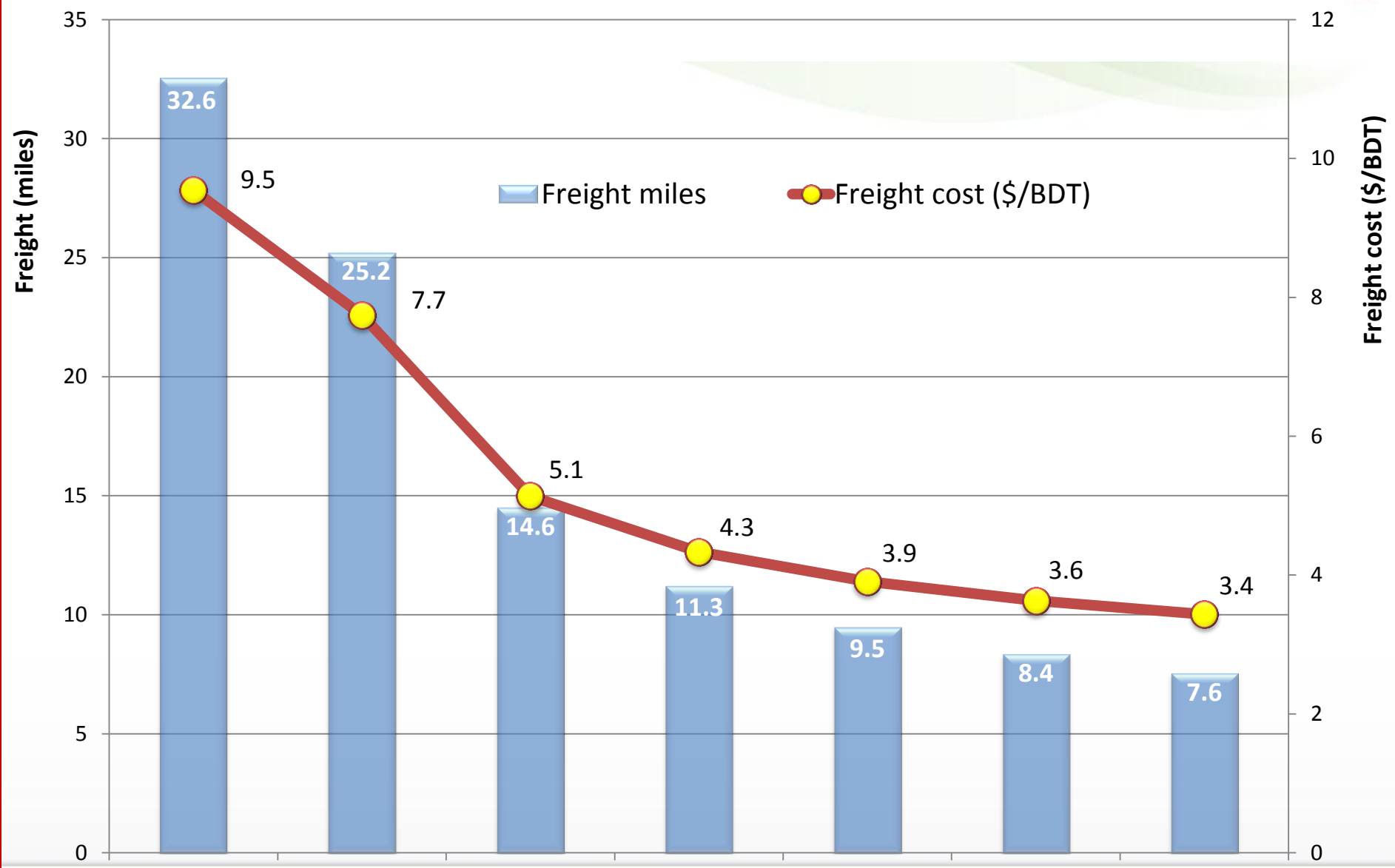
Co-generation with bagasse

Range of Returns for Eucalypt Plantations (1)

Rotation	Origin	Cost/acre ($)	Harvest Age (green tons/acre)	Stumpage Prices @ return rate 6%	10%
1st	Seedlings	525	89	9.02	11.44
2nd	Coppice	215	102	3.42	4.24
3rd	Coppice	215	88	3.86	4.80

- (1) Dougherty, Derek and Wright, Jeff (2010). Financial evaluation of eucalypt bio-energy plantations in the southeastern United States. Forest Landowners.

Effect of % cover area on freight distance & cost



US South Delivered Wood Fuel Prices

- Wood fuel defined as by product of pulpwood chipping
- Price in Q4 2011 was $20.32/delivered green ton (1)
- Plantation growing cost (stumpage) $4-9/green ton
- Cut, chip, haul cost $10-16/green ton
- Total $14-25/delivered green ton
- (1) Source: Forest2Market February 2012

Questions?

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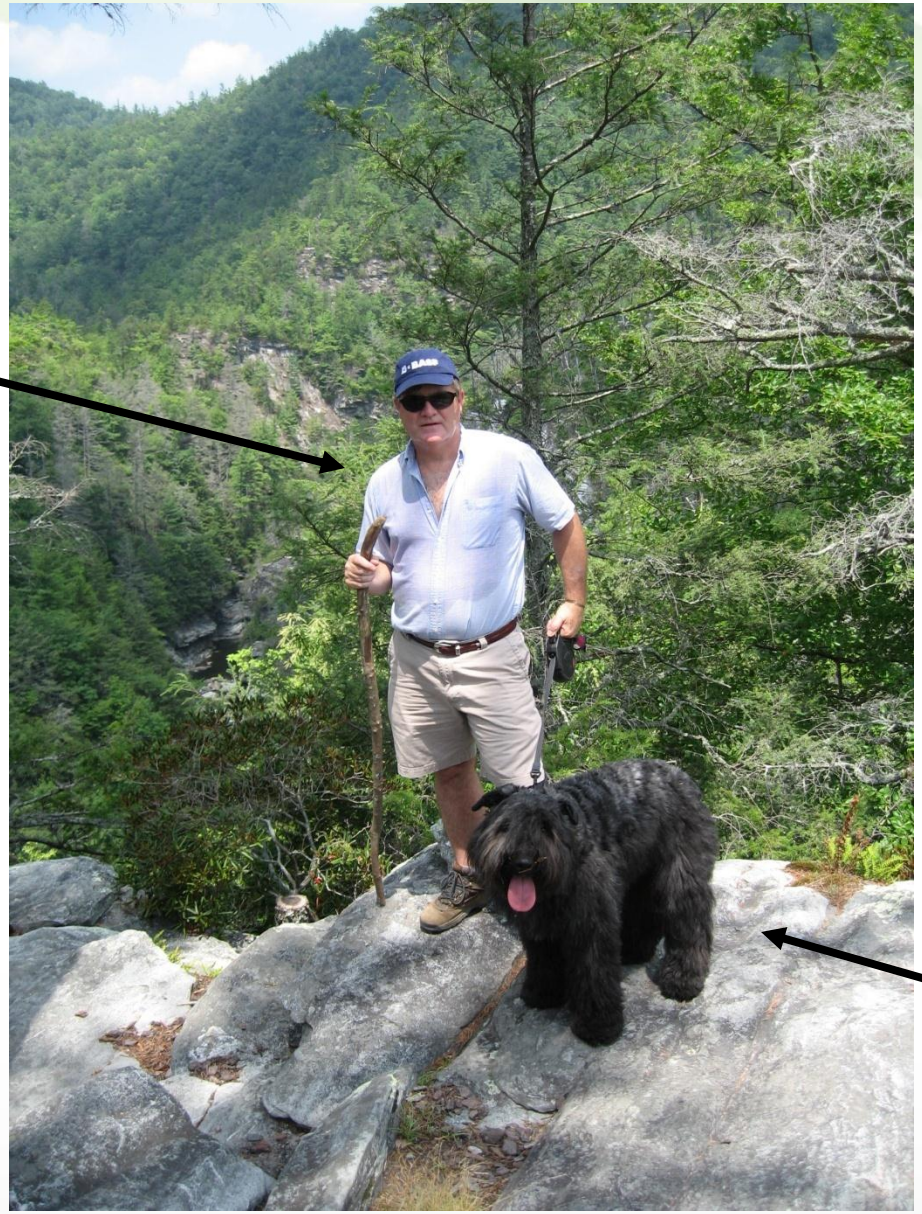

Coltrane