Biomass Supply

Improving lives through science and technology

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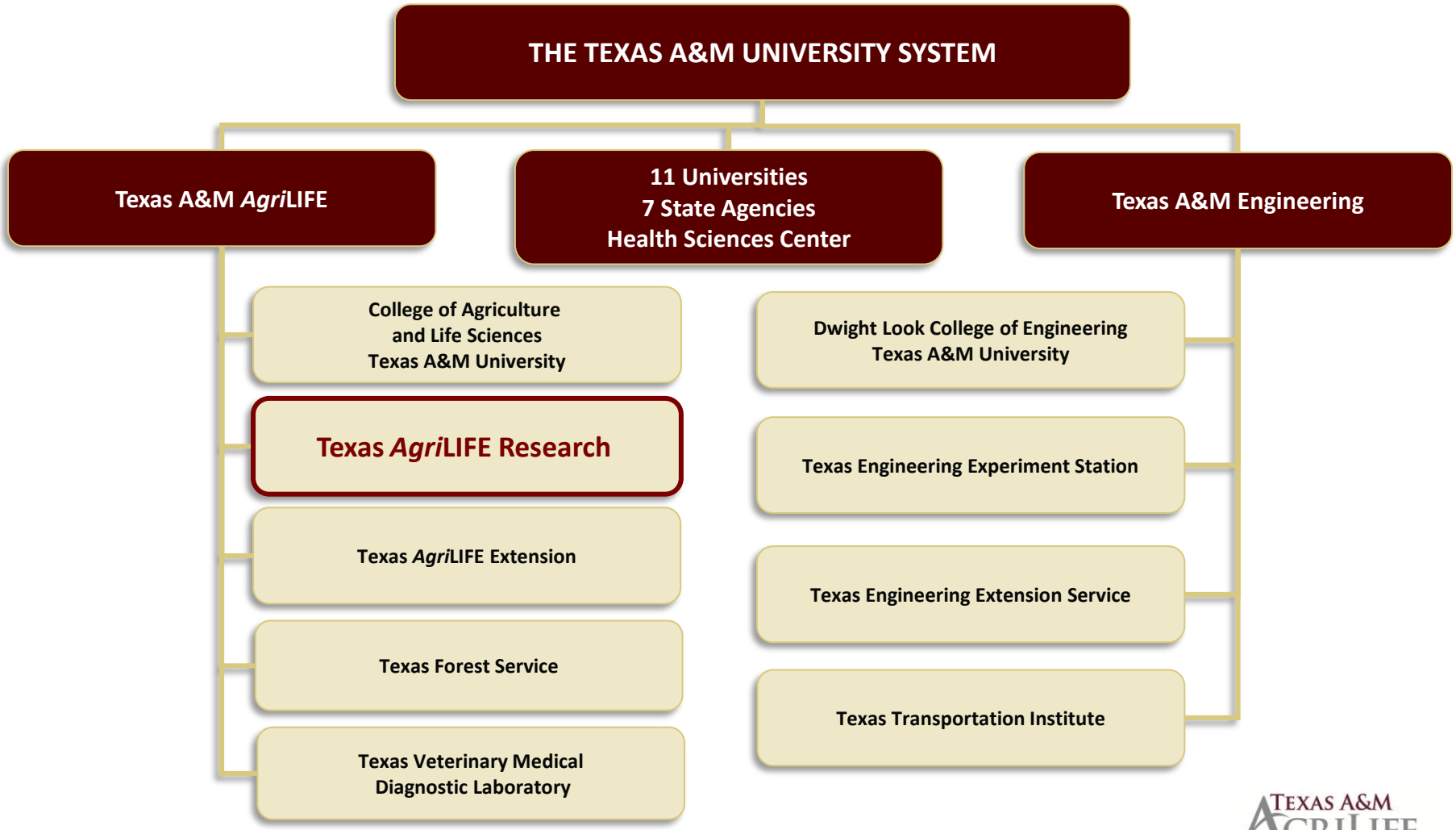

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Bioenergy Program Scope

- Over 40 projects with a portfolio value of over $40 million
- Major programs with:

  Ceres (Sorghum)

  Chevron (Oil seeds and energy cane)

  BP (Energy crops)

  State of Texas (ETF and appropriations)

  U.S. Govt. (DOE, DOD, USDA)
- About $30 million in new proposals in process

ceres

Chevron Human Energy

bp

NAABB
National Alliance For Advanced Biofuels and Bio-products

THE STATE OF TEXAS

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Lignocellulosic Crops

Energy Canes (Perennial)
- Sub-tropical production
- Good soils
- High water demand
- High Biomass Production (20+ Tons/acre)

High-tonnage sorghum (Annual)
- Long Canopy Duration
- Good soils
- Drought Tolerant
- High Biomass Production(12-15 Tons/acre)

Sweet Sorghum (Annual)
- High sugar content (alcohols)
- Drought Tolerant
- Good soils
- Med. Biomass Production (5-10 Tons/acre)

Grasses (Perennial)
- Drought Tolerant
- Marginal soils
- Med. Biomass Production (5-10 Tons/acre)

Woody Species (Perennial)
- High water demand
- Marginal soils
- Low-Med. Biomass Production (5 Tons/acre)

Production Comparisons

Lignocellulosic Crop	Dt/Ac.	$/DT	Drop in Fuel (Gal./Ac.)
Energy Cane	20	90	1400
Energy Sorghum	12	85	840
Sweet Sorghum	8	75	1000*
Perennial Grasses	8	95	560
Woody Species	5	75	350
Oil Seeds	-	-	>100

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Sustainable Bioenergy Economy

- Consistent energy/biofuels policy
- Oil prices > $70/barrel?
- Loan guarantees for early projects
- Technology advances
- Markets for biofuels
- Positive economics
- Environmentally sound production practices
- Positive Life Cycle Analysis

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Bioenergy Strategic Questions

- When will commercial-scale lignocellulosic conversion biorefineries come on line?
- Do we have available land?
- How can/will feedstock production lead biorefinery demand? (ie 24/7/365 supply)
- How/can reliable delivery logistics be assured?
- What agronomic practices assure that bioenergy crops will be produced in a sustainable manner?

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Bioenergy Strategic Questions

- How do we produce bioenergy crops in concert with food and feed crops?
- What are the impacts on water usage?
- What are the life cycle/carbon implications?
- How do we mitigate impacts on animal agriculture?
- Will financing be available?
- Will we have consistent energy policy?

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Bottom line for Dedicated Energy Crops

- High tonnage production(15+ DT/ac) on good soils in rotation

(Marginal lands (perennials) can help but high production on good soil is critical.)

- Moderate to high nutrient input

(To produce biomass, nitrogen and other nutrients are needed.)

- Adequate moisture

(Consistent rainfall of 30+ in/year, surplus irrigation capabilities, or drought tolerant crops will be required.)

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System Logistics

The logistics of producing hundreds of millions tons per year of lignocellulosic feedstocks is the Achilles' Heel!

- Production
- Harvesting
- Transporting
- Storage
- Processing

To meet USDOE projections, 110,000 truck loads per day required!

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Biomass Delivery Cycle

Fall/Winter

Winter/Spring

Spring/Summer

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Sourcing - Cooperative

Landowner/cooperative member ownership/control of land and equity position with biorefiner.
Cooperative (biorefiner) ownership/control of: production/harvest operations; transport, storage, and pre-processing.

- Biomass quality risk – medium
- Biomass delivery reliability risk – low
- Biomass cost risk – low
- Capital cost – medium
- Management control - medium

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Sourcing - Contract

No biorefiner ownership/control of: land; production/harvest operations; transport, storage, and pre-processing. Assumes long-term (5 years+) contracts.

- Biomass quality risk – medium
- Biomass delivery reliability risk – medium
- Biomass cost risk – medium
- Capital cost – none
- Management control – medium (contracting)

Sourcing - Commodity

No biorefiner ownership/control of: land; production/harvest operations; transport, storage, and pre-processing. Assumes a viable commodity supply system.

- Biomass quality risk – highest
- Biomass delivery reliability risk – highest
- Biomass cost risk – highest
- Capital cost – none
- Management control – low (hedging)

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Conclusion

- Commercial varieties of lignocellulosic crops that can produce large volumes of feedstock per acre per year.
- Production systems that significantly reduce the unit cost of the feedstock.
- Efficient logistics systems that harvest, preprocess, transport, and store biomass feedstocks.
- Environmental systems that will protect water quality, soil quality, and air quality and manage water use and the carbon footprint.
- Economic systems to ensure life cycle costs, investment and production costs, and economic development value.
- Compatible conversion technologies on line.

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THANKS

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