Southeast Biomass: Highest and Best Use

Non-food Biofuels from Sustainable Forest Resources

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Who is Catchlight Energy?

- Catchlight Energy LLC (CLE) is a 50/50 Chevron and Weyerhaeuser joint venture.
- Our Mission is to commercialize the large scale production of liquid transportation fuels from sustainable forest based resources.
- Our Vision is to be the leader in delivering advanced biofuels “from forest to fuel”.

To accomplish this we will:

- Research, develop & commercialize the technologies & business models to produce 2\textsuperscript{nd} generation biofuels
- Leverage synergies between CLE, WY, CVX and 3\textsuperscript{rd} parties
CLE’s End-to-end Value Chain

Enables “Forest to Fuel” Solution

Leverages the strengths of two leaders in their industries
Drivers for Joint Venture

- **Develop sustainable renewable energy platform**
  - Climate change and green house gas mitigation
  - Renewable fuels market established & growing
  - Gen I demand capped. Growth to come from 2nd Generation biofuels

- **Increase domestic energy independence & security**
  - Domestic energy reduces trade deficits
  - National security

- **Parent’s shared view**
  - Cellulosic biofuels important to diversifying U.S. energy supply
  - Growing energy demand & the “end of easy oil” create opportunity for biofuels once economies recover from the current recession

- **Parent complementary strategies**
  - WY: innovative growth and revenue from trees
  - CVX: obtain Renewal Fuel Standard advanced biofuels
Catchlight Energy LLC Goals

- Develop Technology & Business Model
  - Sustainable Supply Chain Business Model
    - biomass at scale
    - engage stakeholders & determine sustainability with science
    - competitive long-term without subsidies
  - Conversion Technology
    - internal and 3rd party
- Industry leadership through early commercialization
- Start in North America
- Build, own and operate facilities
Our Challenges

- **New and evolving biofuels market**
  - Set by Renewable Fuel Standard (RFS) – regulatory uncertainty
  - Requires rapid ramp up

- **Feedstock scalability**
  - Require tens of millions of tons annually

- **Sustainability**
  - Diverse stakeholders

- **Conversion processes**
  - Currently unproven and uneconomic

- **Logistics infrastructure to collect, process and distribute both feedstocks and biofuel products**
  - Compatibility with present infrastructure is key
US Cellulosic Biofuels Market Defined by the Renewal Fuel Standard (RFS2)

Mostly Corn based ethanol

RFS2 Volume Requirements

RFS2 Cellulosic

BGPY

Year
Feedstock Challenge

• Volume Ballpark Estimates
  • Feedstock/Biomass 10 tons/acre
  • Conversion Process 100 gallons/ton

• Conversion Facility
  • Commercial size, gallons/year 100 million
  • Feedstock supply per facility 100,000 acres
  • Price per facility $300 to $600 million

• Requirements to meet the RFS mandate (16 Billion gallons/year)
  • Number of commercial facilities 160
  • Capital requirements to build $80 Billion
  • Biomass feedstock requirements 16 million acres
Feedstocks Strategy

- Forest-based
  - Build on Weyerhaeuser's existing forestry base
- Grow energy crops in conjunction with high value timber
  - Maintain supply for traditional forest products
  - Deliver a new and sustainable resource for biofuels
- Supplement Weyerhaeuser feedstocks with third party supply
- Achieve scale consistent with billions of gallons per year of liquid transportation fuels
Why Forest Based?

- Builds on an large existing infrastructure that is consistent with large scale production of biofuels
- Leverages Weyerhaeuser's strengths in managing large scale ecosystems
  - Precision forestry and science-based sustainable forestry
  - Extensive and efficient harvest, handling and transport infrastructure
  - Expertise in feedstock procurement from third parties
  - Expertise in genetic improvement to improve yield, product quality and throughput of conversion processes
- Woody feedstocks can provide superior assurance of supply
- Recognition that forestlands can grow more than just sawtimber alone
Weyerhaeuser Forestlands Provide the Foundation
Adapting the Forestry Strategy

- Weyerhaeuser's traditional focus has been high value sawtimber
  - Forests intensively managed for value, not for maximum biomass production
- During much of the rotation the forest has potential to support production of additional biomass for emerging biofuels markets
  - Residuals, understory crops, (short rotation) trees, perennials to complement high value timber
Intercropping of Dedicated Energy Crops

One example
- Grow strips of pine trees and an energy crop
- Energy crop harvested annually
- Trees managed for wood products and fiber
Feedstock Sources

- Thinning residues
- Understory vegetation
- Harvest residual
- Thinning
- Intercropping
Feedstock Sourcing

- Sourcing Buildup for first facilities could be:
  - Harvest Residuals
    - Thinning and Clearcut Residuals with cull understory
  - Whole-tree woods chips
    - Either pulpwood or pre-commercial interventions
  - Dedicated Energy Crops
    - Switchgrass
  - Cleanings
    - Understory removal of competition
Feedstock Sustainability Research

- We must assure all stakeholders that the system is truly sustainable
- Well positioned to influence legislation, certification schemes, and forestry regulations/BMPs by demonstrating the sustainability of our management and procurement practices
- Large-scale site studies underway with credible research partners (NCASI, key research Universities, ENGOs) exploring:
  - Soils, nutrients, soil carbon, site productivity
  - Wildlife/biodiversity
  - Water quality/quantity
  - Carbon life cycle analysis

Calhoun County, MS

Pine + switch grass

Pure Switchgrass

Pine only + biomass removal

Pine + switch grass

Pine Only

Calhoun County, MS
Conversion Technology

- Catchlight Energy builds on the strengths and competencies of its parents
  - WY: feeding, & converting biomass
  - CVX: chemical and thermochemical conversion to liquid transportation fuels
Conversion Technology

- Range of bio-fuel products
  - Ethanol and other alcohols
  - Hydrocarbons
  - Intermediates
- Manufacturing facilities likely to involve multiple technologies
  - Biological
  - Thermochemical
  - Chemical/catalytic
- We do not expect to do it all alone; third party technology will be important to our success
Logistics / Infrastructure

- Highly distributed nature of biomass does not fit the traditional centralized refining model
- Matching continuous conversion processes with a discreet harvest system is a challenge
  - Biomass supply varies through the year
  - Season to season variability with perennials
  - Assuring security of supply – multiple feedstocks?
- Overcoming the feedstocks / conversion conundrum
  - A market must exist before feedstocks will be planted
  - But feedstocks must be available before conversion facilities will be built
Learnings since CLE’s formation

- It will not happen as quickly as first thought
- Technology is not the only challenge
- Key driving forces are outside our control
  - Volatile energy prices; uncertain federal policy
- No single technology is likely to dominate
- Ethanol alone is not the answer;
  - Hydrocarbons should also be in the portfolio
- Competition for forest resources is inevitable
- A consistent and predictable government policy is essential
The Heritage of the Parents

"The power of Human Energy to find newer, cleaner ways to power the world"

"Releasing the potential in trees to solve important problems for people and the planet"

These are the ideals that created Catchlight Energy

We acknowledge the risk and uncertainties, but —

We believe Catchlight Energy is uniquely positioned to make large scale, renewable transportation fuels from a sustainable forest resource a commercial success