



Diversified Energy Corporation

Advanced Biofuels Opportunities and Challenges Southwest Energy Innovation Forum 18 Oct 2010

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CEO



Who is Diversified Energy?

- Alternative and Renewable Energy Technology Company – HQ Phoenix, Arizona, USA
- 5 Yrs Working in Two Major Energy Areas:
 - “Clean Carbon” Gasification
 - Advanced “Drop-In” Biofuels
- Focused on Development and Commercial Introduction of Promising Technologies
- Core Team in Place and Key Partnerships Established to Support Development
- Millions in Revenue -Technologies Funded by Private \$\$, Five Separate U.S. Government Agencies, and Commercial Partners



Headquarters – Gilbert, Arizona

“Develop and mature alternative energy technologies, systems, and projects to economically address United States and World energy demand”



Diversified Energy Beliefs/Principles

- Founding Beliefs:
 - “Peak Oil” has Arrived or Will Shortly
 - Global Energy Demand Will Continue Strong Growth
 - Energy and Fuel Costs Will Rise
 - Major Transportation Energy Crisis Continues to Build Long-Term
- Founding Principles:
 - Be Technology Diverse
 - Processes Ideally Use Multiple Input Feedstocks
 - Multiple Output Products, All “Fungible” Drop-In Replacements
 - Focus on Low Conversion Cost and Realistic Commercialization Scenarios
 - Be a Leader in Alternative/Renewable Liquid Transportation Fuels



The Problem Is Staggering.... (Optimist: What an Opportunity!)

- 840 Million Gallons Per Day of US Petro Fuel Use
 - 90 Day Supply In Pipeline for Country On any Given Day
 - Highly Bottlenecked Supply System, Very Vulnerable
 - Over 75% of World In-Ground Supply controlled by NOCs
 - Big Oil Majors Really Just Truckers and Refiners.....
 - US Domestic and Military Fleets Near 100% Petro-Fueled
 - 215 Million Automobiles
 - 85 Million Light Trucks
 - 6 Million Long-Haul 18-Wheelers
 - 6000 Long-Haul Aircraft
 - Major Railroads Each Using over 1 Billion Gallons Diesel Per Year
 - Hundreds of Thousands of Military Vehicles – Largest Single User
 - The Era of Low-Cost Plentiful Petro Supply is Over
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Review of Scale For 10 MMGY Outdoors

- For a 10 MMGY Fuels Farm (Cyanobacteria Example)
 - 1500 acres of land
 - 250,000,000 gallons of water - standing
 - 150,000,000 linear feet closed tubes – 126,000,000 lbs plastic
 - 13,000,000 linear feet troughs
 - 750,000 gallons per day lost to evaporation (open system in AL)
 - >3" diameter make-up water piping to fields
 - 722 tons CO₂ consumed per day
 - 20,000,000 L/hr CO₂ gas flow rate to farm (>10 MW compression)
 - 10,000 GPM flow rate through extraction (16 MW pumping)
 - 155 tons of fatty acid produced every day
- Material & Energy Requirements for only 1500 Acres HUGE
- Approaches \$100 Million CAPEX for this Small Farm



Extending Prior Example to NATIONAL Scale (Worst Case - Doing it All)

- Need 20 Million bbls per day
 - 840 Million gallons per day
 - 306,600,000,000 gallons per year
 - Need 30,660 Algae Farms like the One Just Described @ 10 MMGPY
 - Requires 45.9 Million Acres of Flat, Sunny, Temperate Land
- Requires 7.6 Trillion Gallons of Standing Water
 - Open System Loses 22.9 Billion Gallons Water/Day to Evaporation
- Requires 3.8 Trillion Lbs of Plastic (Replaced Periodically)
 - (We Just Ran Out of Oil and Gas to Make it All)
- Gobbles Up 22 Million Tons of CO₂ Per Day!
 - CO₂ Crowd Will Like THAT!
- Consumes 490 Gigawatts of Electricity To Pump the Water
 - Probably Generates More CO₂ To Pump the Water than Saved....



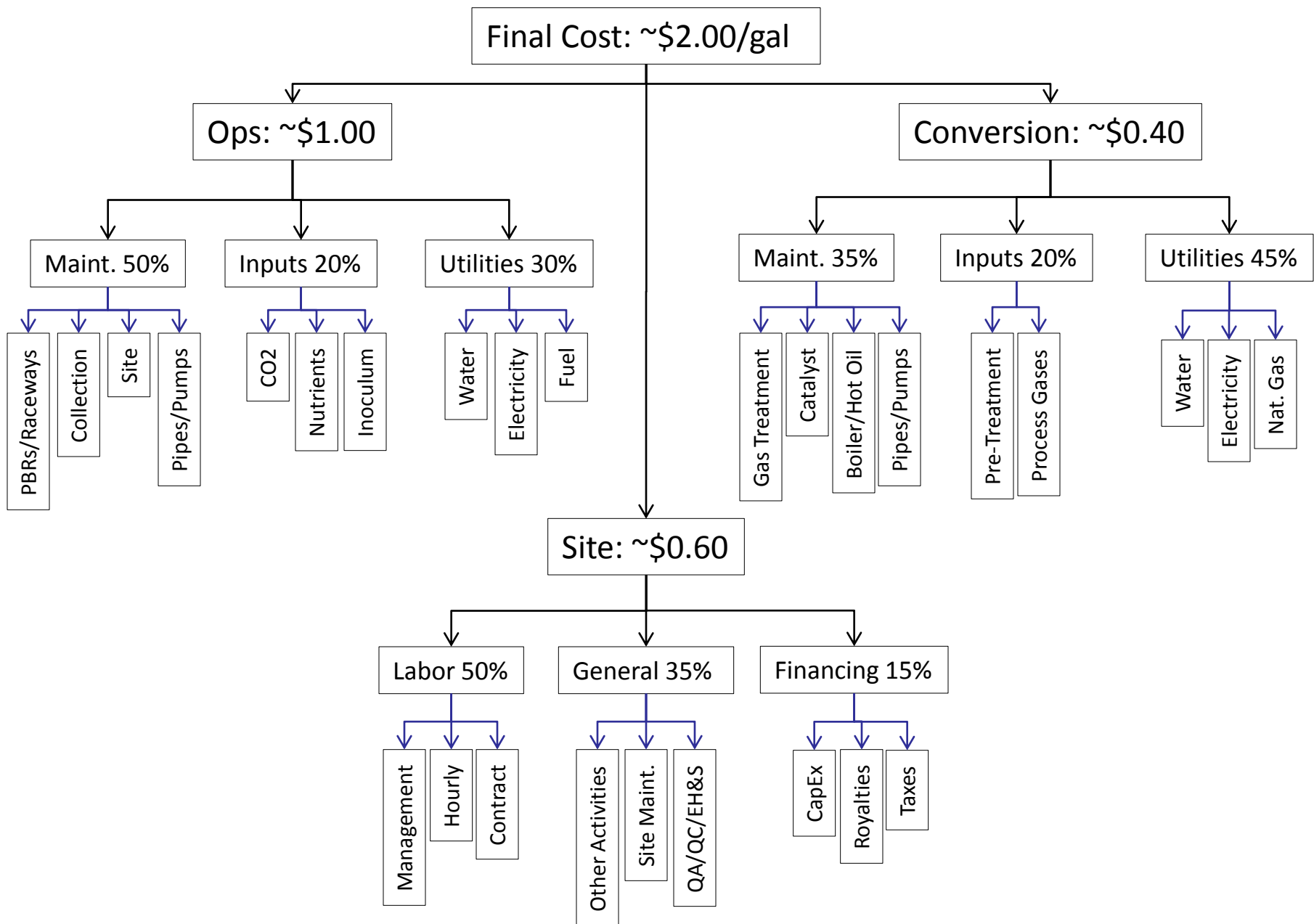
Thompson's Prediction and Question

- Obviously Won't Work, Country Will Not Go to This Scale
 - Only A 10% Supply Contribution Would Help
 - We Will See a Smorgasboard of Future Fuel Offerings
- Food Crops Will Eventually Be Outlawed as a Fuel Source
- Cellulosic Ethanol Costs Too Much In Infrastructure Mods
 - Near- Broke Country Can't Afford \$5 Trillion Infrastructure Change
- Future Fuels MUST be 100% Drop-In Replacements
 - Preserve the 300 Million Vehicles in the US Domestic Fleet
 - Military Vehicles Must Have Drop-in Replacements - \$Trillion Cost
 - Demand/Supply Inversion and Costs Ahead will Park Many Vehicles
- US has the Science and Technologies to Jump the Crevasse
 - Will We Move Fast Enough To Implement It??



Drivers for Algae-Derived Fuels

- AFTER We Find the Right Strain.....
- Cost of Containment (Plastics or Other Barriers)
- Achieving Proper Solar Access
- Amount of Water Handling Required
- Efficiently Moving That Water
- Feeding It the CO₂ (Capturing, Compressing, Transporting)
- Dewatering Energy....Or Eliminate
- Oil Extraction Energy....Or Eliminate
- What to Do With Leftover Biomass ...Or Don't Make Much
- Cost Efficient Biorefineries to Convert to Drop-In Fuels





Conclusions

- We Really Have a Lot Of Work To Do Collectively
 - Country is Not Prepared for Coming Fuel Changeover
 - Answer is Going to Have to Be a Smorgasboard
 - Serious Threats to National Security/Finances Ahead
 - Much More Money Will Have to Be Spent, And Quickly
 - Clean Coal, Nuclear, Wind.....all will Play a Part

 - Good News is That America Has a Lot of Very Smart People
 - We Have the Science and Technologies to Solve It
 - Bumpy Road Ahead as National Strategy Jells
 - Many Excellent Opportunities for Entrepreneurs
 - Whole World Will Follow Our Answer
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