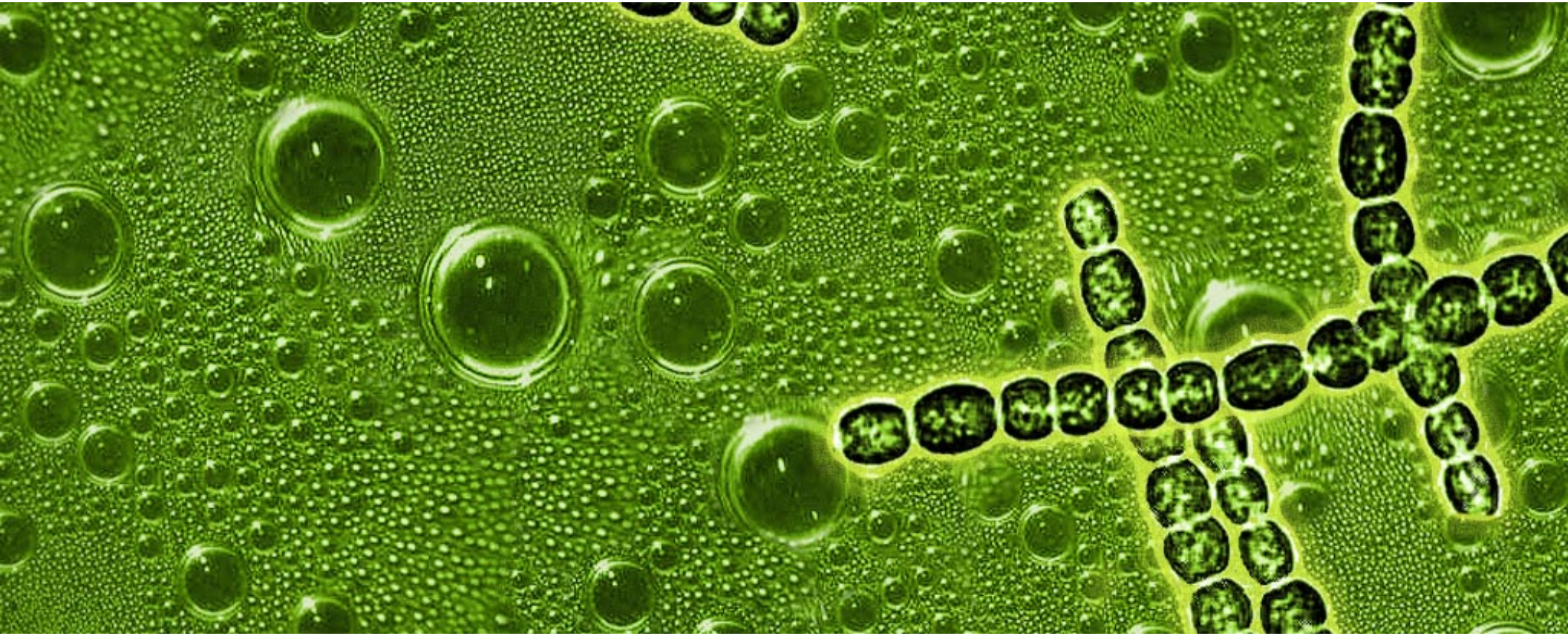
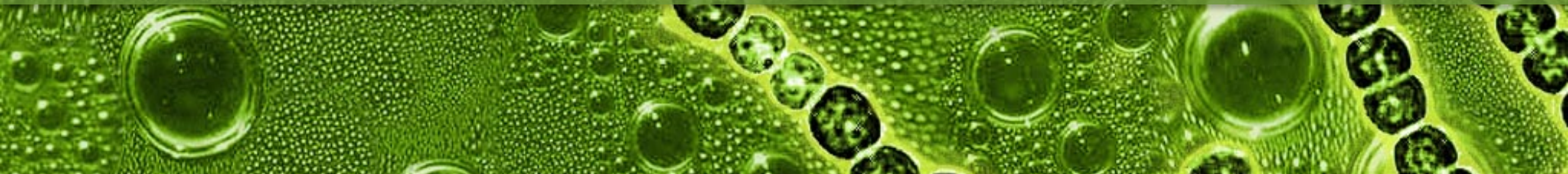


ALGENOL BIOFUELS

Harnessing the sun to fuel the world. ®

DOE Bioenergy Technologies Office - IBR Project Peer Review May 22, 2013

Ed Legere, Executive Vice President, Founder and Principle Investigator



Project Description

Algenol IBR Project Description

- Location: Southwest Florida Coast
  - IBR - Fort Myers, FL
  - Company Headquarters – Bonita Springs, FL
- Feedstocks
  - CO2 – Purchased from local supplier (Industrial grade)
  - Saltwater – Well on site and water from the Gulf of Mexico
  - Sunlight
- Conversion Technology – Direct to Ethanol®
  - Hybrid Algae – Metabolically enhanced cyanobacteria (blue-green algae)
    - Directly connecting photosynthetic (Calvin Cycle) sugar production with ethanol fermentation
- Product Purification
  - 1st stage – Proprietary Vapor Compression Steam Stripper (VCSS)
  - 2nd stage – Membrane
- Scale
  - Up to 2 tonnes CO2/Day
  - Up to 150,000 gallons fuel grade ethanol per year

IBR Overview

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- Site Specifics – Zoned Heavy Industrial/Chemical
  - 36 Acre site in Fort Myers
    - 28.5 acres for photobioreactors and access paths
    - 3.5 acres for buildings and process areas
      - 10,000 sq. ft. Lab and Plastics Shop
      - 11,000 sq. ft. Process Pavilion
    - 4 acres of water control ponds
  - Saltwater well – 50 gallon/minute supply and deep injection well
  - Water filtration - 50 gallon/minute capacity
  - Ozone system - 300 grams ozone per hour
  - Compressed air system - 100 HP – 430 CFM with dryer
  - Centrifuge system – high speed centrifuges & waste water filtration system
  - CO2 system –30 Ton tank with vaporizer (Being installed)
  - 500Kw Back-up generator

4

Algenol R&D Complex and IBR

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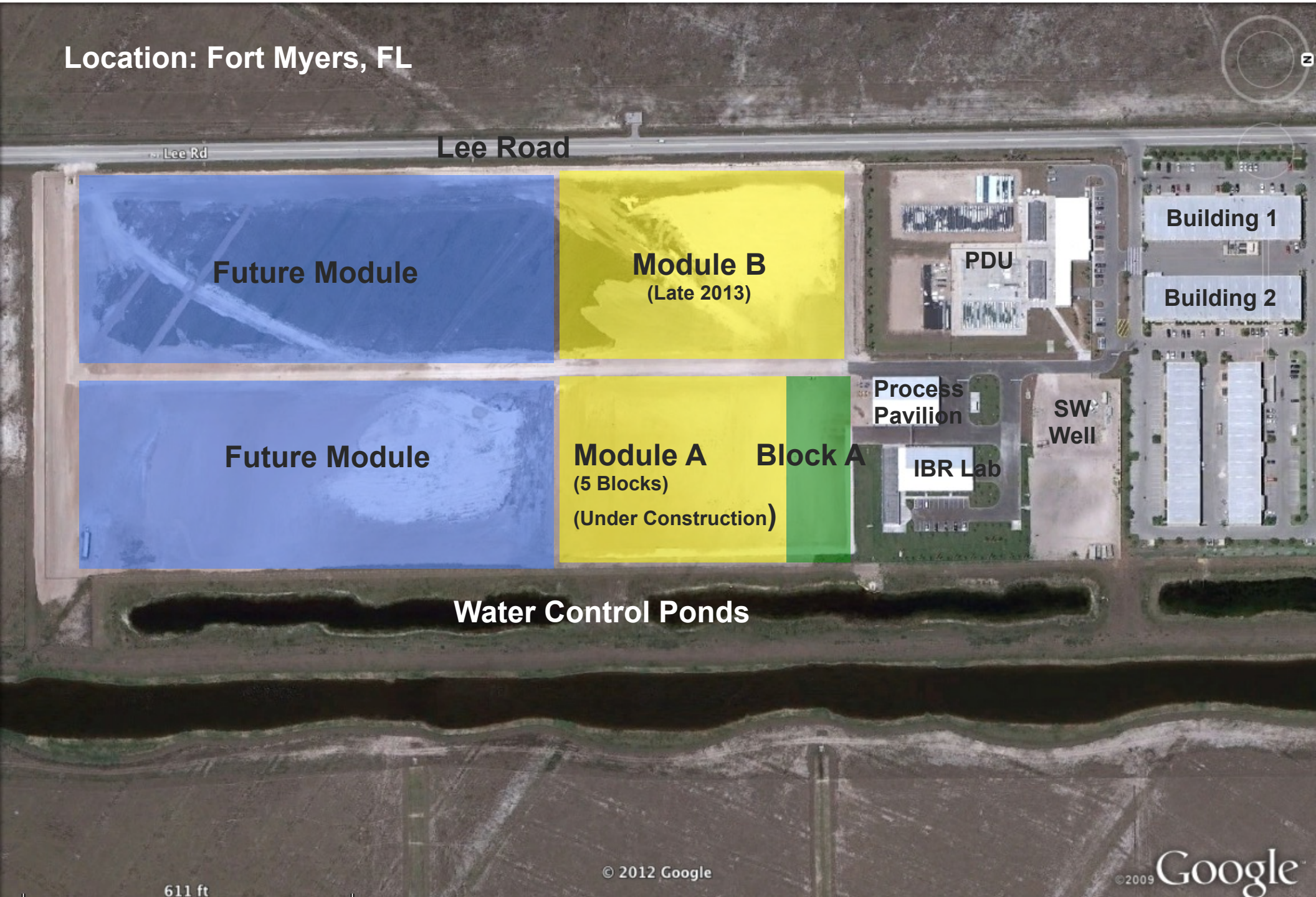

IBR Facilities

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IBR Facilities

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Quad Chart Overview

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Timeline

- Project Dates:
  - BP-1 start date: 01/2010
  - BP-2 start date: 08/2011
    - 67% Complete thru 05/2013
  - BP-3 start date: Target 01/2014

Project Development

- Project schedule is delayed due to change in project scope
- Costs are on track and being managed
- Project End Date: 12/2015

Budget

- Total Project Funding $47 million
  - DOE Share: $25 million
  - Algenol Share: $21.7 million
- Funding Received by Fiscal Year:
- FY10 $6.2m - FY11 $9.2m - FY12 $8.5m
- ARRA Funding: $24.3m

Project Participants

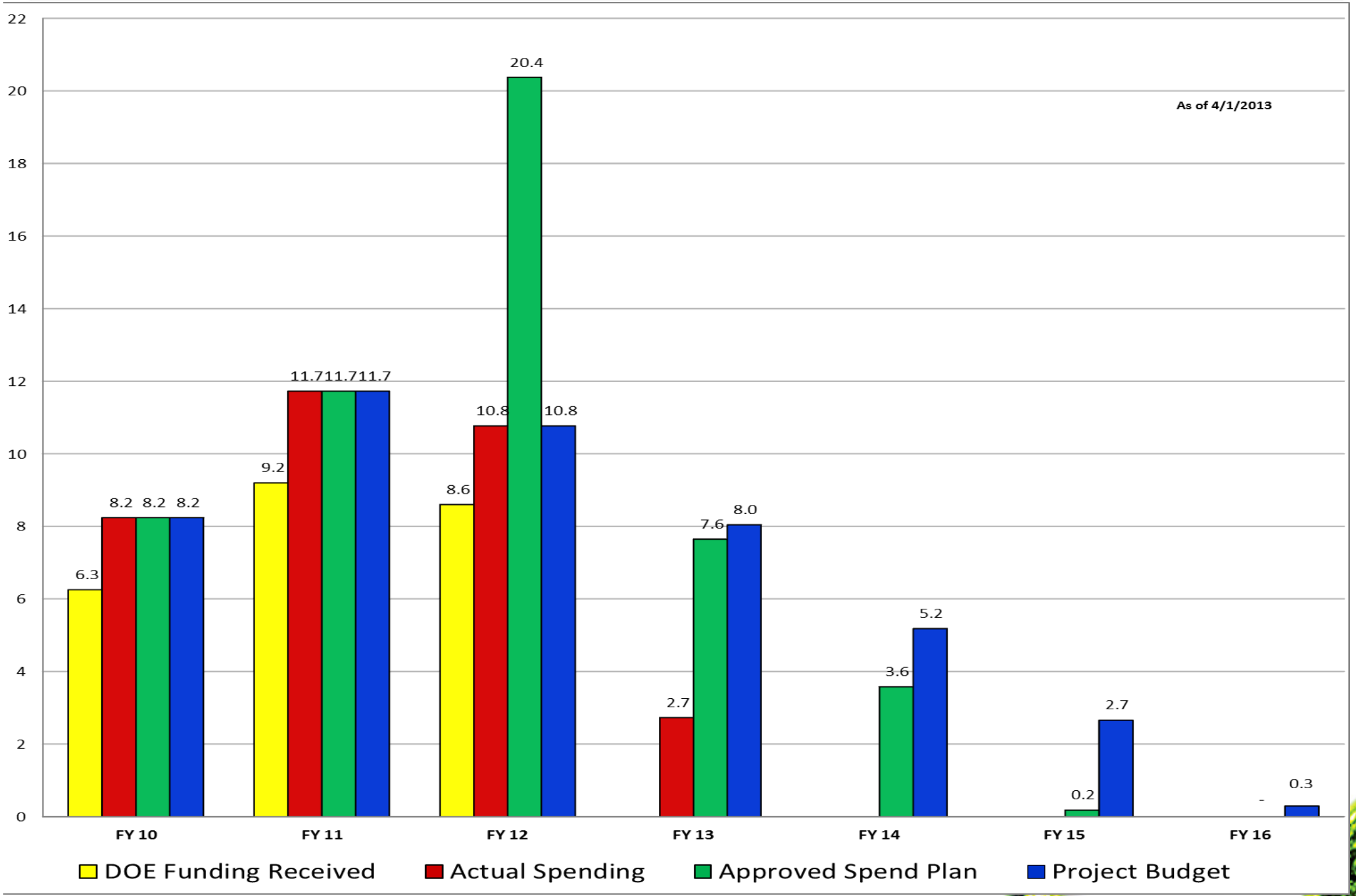
- Interactions/collaborations
- IP Licenses
- Project Management
- Construction Management
- Start-up and Commissioning
- Operations

Budget

ALGENOL BIOFUELS

Budget Area	US Dollars
Total Project Funding	DOE- $25,000,000 Algenol- $21,708,118 Contractor- $263,281
Funding Received	FY'10- $6,251,940 FY'11- $9,233,432 FY'12- $8,596,063
ARRA Funding	$24,331,431

Algenol Project Spend Plan



Project Overview

Project Timeline

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Project Phase	2010	2011	2012	2013	2014	2015
BP-1: Development/Design	BP-1 Start					
BP-2: IBR Construction & Shake-Down Runs			BP-2 Approved			
BP-2a: Construction						
Operations						
BP-2b: Shake-Down Run 1				Continue Operations		
BP-2c: Shake-Down Run 2				Continue Operations		
BP-2d: Shake-Down Run 3 & Reactor Expansion				Continue Operations		
BP-3: Optimize Operations					BP-3 Start	

Biggest Technical Hurdles Encountered

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- Ethanol productivity in cyanobacteria cell lines
  - Previous cell lines were easy to metabolically transform but they lacked the ability to endure outdoor culture conditions and remain highly productive (high heat, oxygen, light & ethanol)
    - Developed over 600 analogs of these cell lines
  - Current commercial cell line took over 3 years to transform
    - Producing at desired ethanol rates in same culture conditions
    - Newer analogs developed in a more compressed time frame are demonstrating higher ethanol productivity gains
      - Developed 15 analogs of this cell line to date
- Ethanol loss due to culture contamination by ethanol consuming bacteria
  - Robust CIP protocols developed to overcome problem
  - We have run cultures for +90 days without loss of ethanol
  - We have demonstrated these protocols at various scales
  - We demonstrate CIP at each new scale before moving to next scale
- 1st generation photobioreactor was not maximized to provide optimal culture conditions for our process

Did project baseline change?

- The project baseline was changed
  - Why?
  - Inability to hit productivity targets with prior photobioreactor system
  - Inability to hit outdoor productivity targets with prior algae cell lines
  - Inability to avoid ethanol decline due to insufficient CIP procedures

Did it involve re-scoping?

- The project was re-scoped to reduce risk and cost
- To reduce cost, the downstream processing equipment was resized
  - Instead of installing a VCSS and membrane system that can process 150,000 gallons/ethanol/year, we took our existing VCSS and upgraded its compressor, heat exchanger and stripper column to save ~$2 million
  - Downsized the membrane system to match the output of the VCSS
  - Downsized the photobioreactor field to match the VCSS output
- We are confident that we can de-risk project at this scale sufficient enough to move to demonstration scale

Project Management

Project Management

- Algenol's DOE program is managed using multi-functional project teams
- Internal Technical Committee (ITC) has overall project responsibility and authority
- Project teams have specific goals and objectives for each budget period that are approved by the ITC
- Goals and Objectives are reviewed bi-weekly and tracked monthly
- The Project is managed using a Gate Review Process for each budget period
  - The ITC reviews pre-specified goals for each budget period to determine if the project is ready to advance to the next stage.

ITC Roles and Responsibilities

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- Annual operating and capital equipment budget
  - Delegation of financial authority for program personnel
- Annual program operating plan
  - objectives for each project team
- Tracking performance:
  - actual expenditures against budget and forecast
  - accomplishments against program plans
- Change Control:
  - Review and approval of any proposed changes to budget or objectives
- Risk Management Plan Update and Approval
- Review and approval of any program reports or public statements about the Program

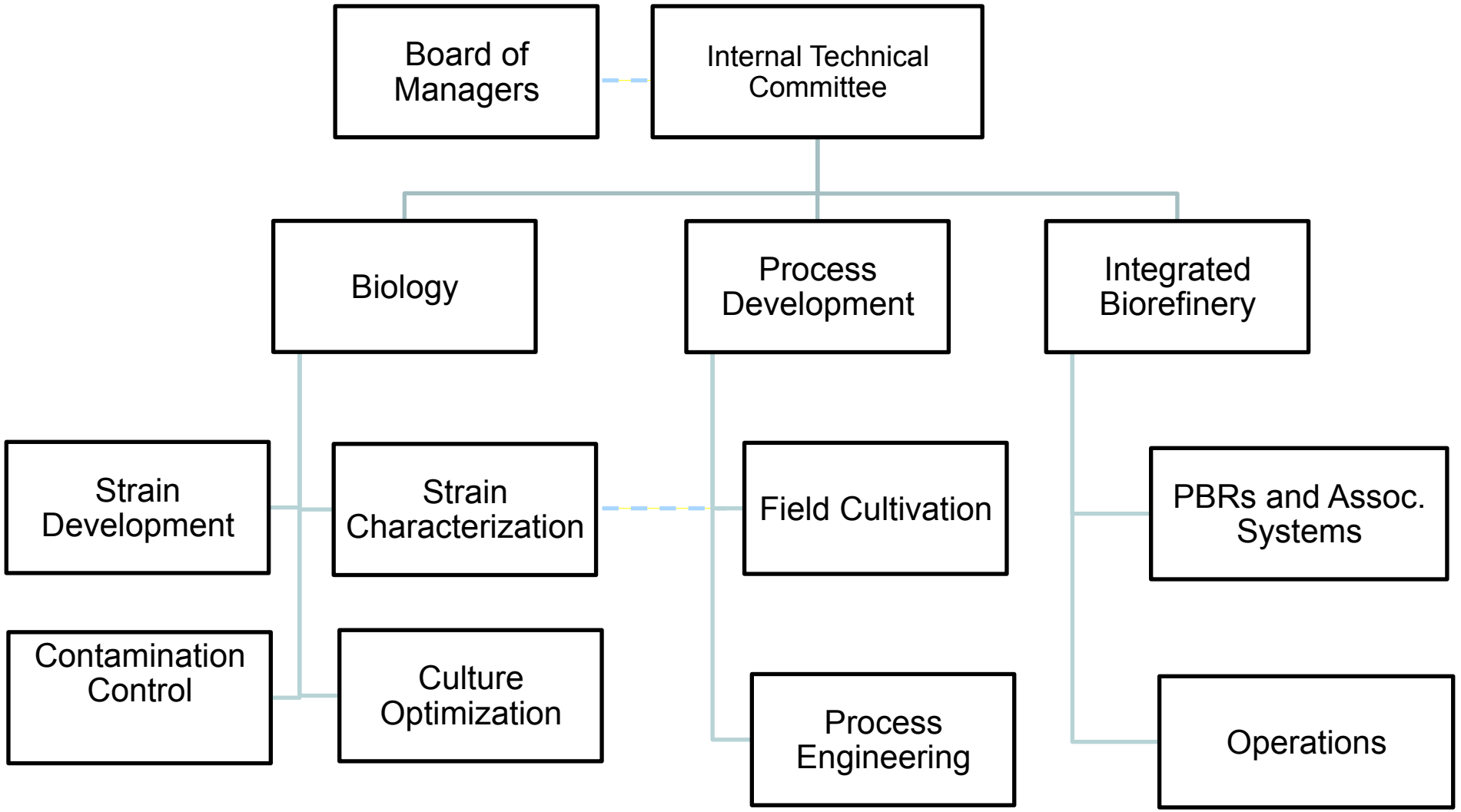
Management Approach

- The Algenol project is broken down into phases separated by evaluations at major decision points
  - Board and ITC reviews have been and will continue to be conducted at key project phases
  - Next gate review scheduled for 5/29/13
- Overall project and technology risk is managed by deploying the project in stepwise expansions and summarized in the risk management plan (RMP)
  - Technology is stepwise de-risked by modular deployment of capacity
  - Opportunity for demonstration of improved technology and yield in subsequent phases is assumed
- Industry and Field Leaders Chosen to leverage experience and ensure project success
  - Senior Management selected with extensive industry operation experience
  - Project Management Team selected with proven industry implementation

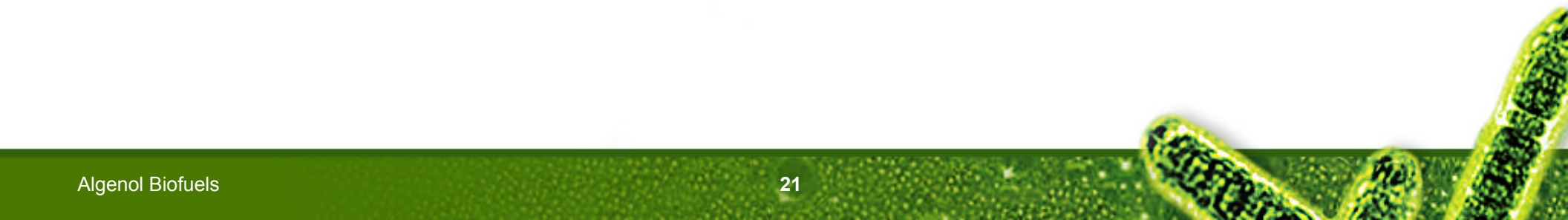
Management Approach

- All biological and mechanical components are extensively studied at laboratory scale
- Prototypes are constructed and performance tests conducted in specialized laboratory facilities
- Components are integrated and system tests are performed
- Components and systems are then tested under outdoor conditions to determine performance and reliability.
- Biological scale up
  - Lab scale indoors and commercial scale outdoors
- Engineering labs used for mechanical engineering, CO_2 capture, and separations technology scale-up and deployment
- Once validated outdoor at scale – transferred to IBR

Project Team Organization:



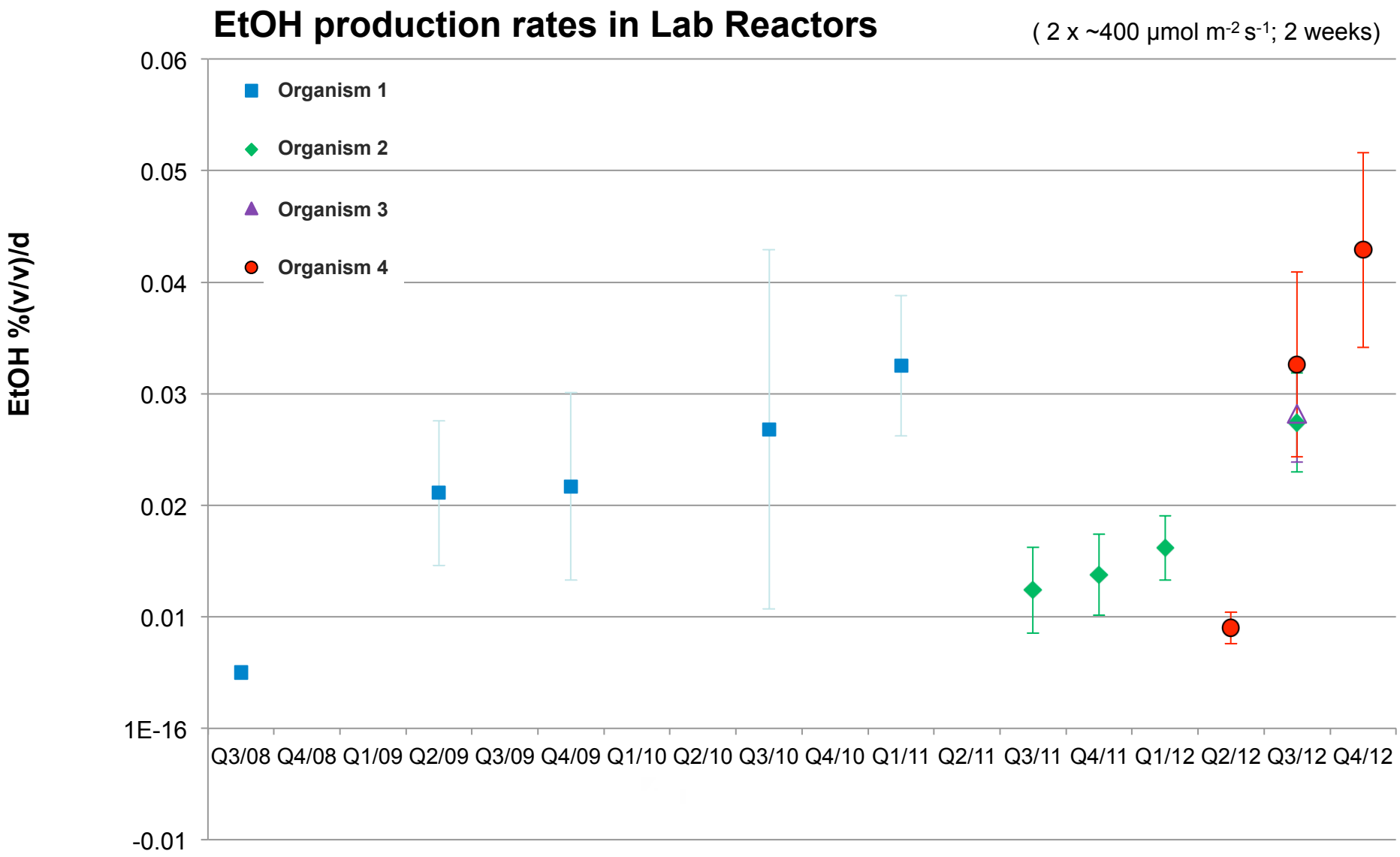
Technical Accomplishments/Progress/Results



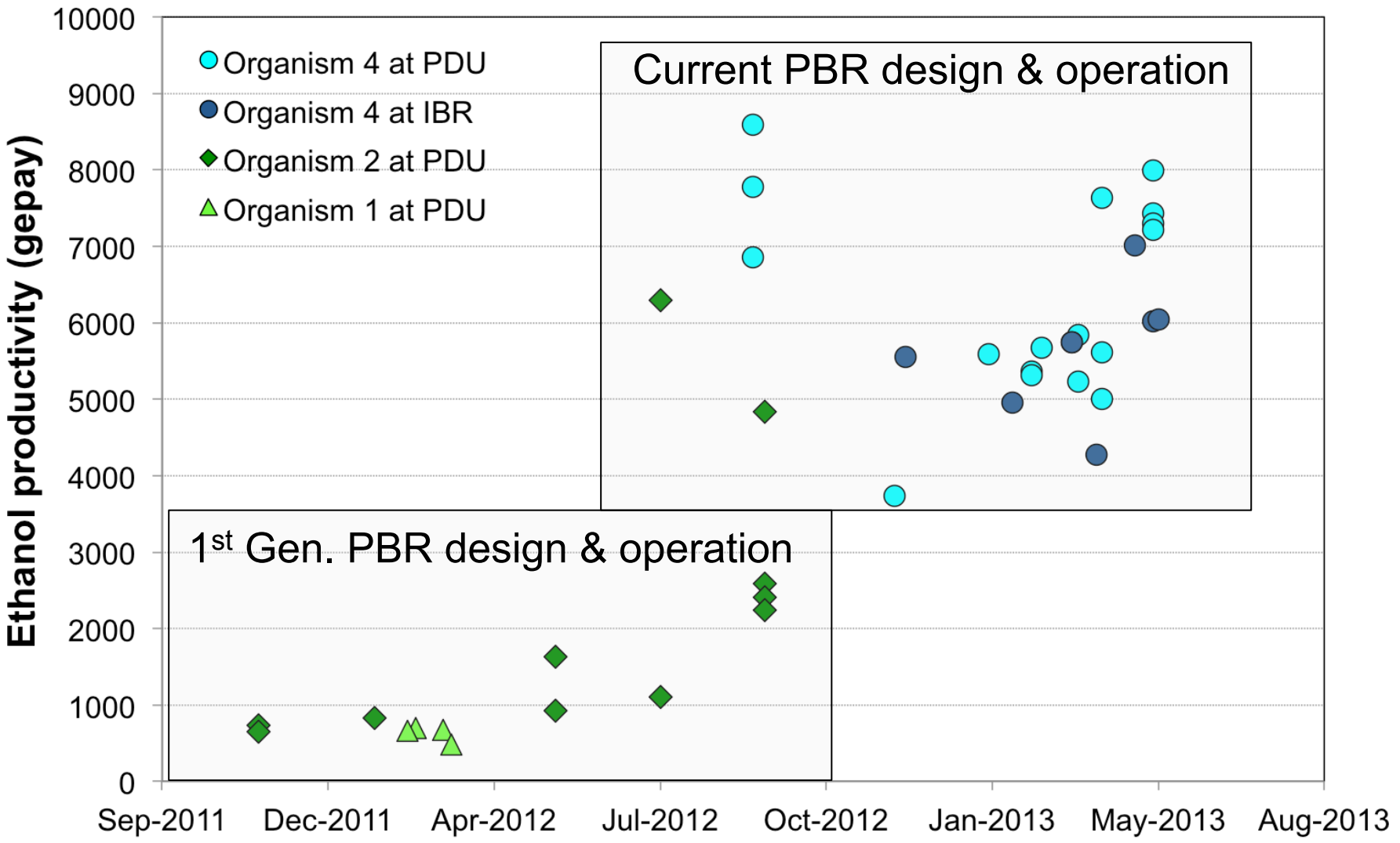
Significant Developments in 2012

- New, more robust platform algae strain
- New PBRs and operations overcame issues with 1st generation PBRs
- On multiple fronts Algenol rapidly progressed its quantitative understanding of the effects of multiple variables on carbon fixation and partitioning between ethanol and biomass
  - Light utilization
  - Oxygen levels
  - Temperature
  - Nutrients
  - Mixing
- This significant progress from our research programs led to a new program aimed at developing photobioreactors that would increase carbon fixation and partitioning to ethanol through:
  - Enhanced light utilization
  - Better gas management (O_2 removal and CO_2 delivery)
  - Reduced maximum temperature levels

Accelerating Ethanol Productivity Gains



Ethanol production in outdoor systems



Rates improved nearly 10 fold in mid 2012 with improvements in PBR design, operation, and with a new ethanologenic organism

Contamination Control

- Ethanol loss due to consumption by contaminants was a significant potential risk
  - In 2011, 2012 and 2013 we devoted significant resources to define and solve this problem
  - A complete research plan was developed and executed to evaluate various water sterilization techniques, photobioreactor clean in place protocols and sterile inoculation protocols
  - Research resulted in standard operating procedures that demonstrated success
- Robust protocols were developed and are tested at every scale prior to advancing to larger scale and/or block and module operations
  - These protocols have been implemented across the company
- We have demonstrated:
  - +90 days of photobioreactor operation without ethanol decline
  - At multiple scales and block sizes, we can run a block of photobioreactors for 30 days, drain it, clean it in place (CIP), fill with sterilized water, re-inoculate it and run it again for 30 days
- Research is being done to develop additional techniques and protocols
- All techniques and protocols are evaluated in the TEM to ensure viability for commercial use

Automated Photobioreactor Operations

- In previous research and development work, each photobioreactor had a dedicated control system
  - Mixing and CO2 injection was controlled using a computer that monitored multiple variables in each photobioreactor
  - Multiple probes were placed in each PBR monitoring different culture variables
  - The cost of these probes and control systems is too high to be used in a commercial setting with thousands of photobioreactors
- Algenol scientists have developed a control system that can control thousands of photobioreactors with one single low cost probe
  - This control system is in use at the IBR
  - We will continue to refine and optimize the control logic to increase ethanol production and lower operating and capital cost

Regulatory

- Algenol has obtained all necessary federal and state regulatory approvals to work outdoors at the IBR with preferred hybrid algae strains
  - Proactive and transparent dialogue is maintained with US EPA and USDA and the Florida Department of Agriculture's Division of Aquaculture, our primary regulators
- With the State, we designed and executed repeatedly, varied environmental studies that demonstrate that our hybrid algae are non-toxic, non-invasive and not plant pests
  - Hybrid algae strains deployed outdoors have been vetted by these studies and robust laboratory screening in order to receive approval
  - An advisory panel has been established with State regulators and their consultants to review these studies to determine if additional studies are required for commercial operations
  - We have operated in good standing state licensed aquaculture facilities since 2007
- In 2013, Algenol met with representatives from the US EPA to discuss the development of a clear regulatory path to licensing a commercial facility in Florida
  - Comprehensive information regarding preferred hybrid strains along with environmental testing results is currently being consolidated in order to file an MCAN
- Algenol is researching regulatory requirements in other States and will soon initiate outreach to discuss the process of licensing commercial facilities
  - Experiences in Florida will serve as a template for educating regulators about the technology and documenting its environmental safety

Relevance

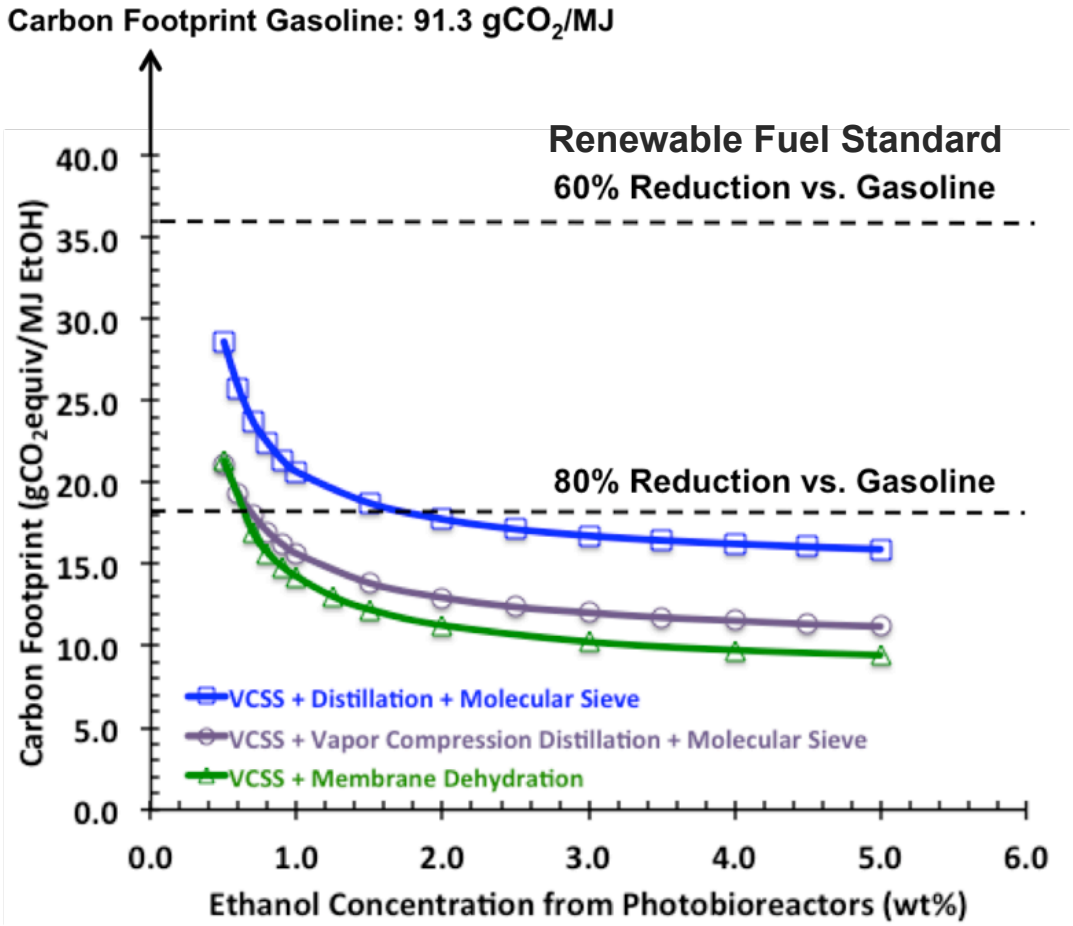
Relevance

- Importance of the DOE Biomass Program to nascent biofuels technologies
  - Attracting private capital
    - Development of biology based technologies is expensive, time consuming and very risky
    - Private capital sources look to leverage assets like the IBR to decrease risk, reduce the time to market and validate technologies
    - The IBR project was critical to Algenol's success in raising its last round of capital and will be even more important in raising subsequent capital
  - Encouraging the implementation of proper project management, risk mitigation, and stage gate processes to control and minimize risk
    - Small, entrepreneurial companies usually fail to implement these processes
    - These are proven strategies to de-risk technologies and minimize cost
- Detractors of this program should read the history of DOE funded projects
  - The most important energy technology breakthrough in the past 50 years was funded by the DOE over a period of more than 20 years
    - The DOE subsidized wildcatting engineer-entrepreneur George P. Mitchell to drill his first horizontal well
    - This led to the development of fracking technology
  - Fracking has led to the renaissance of the oil and gas industry in the United States, providing thousands of jobs and billions of dollars of revenue to American companies

Relevance

- Renewable Fuels Standard
  - The Renewable Fuels Standard (RFS) is critical for the near term survival of the biofuels industry
    - Ensures a market for biofuels produced from nascent technologies
    - Once nascent technologies reach the market, increase efficiency and lower costs, a tremendous amount of private capital will be deployed to bring these technologies into the mainstream to achieve and surpass RFS goals
    - Once critical mass of biofuels production has been achieved, the RFS will no longer be needed
- The IBR is critical to demonstrating the Direct to Ethanol technology works and demonstrate its commercial potential
  - The planned deployments of hybrid algae, photobioreactors, ethanol and biomass processing technologies will de-risk the technology sufficient to move to demonstration scale
- Based on the success of the IBR, Algenol is planning to build a 400 acre demonstration scale plant in 2015
  - 4 million gallon annual capacity
  - The demonstration sale plant in 2014 and 2015 will be built on a site that can be expanded to over 1,500 acres and 15 million gallons annual capacity
- Success at the demonstration scale will allow us to attract the private capital necessary to deploy at the +100 million gallon scale

LCA for Evaluating Carbon Footprint and Technology Options



Life Cycle Analysis Appears in: D. Luo, Z. Hu, D. Choi, V. Thomas, M. Realff, and R. Chance, Env. Sci. & Tech., 2010, 44 pp 8670–8677.

- LCA study is designed to be evergreen – continuously updated as part of our DOE project.
- *Renewable Fuel Standard is met in all scenarios studied.*
- LCA is important part of the evaluation of new technology options.
  - Example: Polymer membrane technology (MTR), in combination with Algenol's process simulations and integration concepts, yields lower carbon footprint, as well as lower CAPEX and OPEX.
  - Work on waste biomass disposition, to be performed at NREL, will be incorporated into LCA and techno-economic model.

This LCA is for our original PBR and ethanol processing plan. We have not updated the LCA to include our new PBR. We are certain Direct to Ethanol will meet the 60% reduction required by the RFS.

Critical Success Factors

Critical Success Factors

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- The primary driver for success is the annual ethanol productivity of the hybrid algae cell line
  - Many factors can affect the annual productivity rate
    - Ethanol synthesis by the hybrid algae cell line
    - Culture turnover times
    - Clean in Place operations time
    - Maintenance down time
    - Weather
  - Gains in annual productivity can be achieved by:
    - Increasing cell based productivity through metabolic engineering
    - Increasing culture run times
    - Decreasing down time
- Plant capital expenditures is a key driver for success
  - Capital expenditures are initially tied to ethanol productivity
  - Over time, capital expenditures decrease and ethanol productivity increases
- Plant operating expenditures is a key driver for success
  - Operating expenditures are tied to ethanol productivity
  - There are many avenues to decrease operating expenditures over time

Top Challenges Overcome

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- The biggest challenge overcome was transforming our current commercial hybrid algae cell line
  - The wild type strain exhibited all of the key characteristics we were looking for in a commercial strain
  - It took over three years to transform this cell line
    - Because we refused to give up, we were finally successful
    - Knowledge learned over the past six years of R&D helped to overcome key hurdles
- The second biggest challenge was developing a more advanced photobioreactor system
  - A multifunctional team was put together to develop a new photobioreactor system that could enhance light utilization, decrease oxygen levels, decrease culture temperature, provide nutrients, optimize low energy mixing, make CO2 delivery
  - In eleven months, Algenol developed and tested over 20 photobioreactor designs, thoroughly vetted the winning design and developed a manufacturing process to build it
- The third biggest challenge was overcoming ethanol decline due to contaminant bacteria
    - We developed protocols to sterilize seawater and the photobioreactors
    - We have successfully demonstrated our protocols at multiple scales

Risks Mitigated

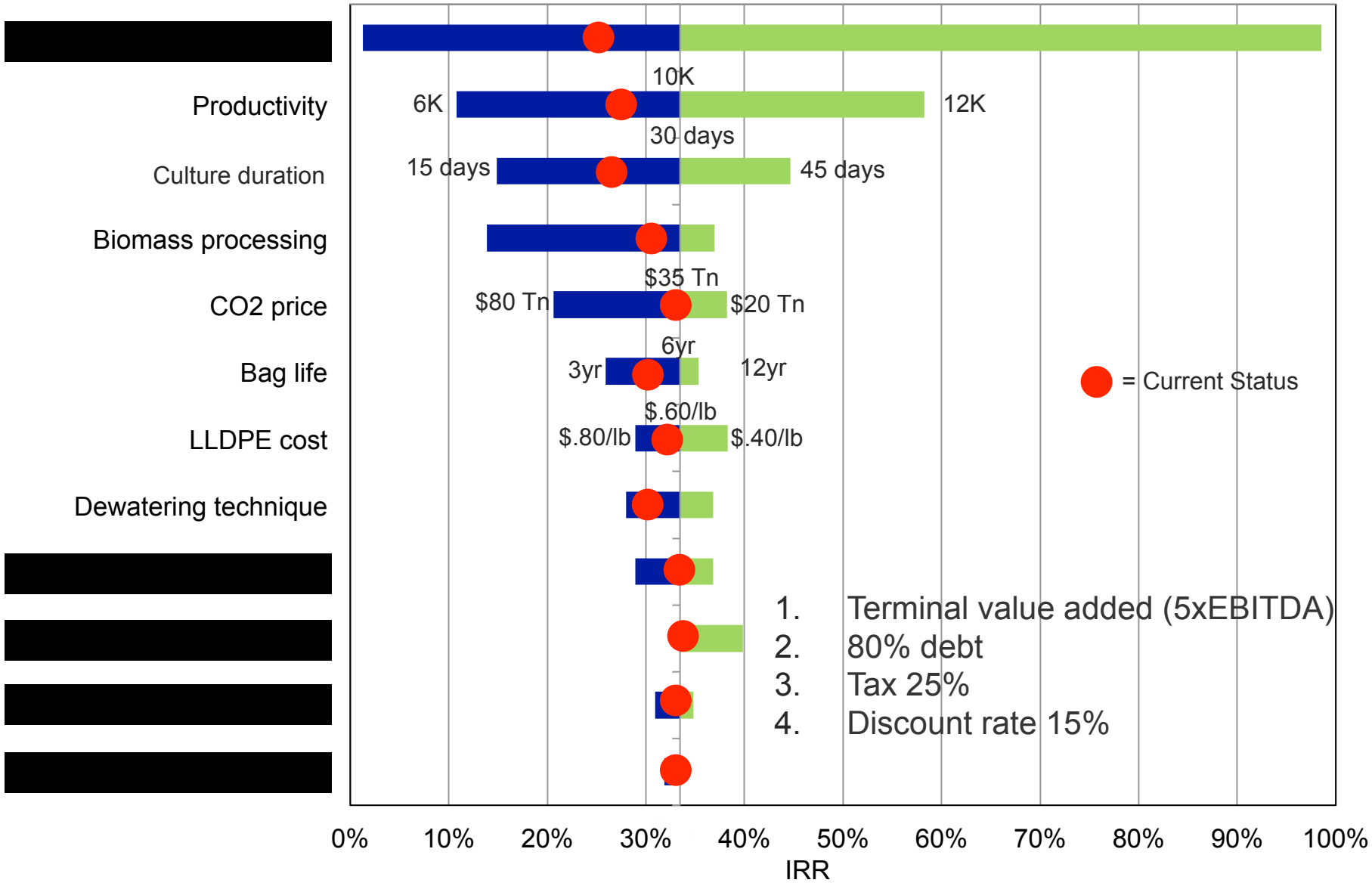
- Transforming our current commercial hybrid algae cell line
  - If we were not successful, the project would be in jeopardy
- Developing a more advanced photobioreactor system
  - If we were not successful, the project would be in jeopardy
- Overcoming ethanol decline due to contaminant bacteria
  - If we were not successful, the project would be in jeopardy

Top Future Risks

- Identifying a contract manufacturer for our photobioreactors at the next deployment stage
  - Volumes are too big to do in-house with current manufacturing technology
- Identifying a equipment manufacturer that can supply us equipment to manufacture the photobioreactors in-house
- Failure of ethanol purification equipment to perform as designed
  - VCSS has been operated before and met performance criteria
    - Changes in the equipment have not yet been tested
  - Membrane equipment is less likely to perform as designed
    - Greater operational experience with the design
- Major hurricane strike at our facility
  - A major hurricane would set back the project schedule and increase the cost

Benefits and Expected Outcomes

Economic Analysis – Commercial Targets



- Tornado Diagram at Commercial P50, IRR ~33%

Path to Commercialization

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Operating Plan Goals through 2015 Commercial Readiness

- 2013 – 6000 gepay, CAPEX ≤ $15/gal, OPEX ≤ $1.70/gal
- 2014 – 8000 gepay, CAPEX ≤ $11/gal, OPEX ≤ $1.35/gal
- 2015 – 10,000 gepay, CAPEX ≤ $9/gal, OPEX ≤ $1.20/gal

Technical Readiness Document

- Document has been completed with our strategic partners that is our road map for commercial deployment

Plan Forward

- Continue to use the TEM as a guidance tool for Research and Development
- Minimize CAPEX and OPEX
- Increase productivity from 9,300 peak to 10,000 gepay
- Refine culture management methodology
- Optimize PBRs
- Improve ethanol recovery and purification processes
- Validate bio-crude production technology

Future Work

Work Plan

- We will have a critical gate review on 5/29/2013
  - Move from block operations to module operations
  - 10x number of photobioreactors than current system
- Install VCSS and Membrane system for ethanol purification
  - June/July delivery for equipment
- Install 30 tonne CO2 tower
  - June/July delivery
- Install ethanol storage tank
  - September/October
- Integrate, start-up and shakedown all equipment
  - VCSS and Membrane system will be run in recycle mode for shakedown runs and should be fully operational for full operations of 1.8 acre scale production system
- Receive and test new algae separation technology
  - June-August
- Plan and execute next level module operations for 1.8 acre scale
  - End of 2013 Gate review
- Finish evaluation of biomass conversion for biocrude

Summary

Algae Biofuels are For Real!

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Algae Biofuels are not a pipe dream, and they are not 20 years off