# INEOS New Planet BioEnergy
# Indian River BioEnergy Center

## 2013 IBR Platform Peer Review

May 21, 2013

**Dan Cummings**
Vice President INEOS Bio
Director INEOS New Planet Bioenergy

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# Commercial Demonstration Facility (May 2013)

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# Vero Beach, Florida


- 8mmgal/yr cellulosic ethanol
- 6 MW gross power generated
- Vegetative, Agriculture & Yard Waste + MSW (4Q - 2013)
- 300 dry tpd used in facility
- 40 Acre Feedstock Site
- Thermochemical – Biochemical (Syngas-Fermentation)

# Quad Chart Overview

## Timeline

- Project start date
  - Budget Period 1 – 03/31/10
  - Budget Period 2 – 09/22/10
- Project end date
  - Mechanical Turnover 06/12
  - Commissioning 2H/12
  - Start-up 2Q/13
- 100% complete

## Budget

- Total project funding
  - DOE share: $50 m (38%)
  - Owner share: $82m (62%)
- Funding received by Fiscal Year

  '10 ($5.9m) '11 ($15.4m)

  '12 ($25.2m) '13 ($3.5m)
- ARRA Funding – 100%

## Project Development

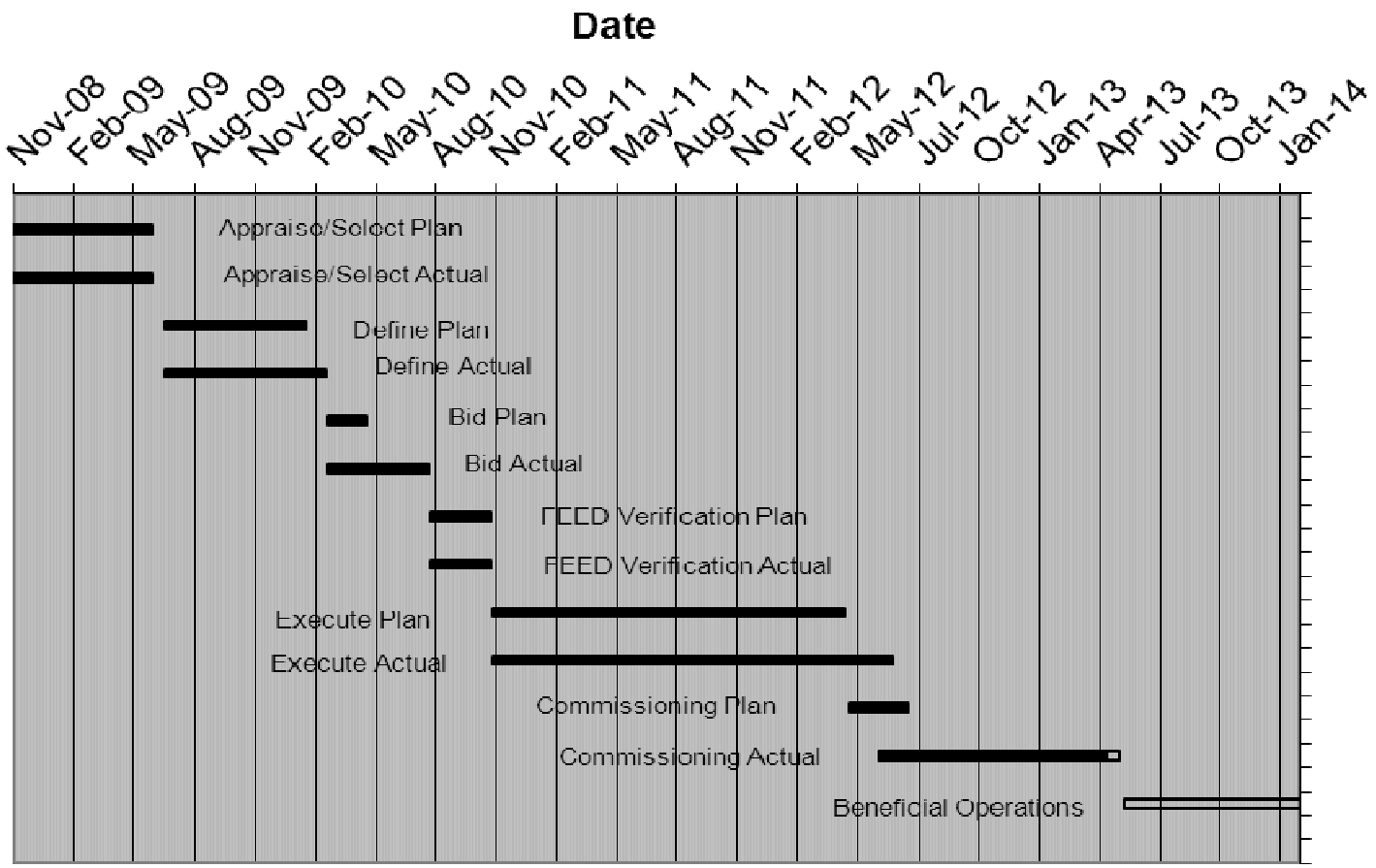
- Broke Ground – 2/2011
- Construction Completed – 06/2012
- Scope did not change
- Project completed under budget

## Project Participants

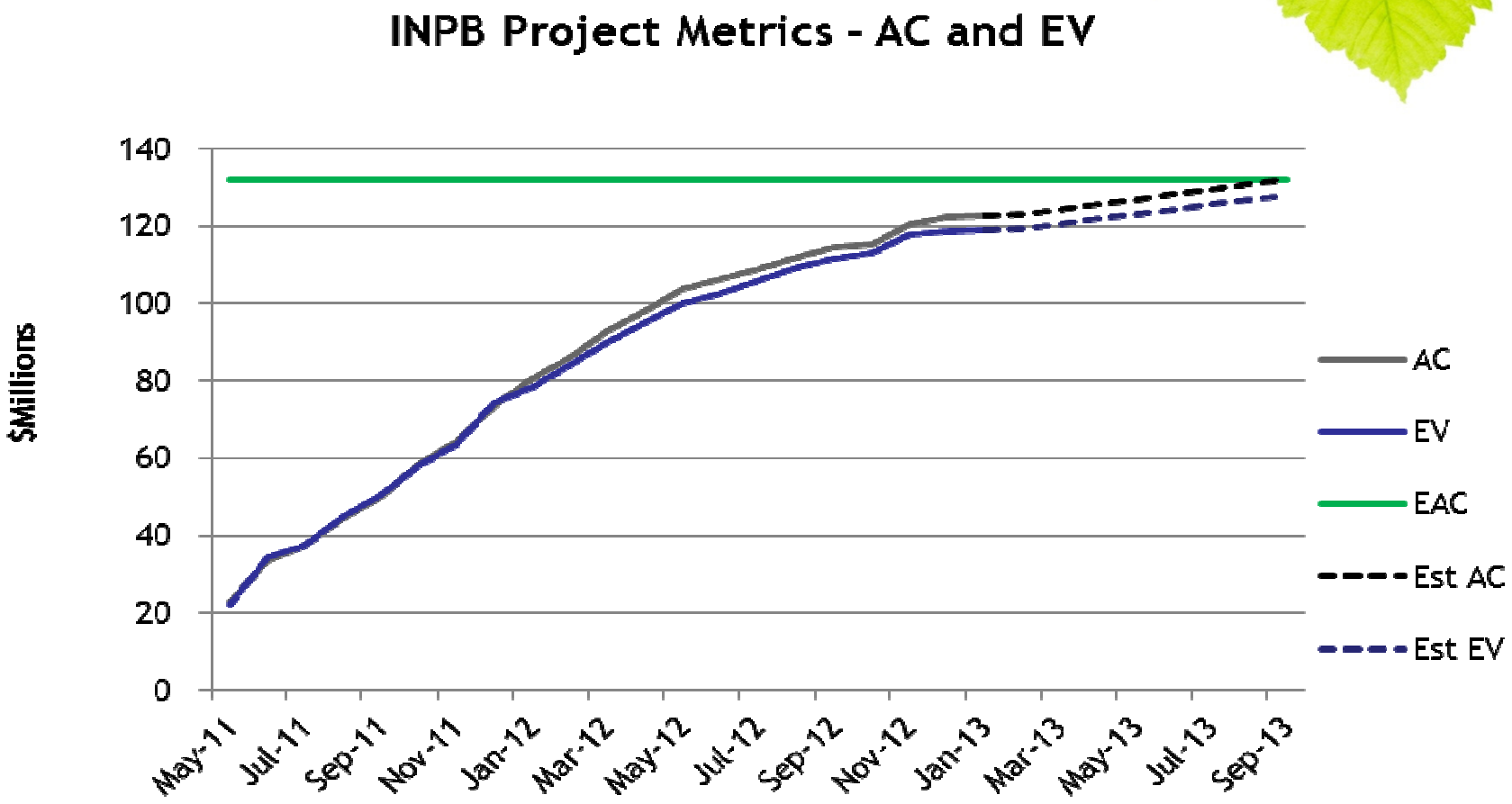
- INEOS Bio
  - Technology license
  - Overall project management
  - Start-up and commissioning
  - Operations
- New Planet Energy
- USDA
- AMEC
- CDM-Smith
- Air Products

# INPB Project History

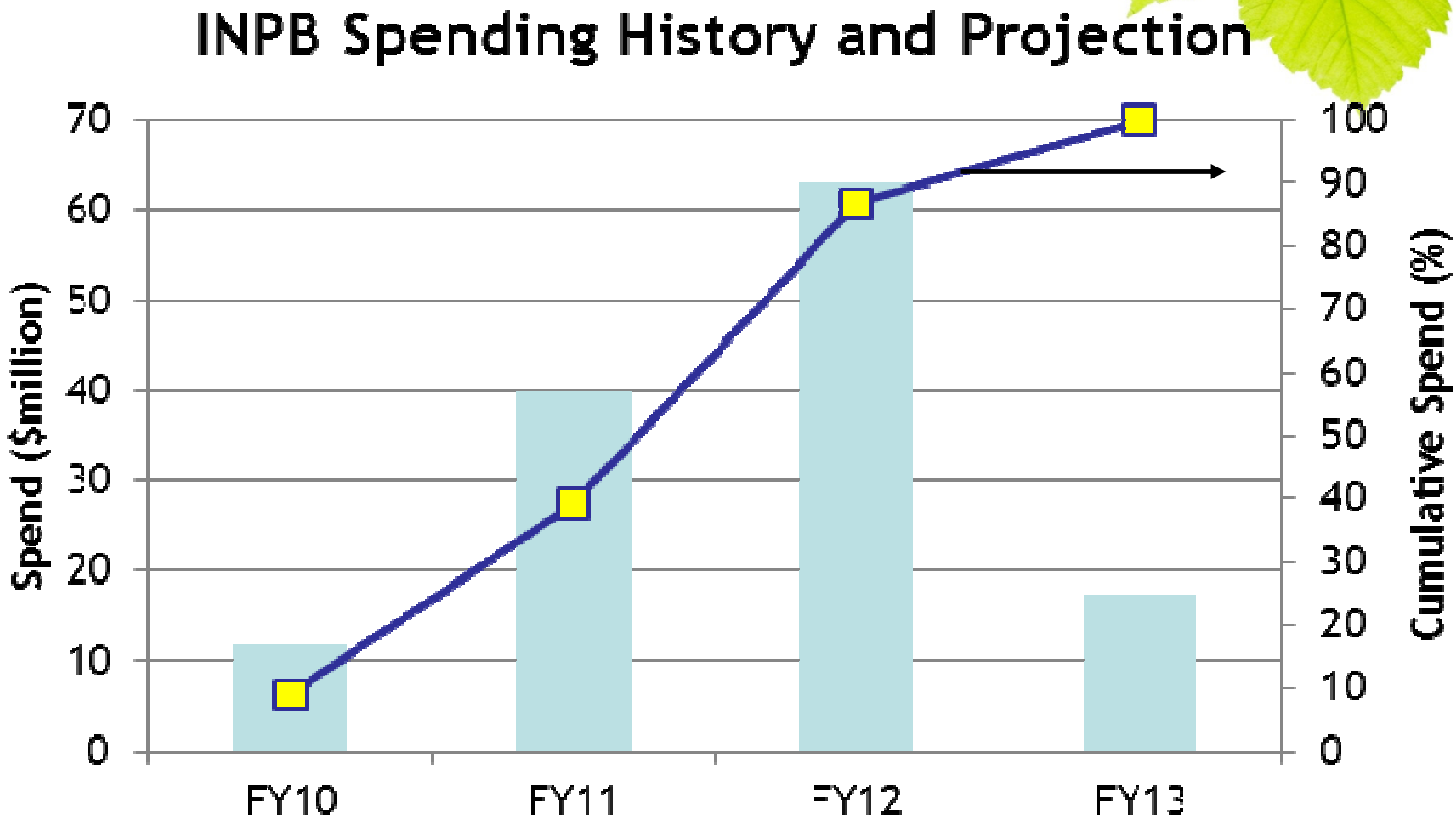
## INPB BioEthanol Project History



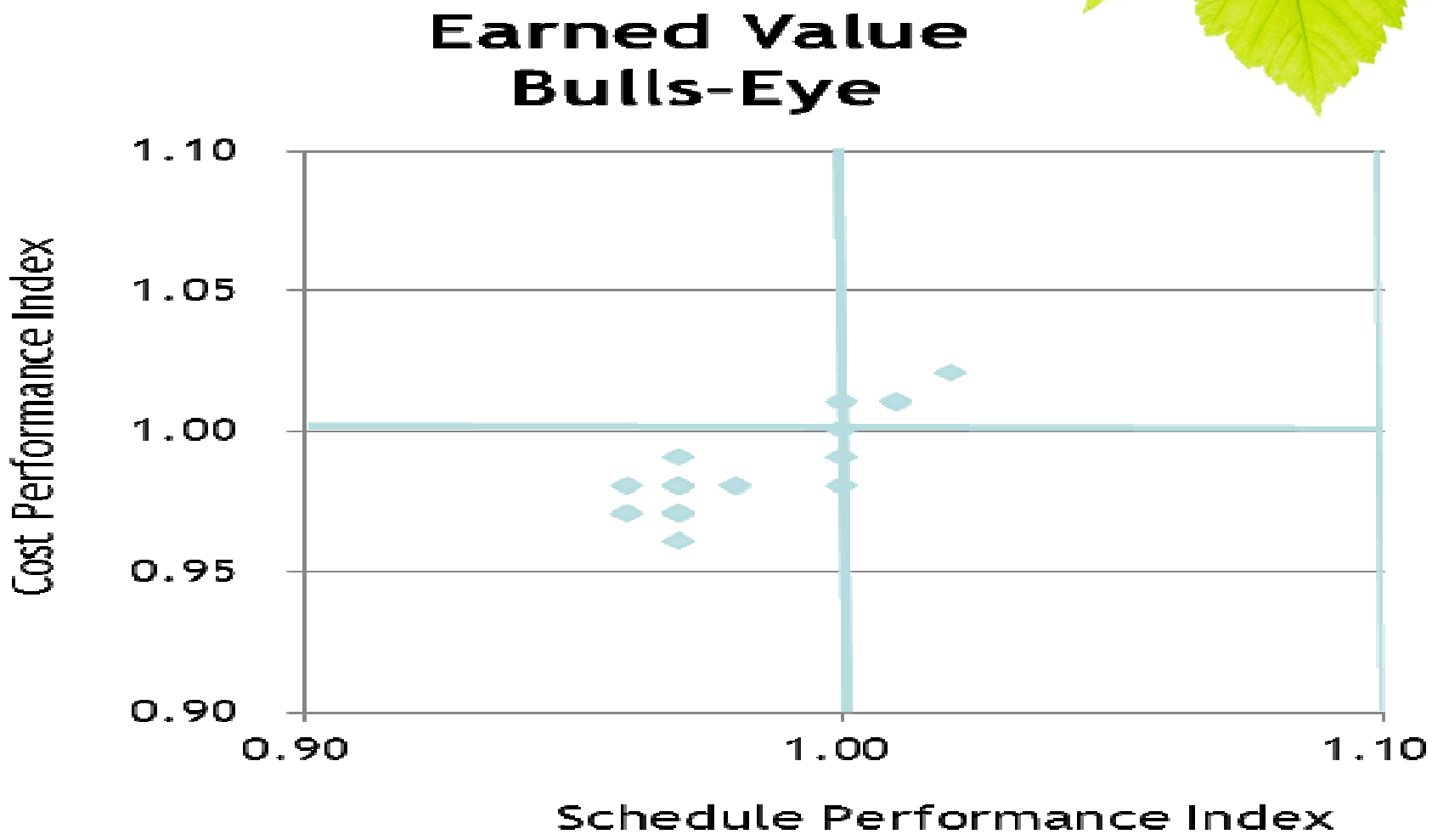
# INPB Project Metrics



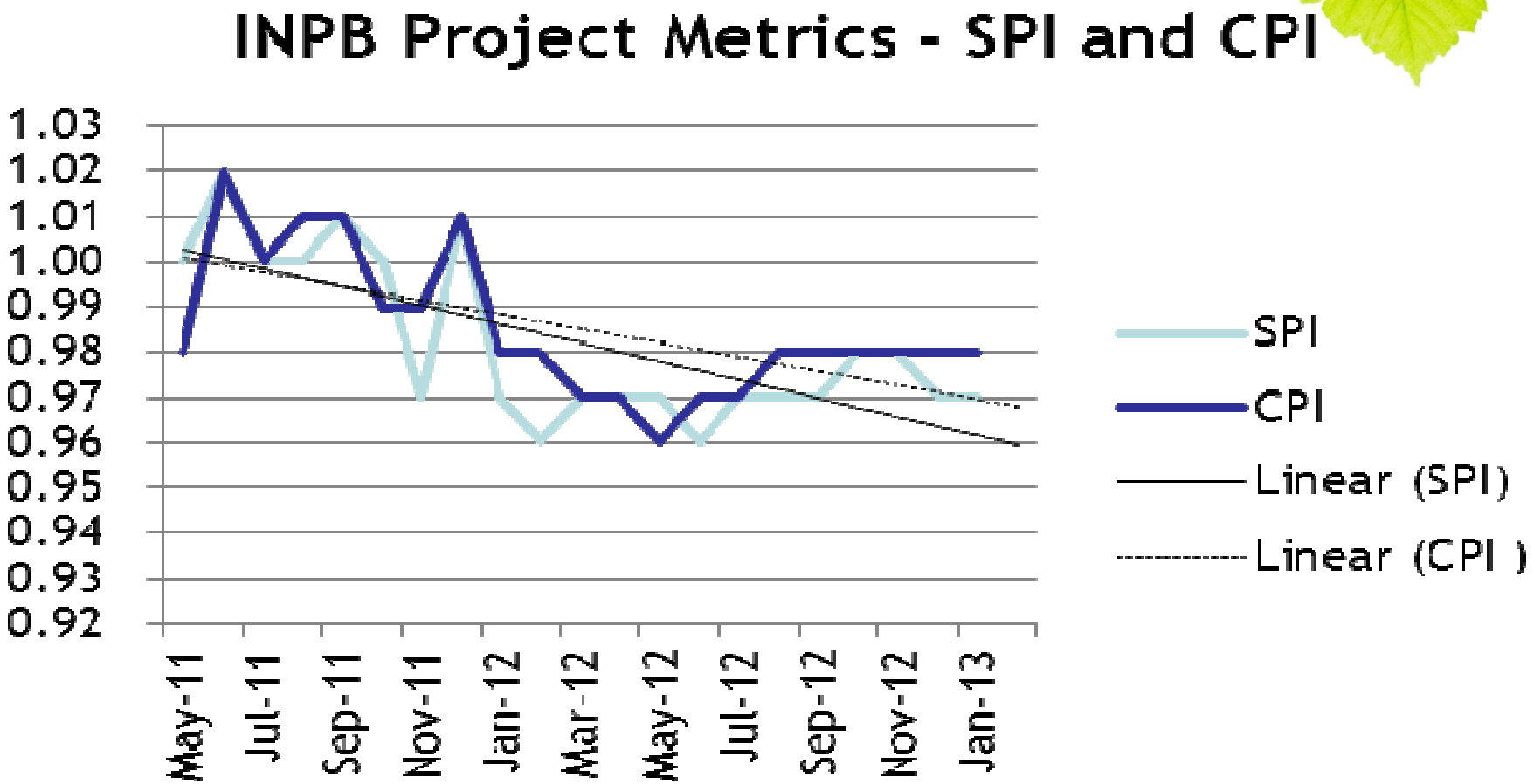
# INPB Spend History & Projection



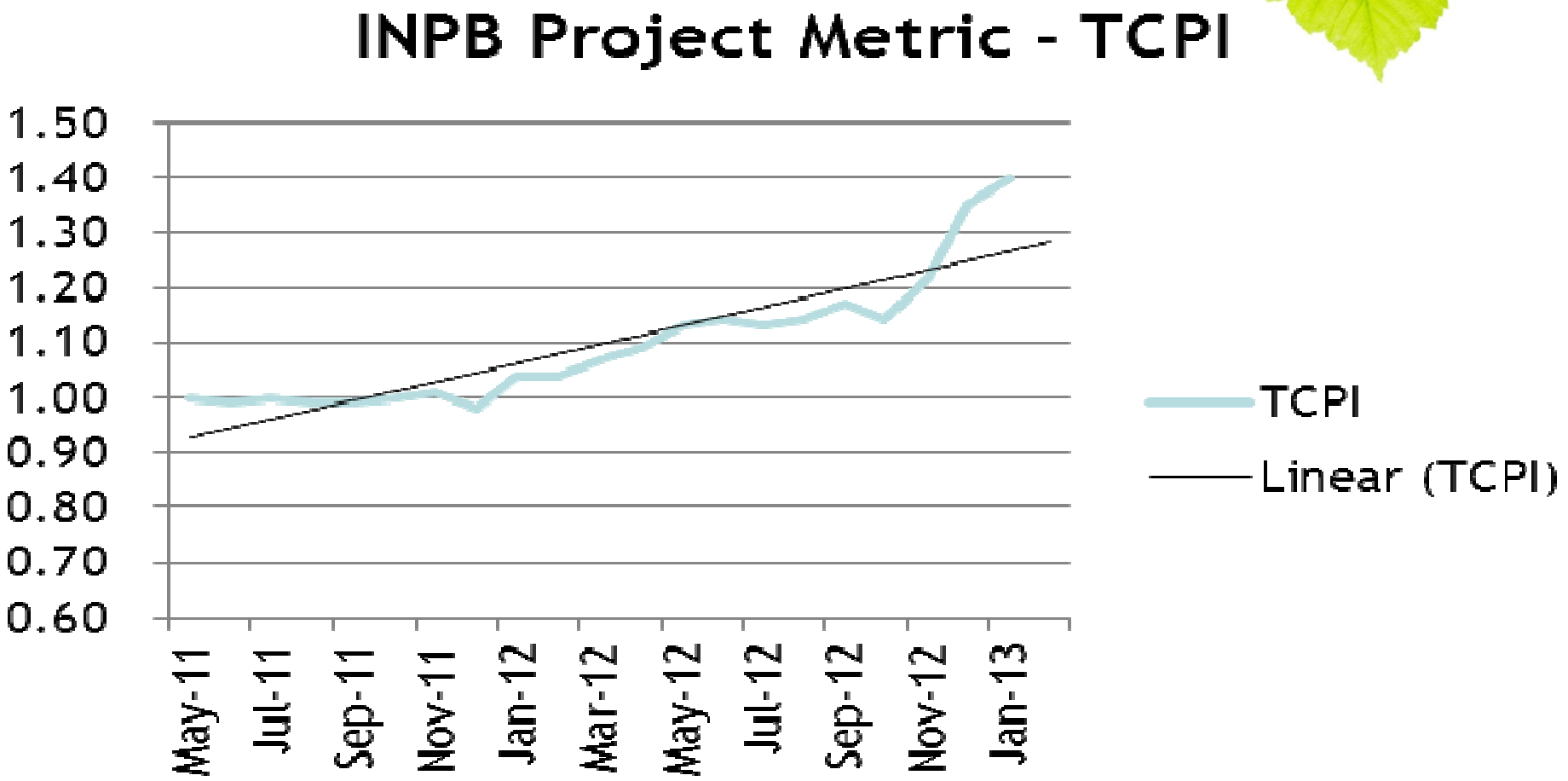
# INPB - Earned Value Bulls-Eye



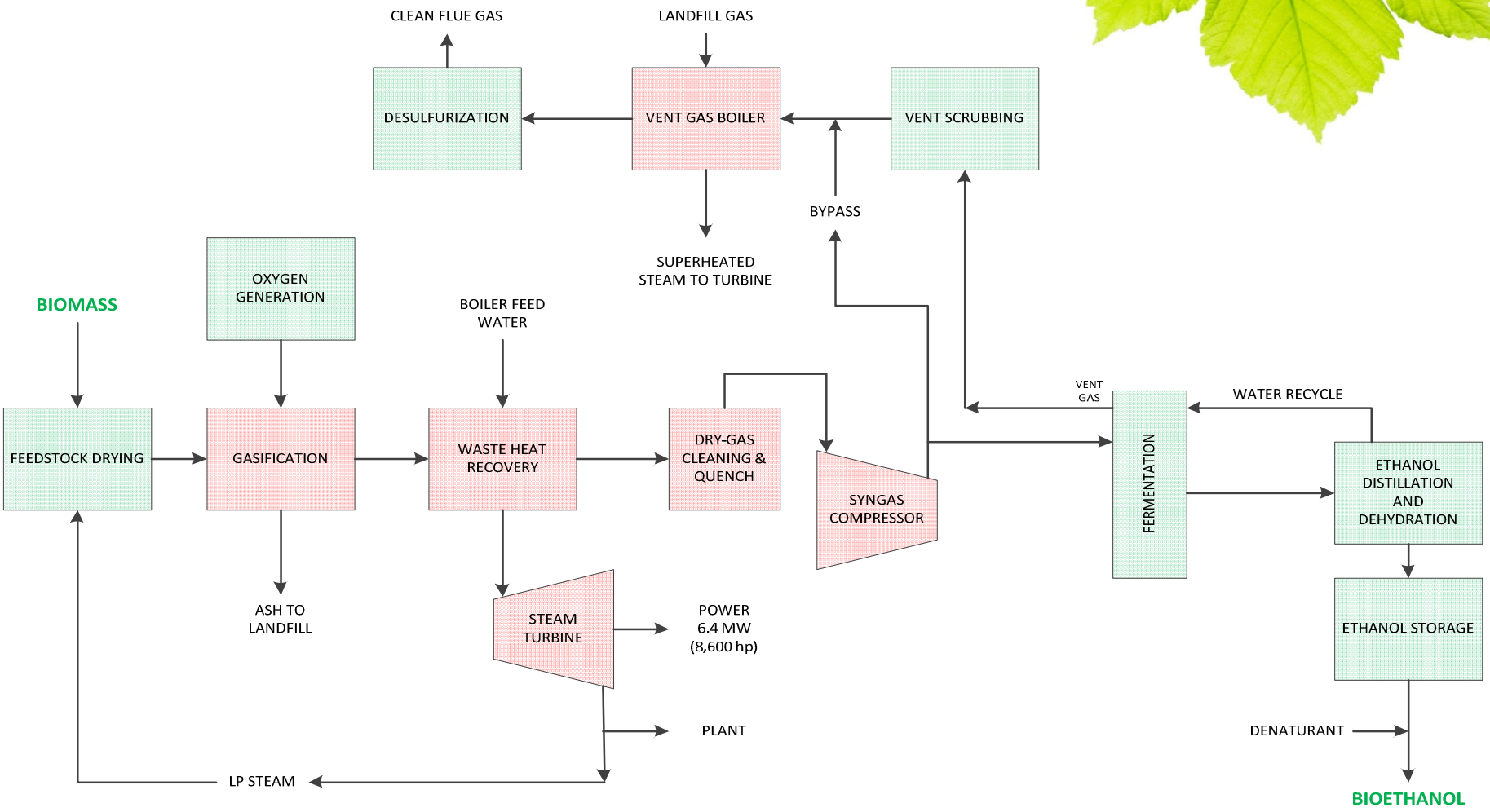
# INPB Project Metrics



# INPB Project Metric - TCPI



# Process Overview
# INEOS New Planet BioEnergy Center



# INEOS New Planet BioEnergy Commercial Demonstration Facility (May 2013)

# Key Process Steps

- Feed Reception/Drying
  - Biomass material is delivered to site, stored and dried for processing;
- Gasifier
  - Biomass is converted to CO & H2 (syngas);
  - Syngas is cooled and cleaned up in preparation for fermentation;
- Heat Recovery
  - Hot syngas is cooled & recovered to generate renewable power and for use in distillation and drying of feedstock;
- Fermentation
  - Cooled syngas is fed to proprietary micro organism. Biochemical synthesis occurs at low temperature and pressure and at high yield and selectivity. A continuous process;
- Power Generation
  - Power is generated by recovering heat from hot syngas and by combusting vent gas from the fermentation stage and landfill gas from the nearby landfill;
- Distillation/Dehydration
  - Fermenter liquid is continuously extracted, distilled and dried to meet ASTM anhydrous specification to recover 8 million gal/yr of ethanol;

# Vero Beach Feedstock and Gasifiers

# Key Technical Barriers

Project addressed the following technical barriers:

- Feedstock receiving and preparation
  - Processing control to minimize loss of material
  - Bio-drying to reduce moisture
  - Movement of material to storage and gasifier
  - Weighing and flow control of material
- Biomass gasification
  - Ability and experience in running a variety of heterogeneous feedstocks through gasification at full commercial scale

These have been achieved

# Key Technical Barriers

- Fundamental process scale up issues
  - From  integrated pilot plant to full commercial scale
- In particular technical issues addressed in gasification and fermentation
  - Design validation data was provided by integrated pilot plant operation

These were key success factors

# Project Management Approach

- This project has been managed using a five-stage capital project management process
  - Appraise, Select, Define, Execute and Operate stages;
- Appraise
  - Utilized extensive integrated pilot plant data (40,000+ hours) to define comprehensive material and energy balances for each unit operation;
- Select
  - Utilized focused pilot plant trials, some with vendor support, and extensive EPC contractor expertise to select specific equipment that minimized capital while mitigating risk;

# Project Management Approach

- Define
  - Utilized site specific feedstock in pilot trials and extensive EPC contractor expertise to optimize the process design, plant layout and equipment vendor selection with a key focus on final definition to minimize any changes in Execute;
- Execute
  - Detailed design and construction was completed in 20 months – an excellent outcome for a project of this type and complexity;

# Technical Accomplishments
# Progress & Results

- Detailed design completed, project bid, AMEC signed as EPC contractor;
- Key Milestone achieved breaking ground and construction of core plant in 15 months – Feb 2011 – June 2012;
- Project constructed on schedule and under budget;
- 1,000,000 work hours on project – zero classified reportable injuries
- OSHA Classified Rate for project of 0.201/100,000 hrs

# Technical Accomplishments
# Progress & Results

- All Federal, State & local permits received;
- EPA pathway approved under RFS II;
- Generation of Renewable Power began in 9/2012 and export of excess power to the FL grid;
- Commissioning of core plant complete;
- Moving into BioEthanol production;
- Performance Test scheduled for mid 2013;

# Relevance - Carbon Neutral Advanced Biofuel from Waste

| **Waste to bioethanol with INEOS Bio Technology** | **GHG Saving vs. Gasoline** |
|---|---|
| Vegetative Waste | 120% |
| Post-recycled Municipal Solid Waste | 80 - 90% |
| Waste wood | 125% |
| 50:50 Garden & Food Waste | 110% |
| **Indian River Bioenergy Center expectation** | **105%** |

- GHG savings exceeds RFS2 threshold target of 60%
- One gallon saves ~5 pounds of $CO_2$ *vs.* gasoline

# Relevance - Meeting Key Societal Challenges and Market Needs

## World-scale biorefineries

### Utilize INEOS BioEnergy Technology

- Low cost, carbon neutral advanced biofuel for use in today's cars
- Local waste to fuel & power for local use
- Robust, reliable & safe
- Market ready

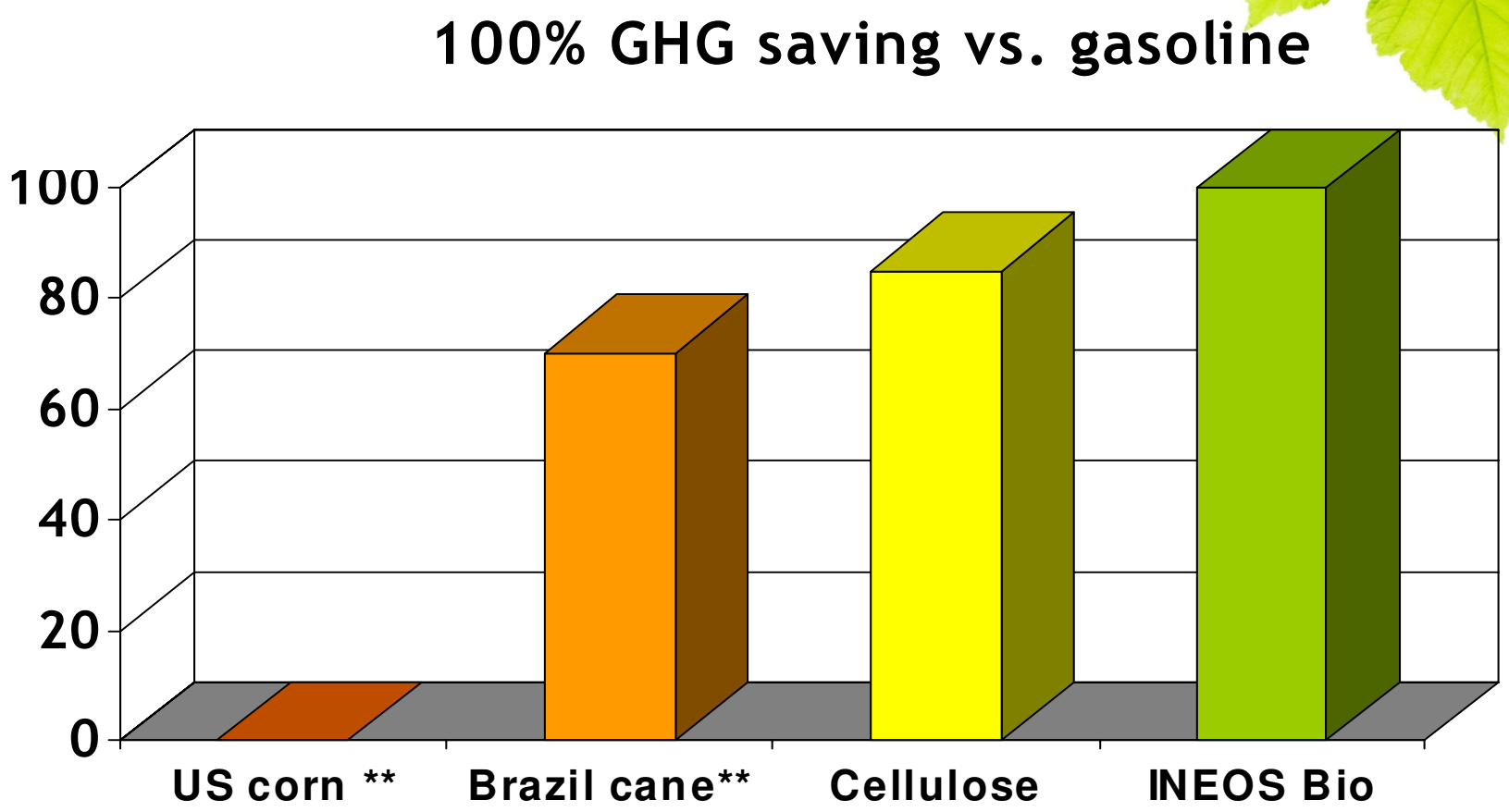
### Meet Society's Emerging Challenges

- Climate change
- Efficient use of waste
- Energy independence
- Energy diversity
- Job creation
- Wealth creation

### Respond to Market Drivers

- Landfill diversion
- Recycling targets
- Energy demand
  - Cellulosic ethanol
  - Renewable power

# Life Cycle Analysis




Independent studies by Eunomia

# Economic Benefits

- Total Jobs – over 400 created & retained
  - 10 States (NY, OH, TX, IL, AR, NC, GA, etc)
- 90% of equipment – U.S. Sourced
- Millions of Dollars into the U.S. Economy
  - Engineering, Equipment, Construction, etc.
  - Use of local subcontractors
- 63 Full time jobs (2/3 from local area)
- Waste Conversion Solution for Community
  - Helping Counties meet 3R's – Reduce, Reuse, Recycle
  - Local source for Agricultural waste solution
- Local Bioenergy (fuel + power) into economy

# Critical Success Factors

*Commercial Viability:* Key factors include overall process reliability and yield;

*Challenges:*

- Demonstrating feedstock flexibility. A substantial body of work has gone into developing and testing methodologies for processing a variety of heterogeneous feedstocks that we have successfully gasified;
- Significant issues resolved around gasifier scale up from 1.5 tpd to over 150 tons per day per unit. High quality syngas now produced reliably;

# Critical Success Factors Continued

Risk Management Examples:

- Coordination of detailed engineering delivery to keep field work progressing to schedule in construction was a challenge;
- Materials of construction issues cropped up early in commissioning that were resolved as part of corrective engineering program;

# Critical Success Factors Continued

Top Risks:

- Project is complete and is commissioned. Operational learnings and process design optimization are the current focus of our efforts;
- Use of integrated pilot plant data considered critical to project success. This pilot plant and research team provided the majority of technical risk mitigation throughout the project;

# Critical Success Factors Continued

Risk Mitigation

- Use of large, experienced EPC Contractor (AMEC);
- Well known & proven equipment providers
  - Vogelbusch, Emerson, Air Products
- Use of IPA process for feedback to project;
- Utilization of Engineering "Bench" from INEOS – leveraged global pool of engineering expertise;
- Experienced Team in Project Design, Execution, Commissioning & Start-up;

# Future Work

- Final Start-up & Production of Cellulosic Ethanol – 2Q 2013
- Optimize systems & de-bottleneck – 2013-2014
- Performance Test – Mid 2013
- Full Production – 3Q/4Q 2013
- Run MSW Feedstock at full commercial scale – 4Q 2013
- Run other feedstocks at Commercial Scale – 2014 & beyond

# MSW/RDF Type Material To Be Run in 2013

# Indian River BioEnergy Center Summary

- World-class technology built in record time, safely, and under budget;
- Use of Integrated Pilot Plant facility in design, optimization, and scale-up – including continued use in further plant optimization & gaining knowledge during commissioning;
- Mitigated risk through experienced team and well-known constructors and equipment providers;

# Indian River BioEnergy Center Summary

- Designed for wide range of waste conversion applications and available wastes;
- Ability to replicate & rapidly deploy to meet goals of the FOA and IBR Program;
- Will complete Core Components of FOA in 2013;
- Awarded “Best Hybrid Project”
  - Biofuels Digest – 2012;

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