Great Valley
ENERGY

Fractionated Sweet Sorghum to Biofuels and Products

California Energy Commission Workshop
Advanced Ethanol Production in California
August 2012

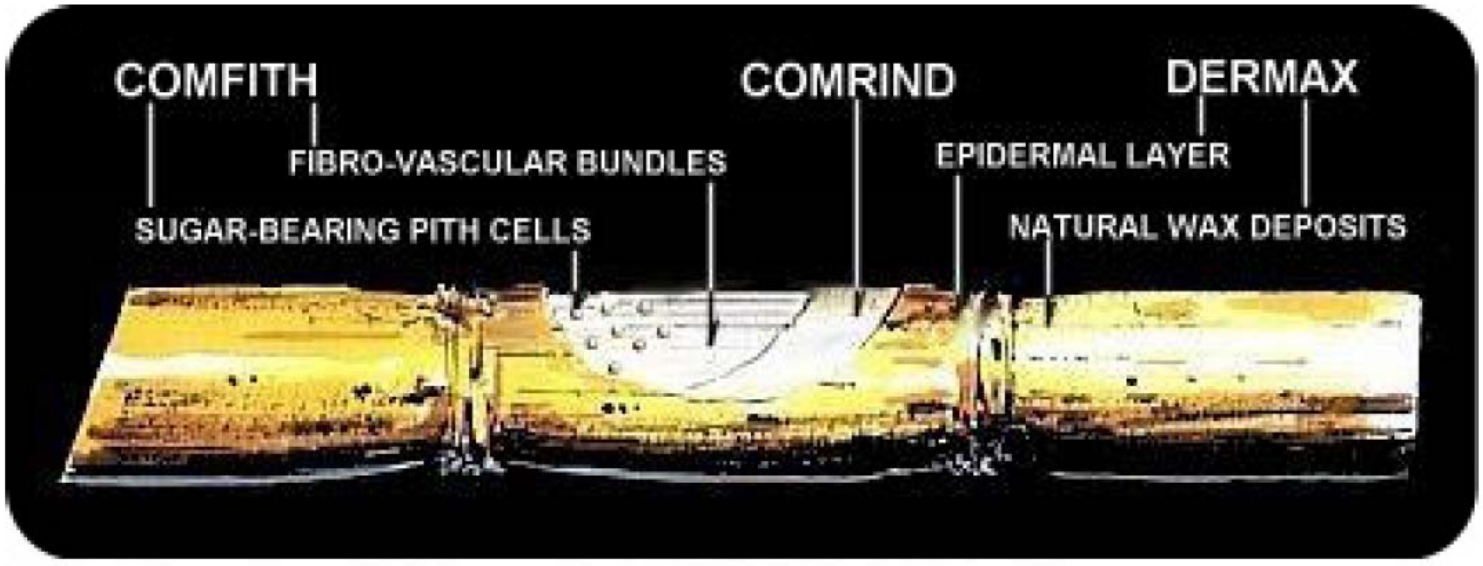
Advanced Biofuels Using Sweet Sorghum

- EPA-Designated Advanced Biofuel
- Grows well in U.S. (for centuries) and in the San Joaquin Valley
- Tolerant of drought and marginal soils
- More efficient plant than sugar cane, fast growing
- Provides sugar, starch and cellulose
- Lots of biomass per acre, will grow back after cutting

Great Valley ENERGY

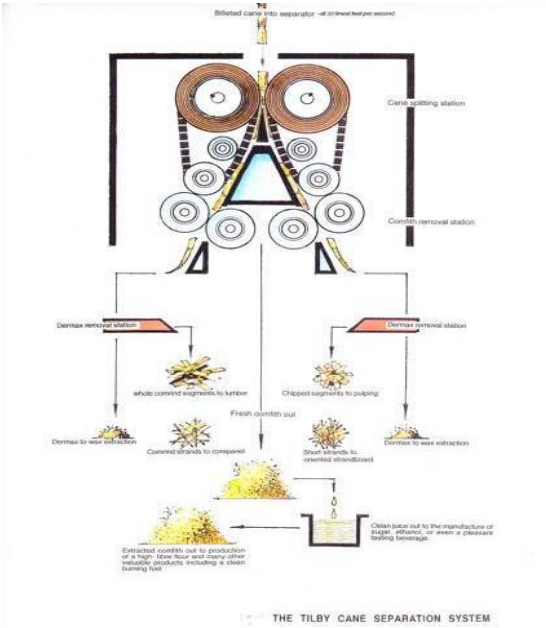
Sweet Sorghum Can be Fractionated

- Comfith contains sugar juice in soft cellulosic material
- Comrind is woody outer material
- Dermax is epidermal layer containing natural waxes and bioactive compounds

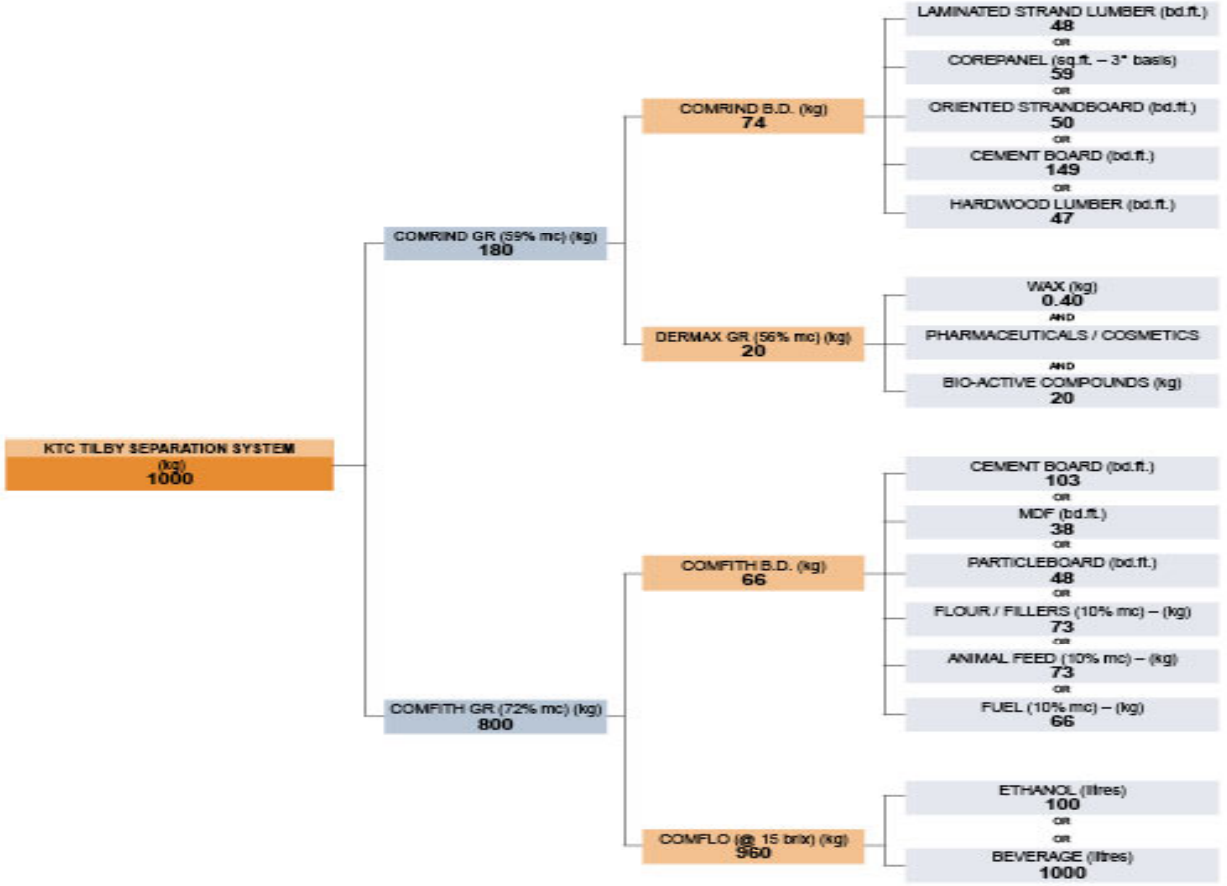


Great Valley ENERGY

Fractions Can Be Processed to Products



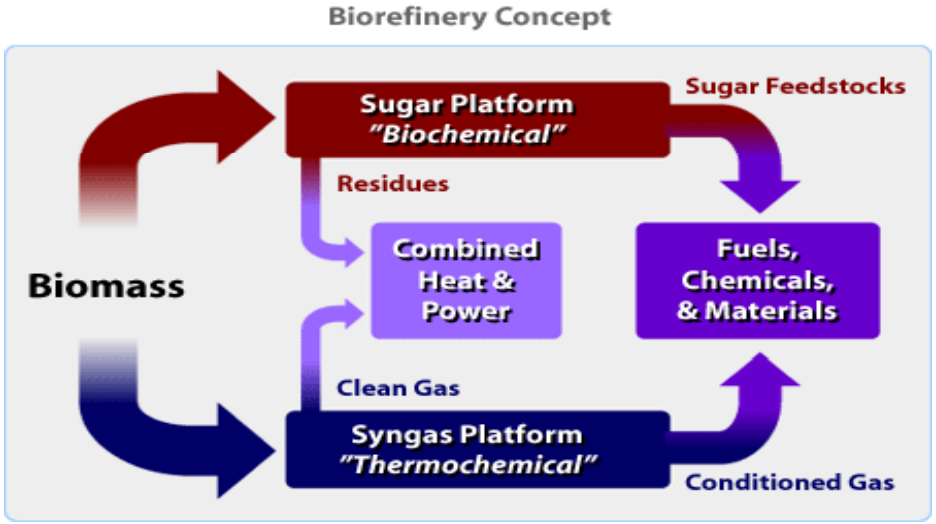
THE TILBY CANE SEPARATION SYSTEM



Great Valley ENERGY

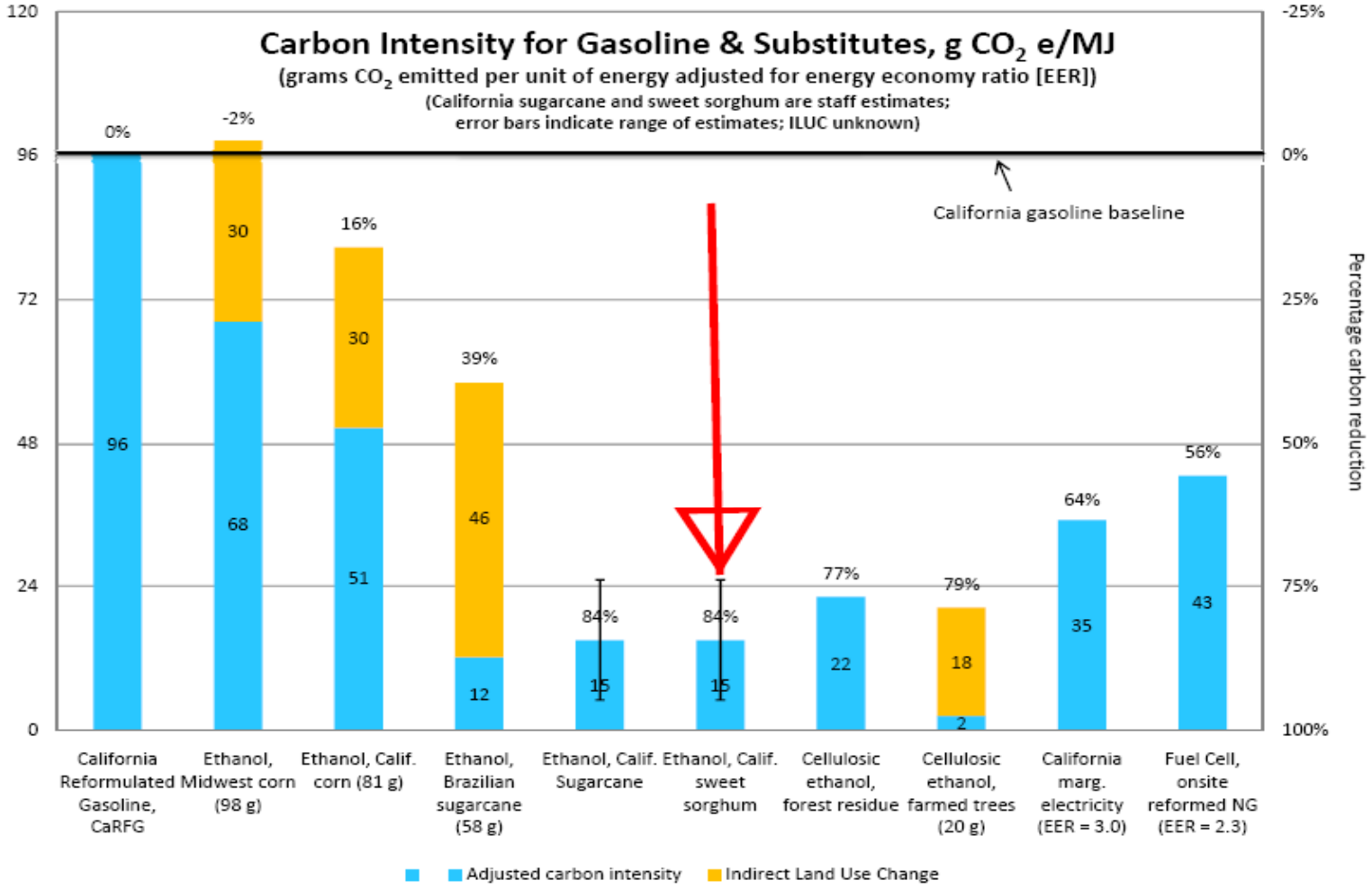
Fractionation - So What? Biorefinery.

- Multiple products = multiple income streams = greater economic stability
- Flexibility to adjust to market changes
- Foundation for further optimization (e.g., cellulosic ethanol when commercially available)
- Follows oil refinery model (many products – gasoline, diesel, LPG, waxes, fertilizers, etc.)



Great Valley ENERGY

Sweet Sorghum to Ethanol is a Low Carbon Pathway



Great Valley ENERGY

Major Grant Objectives

- Determine Sweet Sorghum Agronomics
- Develop Pilot Demonstration Plant to make and test products
- Identify Promising Process Configurations
- Conceptual Engineering on Commercial Demonstration Plant
- Conduct Product Market Research
- Develop *pro forma* Economic Models for Several Configurations
- Explore and Compare Environmental Impacts for Configurations

Great Valley ENERGY

Scope Progress - Agronomics

Goal: Determine Sweet Sorghum Agronomics

- In third year of Sweet Sorghum Crop
- CEC/CDFA purpose-grown crop at WSREC
- Using Public and Proprietary varieties
- Private farming partners (Lemoore, Bakersfield)
- Leveraging existing knowledge/database from CBC/UC Davis

Near-term Activities

- Complete 2012 Growth/Harvest
- Complete CBC/UCD Agronomic Study
- Provide grower input data for Pro Forma Economics and Environmental Study

Great Valley ENERGY

Scope Progress – Pilot Demonstration Plant

Goal: Develop Pilot Demonstration Plant to make and test products

- In second year of pilot plant processing
- Procured and installed equipment for separation of components
- Processed 2011 crop to produce material samples
- Procured belt press for juice extraction

Near-term Activities

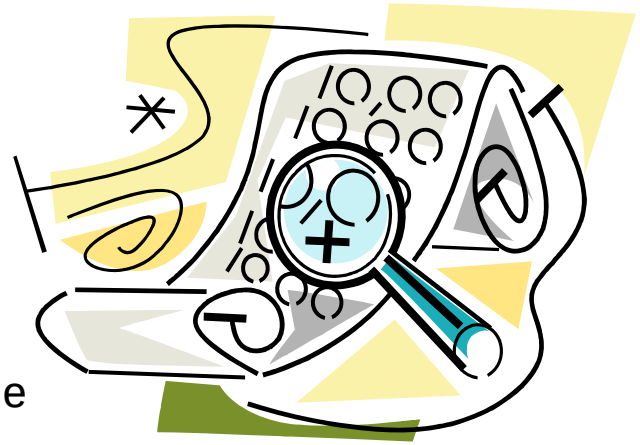
- Procure additional equipment
  - Dryer
  - Hammer mill
  - Pelletizing equipment
  - Juice filtration and sugar concentration
- Process 2012 crop
- Provide samples for offsite processing
- Drop-in biofuels testing
- Ultrafiltration and pasteurization for juice storage

Great Valley ENERGY

Scope Progress – Identify Process Configurations

Goal: Identify promising process configurations

- Mid-Stream, capital light focus
- Produce intermediates (from a consumer perspective)
- Sugar juice/syrup feed to existing ethanol production
- Dry and/or pelletized biomass (storable, transportable)
  - Electricity production
  - Cellulosic sugars/drop-in biofuels
- Bioactive compound extracts (concentrated)
- Possible over-the-fence transactions

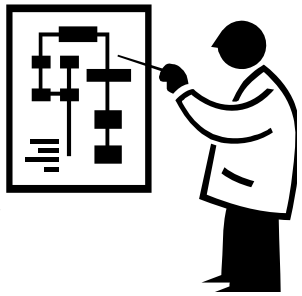


Near-term Activities

- Test ultra-filtered juice and sugar syrup for storage characteristics
- Dry/pelletize comfith and comrind. Test against industry standards (composition, durability, heat content)
- Dry Materials for cellulosic suitability
- Evaluate bioactive compound extraction technology

Great Valley ENERGY

Scope Progress – Preliminary Engineering



Goal: Preliminary Engineering on Commercial Demonstration Plant

- Short-listed four experienced Engineering Contractors
- Currently evaluating scope/budget/contracting with two highly qualified firms

Near-term Activities

- Execute contracts and begin work
- Provide feedback to pilot plant operation
- Develop PFDs and H&M Balances for process configurations
- Estimate capital + installation costs, energy inputs, staff loads for process configurations

Great Valley ENERGY

Scope Progress – Conduct Product Market Research

Objective: Identify markets for co-products outside of transportation fuels

- Testing Dermax at Colorado State University for bioactive compounds
- Results indicate measurable concentrations and activity of compounds
- Construction Materials are possible, but markets are challenged

Near-term Activities

- Complete *in vivo* testing of bioactive compounds
- Identify processing and marketing partners for bioactive compounds
- Compare pellets from comfith and comrind against industry standards

Great Valley ENERGY

Scope Progress – Develop pro forma economic models

Objective: Estimate profitability of process configurations

- Initial models indicate positive returns but significant uncertainty for inputs
  - Capital costs
  - Raw Material costs
  - Product Values

Near-term Activities

- Complete preliminary engineering to +/- 20-30% capital costs
- Complete agronomic study to indicate probable crop cost (and variables)
- Complete product market studies (volume and pricing)

Great Valley ENERGY

Scope Progress – Explore and Compare Environmental Impacts

Goal: Explore and compare environmental impacts for configurations

- Needs input from preliminary engineering for energy use and water balance
- Needs input from agronomic study for inputs and yield
- Reviewing scope and contract from well-to-wheels consulting group for Carbon Intensity

Near-term Activities

- Complete preliminary engineering and agronomic study
- Evaluate water/high salinity water use for crop
- Evaluate water/energy use for process configurations
- Execute Carbon Intensity Study contract and provide inputs
- Evaluate air emissions profile from configurations

Great Valley ENERGY

Commercial Demonstration Plant

Next Growth Phase – Commercial Demonstration

10 Tons/hour Sweet Sorghum Processing

- 2014 Online Schedule
- ~ $15MM Total Installed Capital
- ~ 1000 acres in Sweet Sorghum Production
- Transport of sugar juice/syrup to existing facilities
- Comfith/comrind drying and pelletizing
- Dermax processing (bioactive compound concentrate)

Great Valley ENERGY

Commercial Plant

Next Growth Phase – Commercial Plant

50 Tons/Hour Sweet Sorghum Processing

- 2016 Start-up
- ~5000 acres in Sweet Sorghum Production
- With 10% of nearby acreage in planted Sweet Sorghum, trucking distance is less than 7 miles
- ~$40 million Total Installed Capital
- ~4 million gallons ethanol per year (equivalent) from fresh sweet sorghum sugars– not including storage and not including biofuels from biomass.

Followed by Refinement and Replication …

Great Valley ENERGY

Barriers to Implementation

- Austerity measures, another recession, regulatory (LCFS) and tax uncertainty (e.g., dividend tax rate) will continue to weigh on capital investment decisions for projects like GVE.
- Uncertain commitment to long-term domestic energy plan may keep investors sidelined:
  - Will BCAP or similar program(s) be there when we are ready?
  - Will DOE/USDA/CEC loan guarantees or grants be available if needed?
  - Will starch to ethanol infrastructure be in operation to accept sugar feeds?
- Blend wall

Great Valley ENERGY

Aids to Implementation

- Austerity measures, another recession, regulatory (LCFS) and tax uncertainty (e.g., dividend tax rate) will continue to weigh on capital investment decisions for projects like GVE. Some projections point to lack of sufficient LCFS credits past 2015 and predict ultimate regulatory failure (or fuel rationing).

Suggestion:

- Renew and affirm support of LCFS. Provide long-term "bonus credit" structure assigned to Advanced Biofuels.

  This type of MARKET support will enhance advanced biofuel product acceptance and keep the existing regulatory framework, providing assurance to investors providing at-risk capital.

Great Valley ENERGY

Aids to Implementation

- Will BCAP or similar program(s) be there when we are ready?

Suggestion:

- How about a California BCAP program targeted for non-starch transportation fuels?

  We need FEEDSTOCK support to make sure farmers will grow our crop (incentive), water is available for the crop, crop risk is diminished (insurance/guarantee), and crop can be harvested (equipment available).

Great Valley ENERGY

Aids to Implementation

- Will DOE/USDA/CEC loan guarantees or grants be available if needed?

Suggestion:

- Provide grants, bond instruments, and low-interest loans to offset debt and equity hurdles.

We need FINANCING support to become more attractive to a limited pool of capital, to aid installation of additional equipment at potential customers' facilities (e.g. sugar juice fermenter), to accelerate product time to market and development of commercial plants.

Great Valley ENERGY

Aids to Implementation

- Will starch to ethanol infrastructure be in operation to accept sugar feeds?

Suggestion:

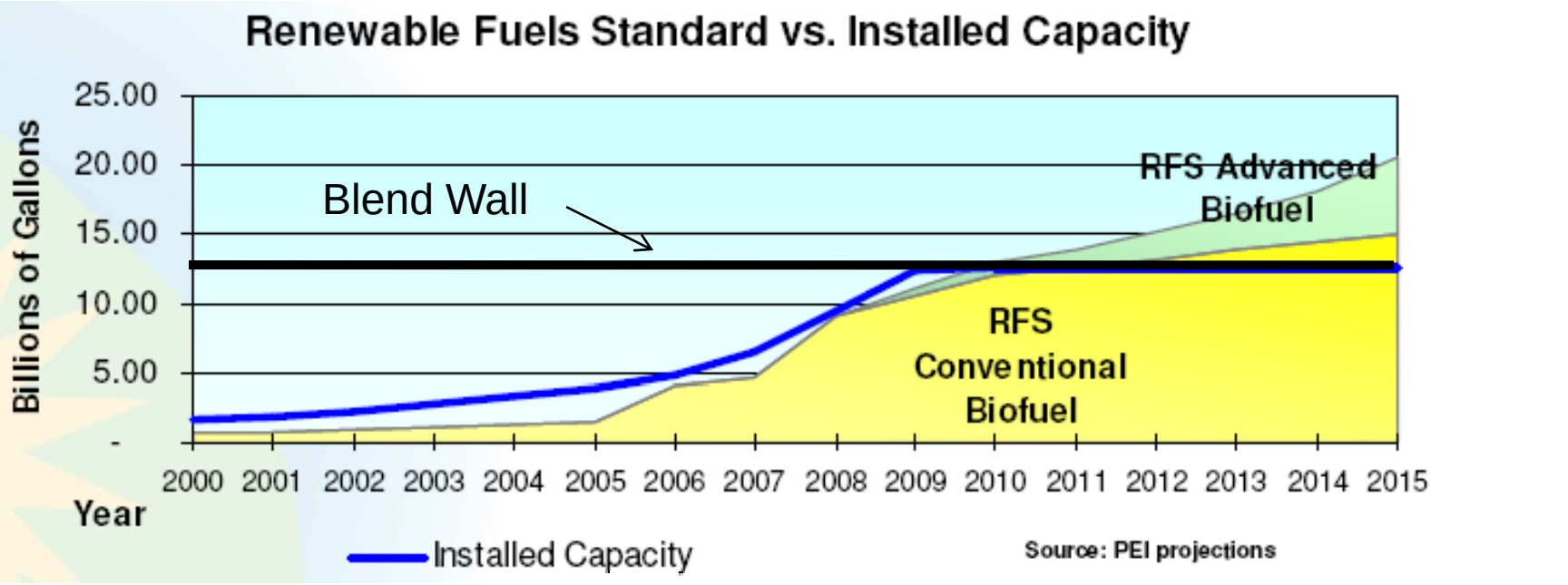
- Continue support of CEPIP.
- Revisit ILUC for all feedstocks.
- Support incentives for infrastructure investments.

We need INFRASTUCTURE support for customers to accept our products, particularly financing equipment adjustments which will accommodate sugar juice.

Great Valley ENERGY

Blend Wall

- New corn to ethanol capacity not needed. Future conventional capacity will be met through existing facilities – expansion and efficiency enhancements.
- New Ethanol Production will be Advanced Biofuel substituting for corn feedstock. Must be a carve-out for sugar-based ethanol like sweet sorghum.
- E15 – E85 infrastructure is needed to meet RFS goals.



Great Valley ENERGY

Aids to Implementation

- Blend wall

Suggestion:

- Continue support of and incentives for E85 pumps and flex fuel vehicles in California.
- Provide special LCFS enhancement to drop-in biofuels which don't count against blend wall.
- Carve out for sugar-based fuels such as sweet sorghum ethanol.

Great Valley ENERGY

Brian Pellens
President
Great Valley Energy, LLC
5419 Woodmere Drive
Bakersfield, CA 93313
800.225.3773
b.pellens@gr8valley.com

Great Valley
ENERGY

August 2012