



Alternative Transportation Fuels

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Biofuels Challenges and Opportunities

- Global Energy Perspectives
- Customer Acceptance
- Biofuel Growth and Success Factors
- Hydrogen Technology
- Meeting Future Energy Demand





Global Energy Perspectives

- Growing energy demand globally, especially in China, India and Latin America
- Increasing competition and investments for resources
- Increasing demand for cleaner fuels and technologies
- Need to improve energy efficiency
- Need to diversify supply & integrate sustainable resources
- Increasing expectations surrounding climate change

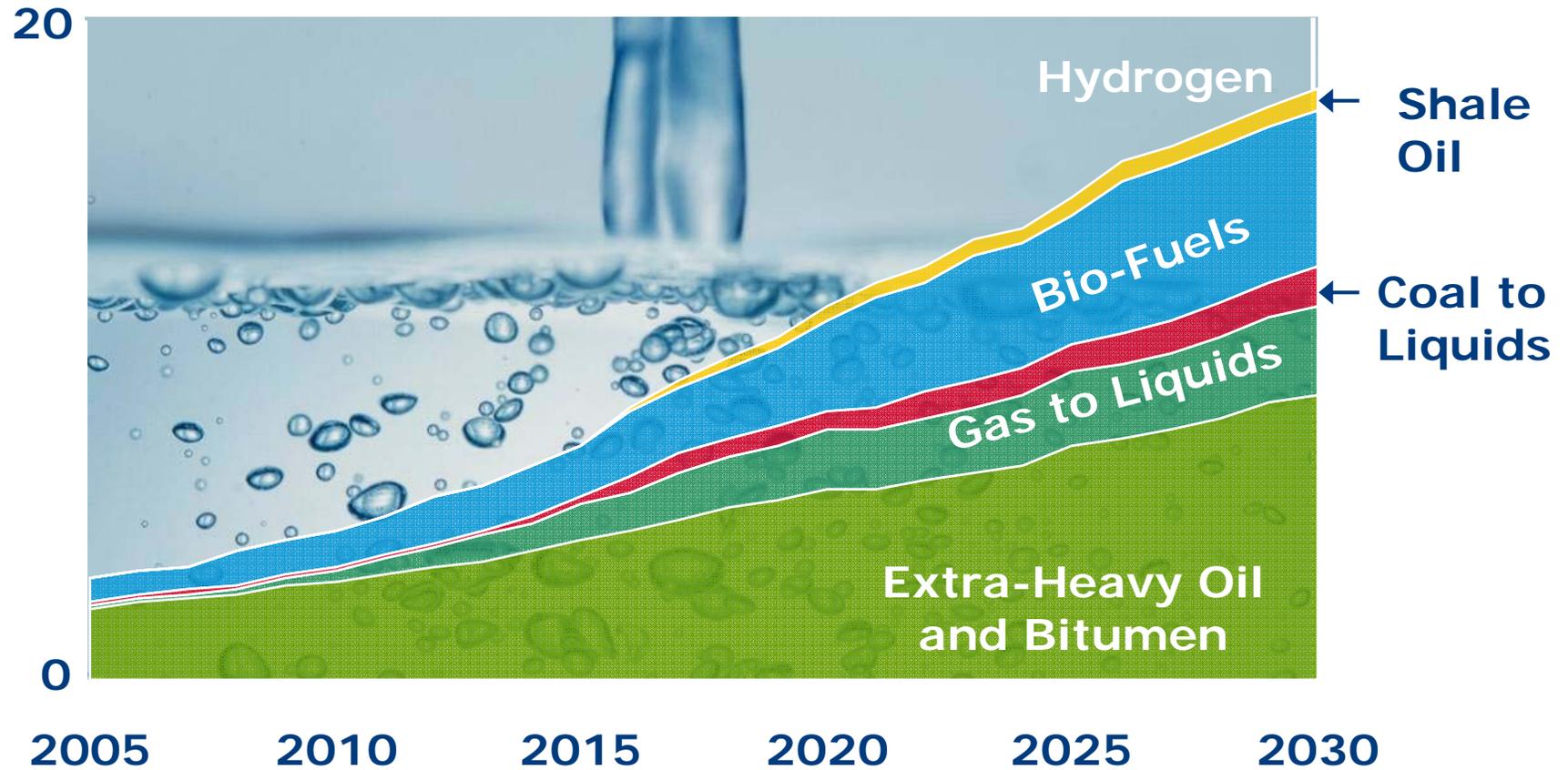




Diversification of Feedstock and Fuel

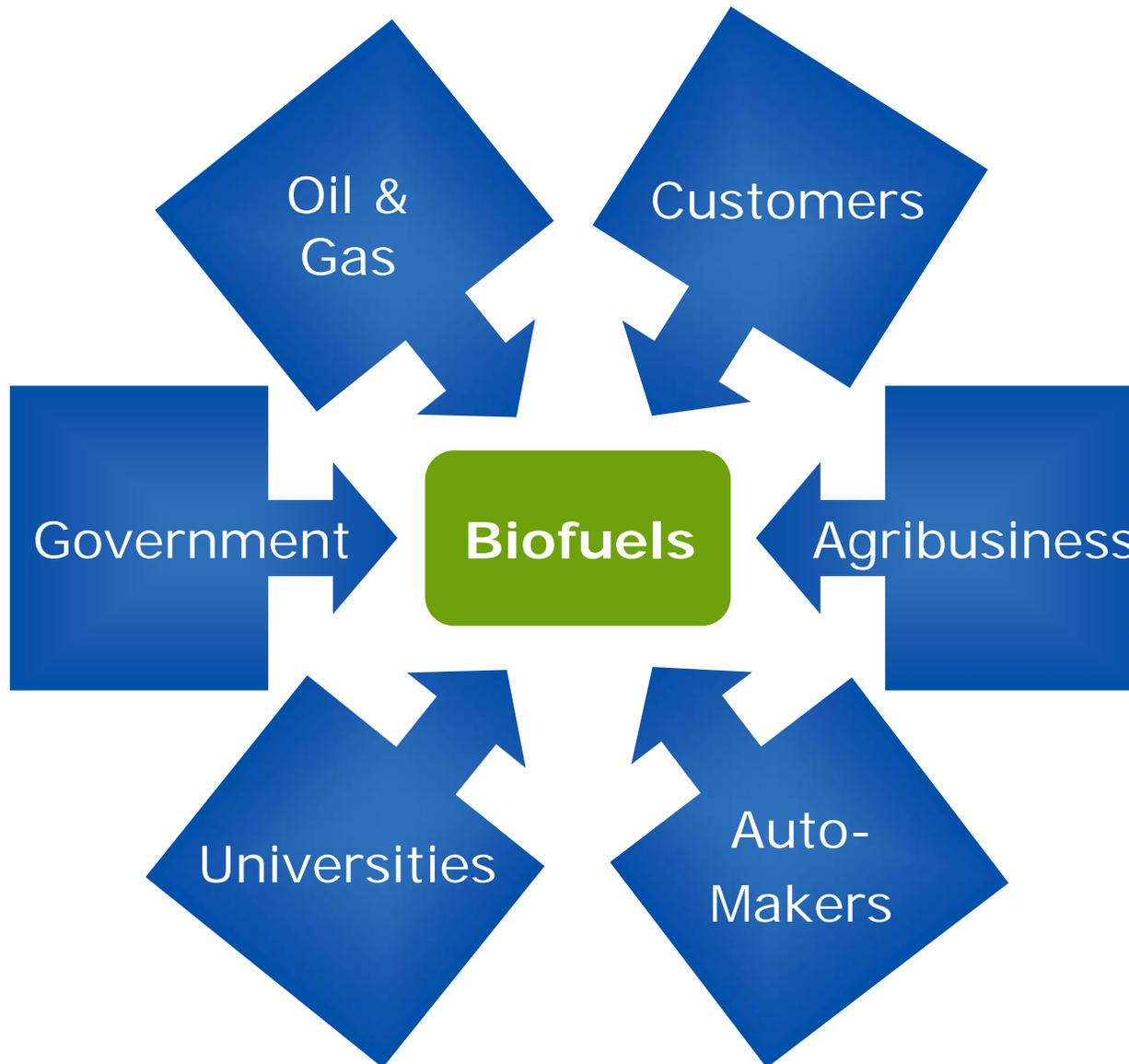
How big will it be? What will it be and by when?

MMBD





Success Requires and Integrated Approach





Customer Acceptance

- Energy companies will provide whatever fuels customers demand
- For a customer to demand an alternative fuel, they want to see three criteria fulfilled:
 - *Equal or improved driving performance, safety, reliability and comfort*
 - *Equal or lower vehicle and fuel costs*
 - *Improved fuel economy and environmental benefits*

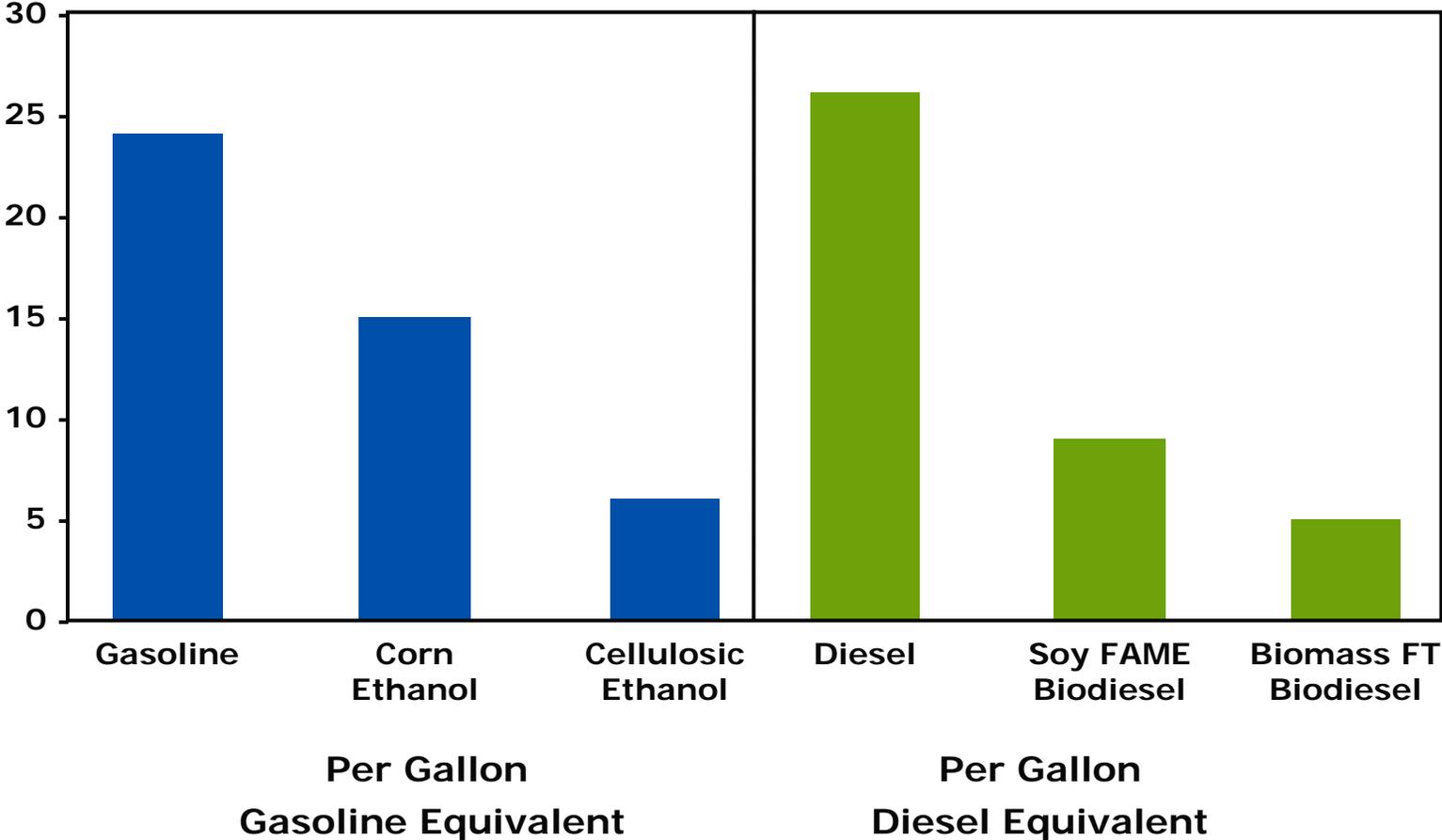




CO₂ Benefits from Biofuels

Wells to Wheels Greenhouse Gas Emissions

LB CO₂ Equivalent Per Gallon





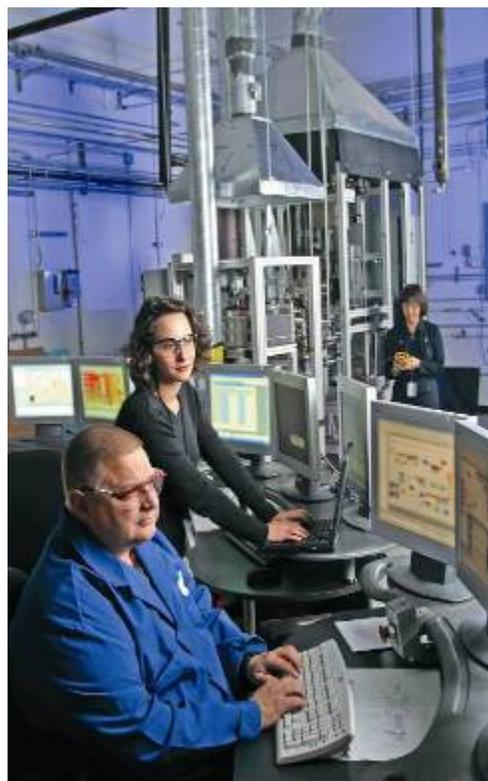
Biofuel Growth Drivers

Sustainable Business Models

Industrial-scale
Infrastructure



2nd Generation
Technology



Large, concentrated
supplies of feedstock





Current Research Alliances

- **Georgia Tech** - Advanced Manufacturing Technologies
 - Chemical characterization of feedstock, pretreatment, fermentation of enzyme hydrolyzed biomass to bioethanol
 - Integration of chemical analysis into a systems model for biomass to bioethanol production
- **UC Davis** – Agricultural Sciences, Biotech, Crops & Fuels Policy
 - California-based; biomass identification and development of technologies to grow, harvest and process into transportation fuels
- **NREL** – Only U.S. National Lab devoted to renewable energy
 - Identification, evaluation and development of second generation biofuels production from biologic pathways (e.g. algae)
- **Texas A&M** – Agricultural Sciences, Conversion Technology
 - Biomass identification and development of technologies to grow, harvest and process into transportation fuels
- **Weyerhaeuser** – Fully integrated supplier of forest products
 - Chevron-Weyerhaeuser biofuels venture aimed at researching, developing, and commercializing the technologies required to transform non-food sources of cellulose into economical, sustainable, clean-burning biofuels



Hydrogen as a Fuel

- Stationary FC power is here
- Distributed H₂ manufacturing works
- Transportation technology is evolving
- H₂ storage is a major challenge





Chevron Hydrogen Infrastructure Demos

■ Objectives:

- Support the DOE and DOD in the development of industry codes, standards, and policies
- Demonstrate safe, practical hydrogen technologies
- Identify and overcome key technical challenges

■ Locations:

- Chino, California
- Oakland, California
- Rosemead, California
- Orlando, Florida
- Selfridge, Michigan



Finding and Encouraging the Best Options...Enabling the Winners



- There is no single solution
 - Issues of dependency, reliability of supply, environmental footprint and cost apply to all fuels to some degree

- All economic fuels--plus conservation--will be needed to meet demand
 - Market-based competition amongst technologies should not be inhibited

 - Consumers have the means to conserve and are beginning to respond

- Allow time for technology to advance
 - New technologies must offer tangible benefits to consumers and real-world wells-to-wheels benefits to the environment

 - Discussions, such as these, are good way to make progress