# Thermal Gasification of Biomass
# United States Update

**IEA Bioenergy Task 33**

Second Annual Task Meeting

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# Outline

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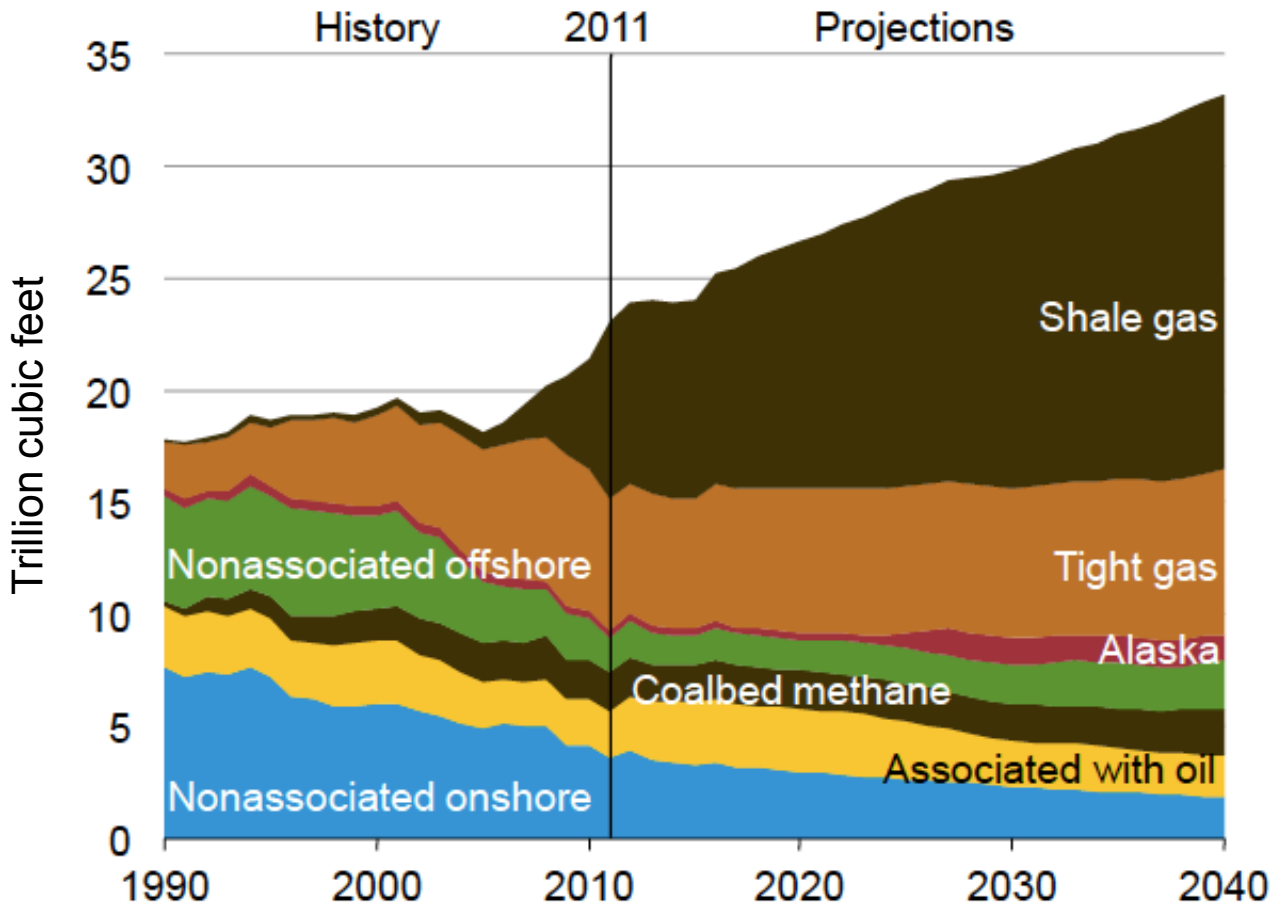
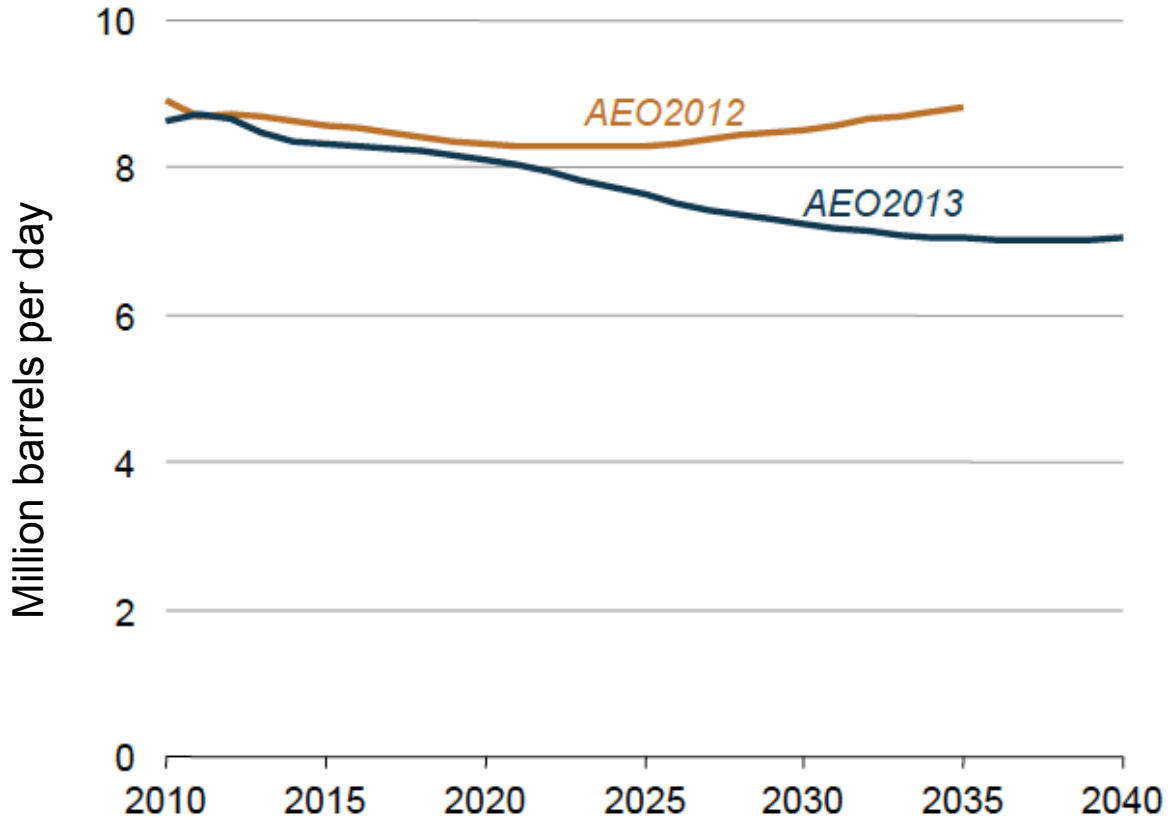
- U.S. energy status and projections
- Biofuel projections
- U.S. biomass gasification projects
- Conclusions

# Domestic Natural Gas Production
## Projection through 2040




Source: U.S. Energy Information Administration (EIA)

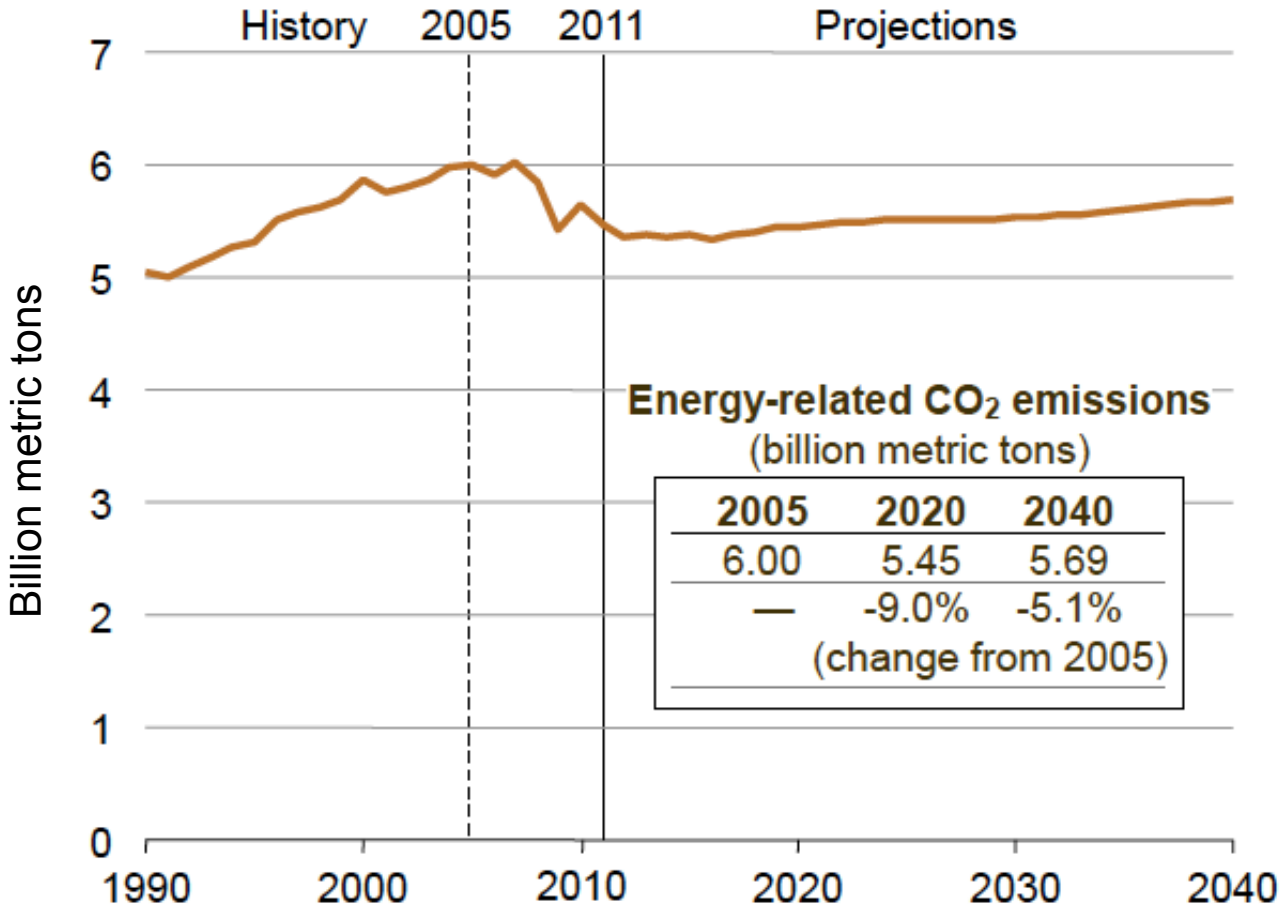
# Liquids Consumption by Light Duty Vehicles
## Projection through 2040




- Difference between the two projections of more stringent CAFE standards
- Increases from 32.6 mpg (7.21 L/100km) in 2011 to 47.3 mpg (4.97 L/100km) in 2025

Source: U.S. Energy Information Administration (EIA)

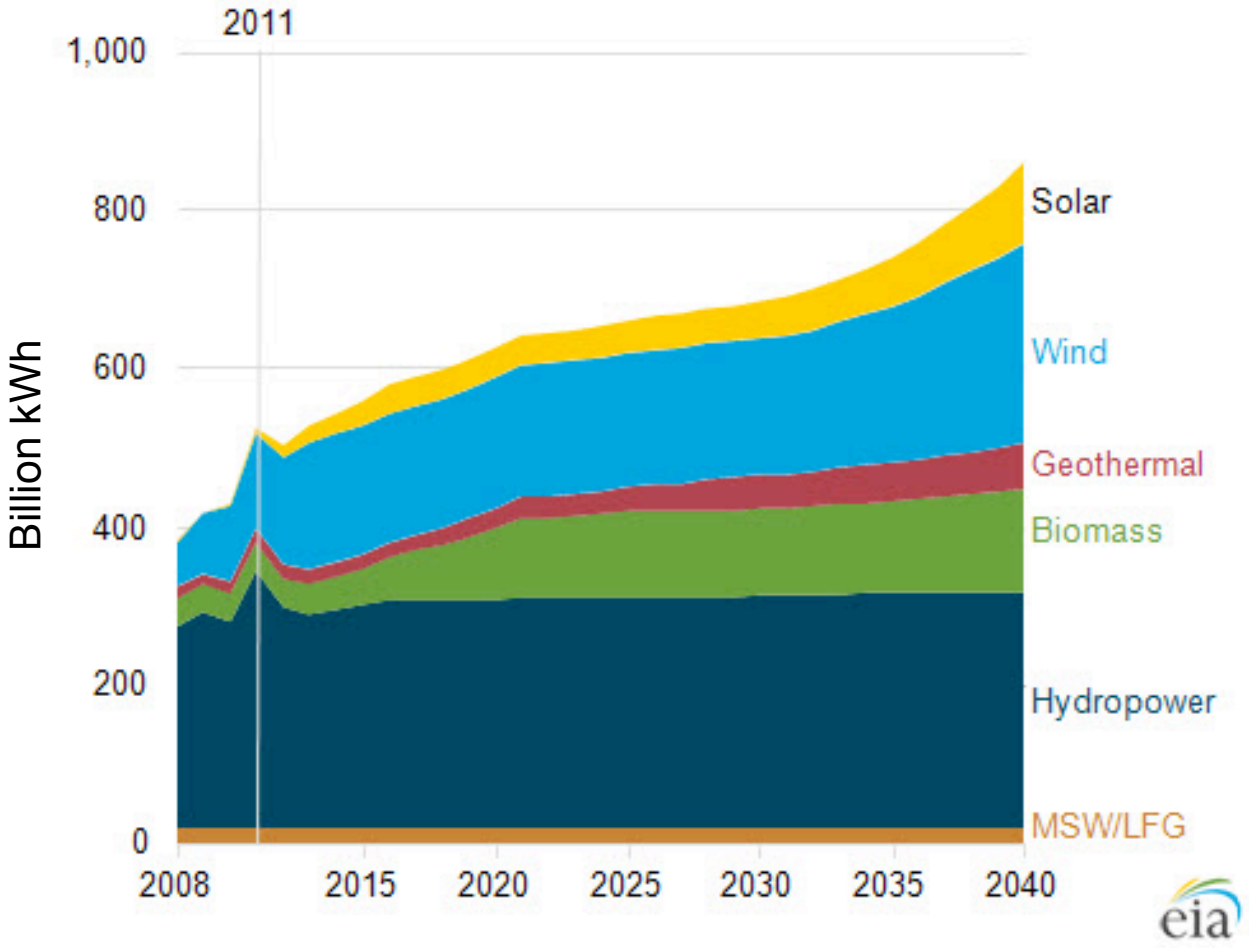
# Energy-Related $CO_2$ Emissions
## Projection through 2040




- Increase is limited by tighter CAFE standards + renewables

Source: U.S. Energy Information Administration (EIA)

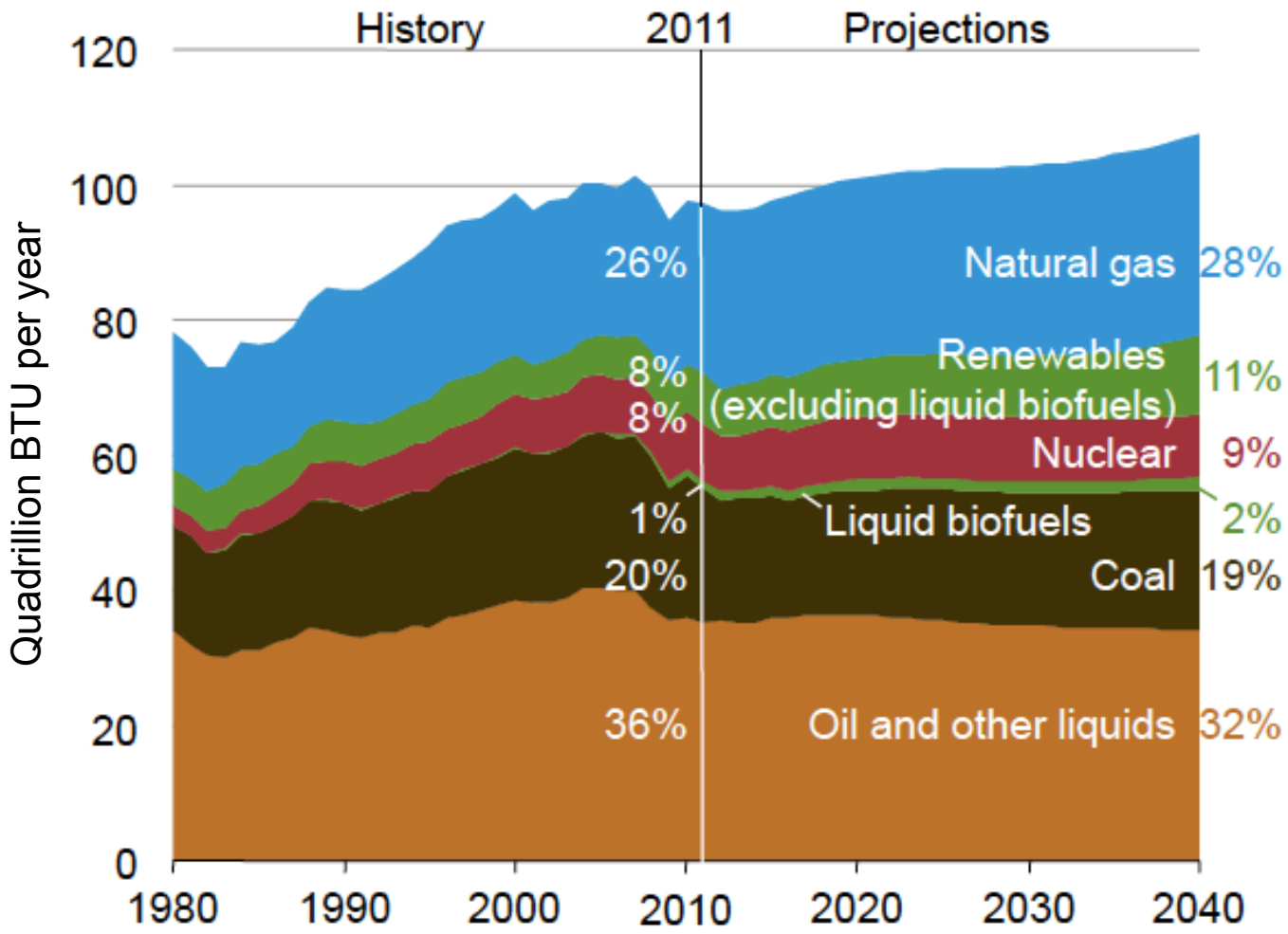
# Renewable Electricity Generation by Type
## Projection through 2040




- Biomass increases by 95 billion kWh
- Average annual increase of 4.5%

Source: U.S. Energy Information Administration (EIA)

# Primary Energy Consumption by Fuel
## Projection through 2040




Source: U.S. Energy Information Administration (EIA)

# Biofuel Production Projection Notes

From the 2013 EIA Annual Energy Outlook Early Release:

"While total liquid fuels consumption falls, consumption of domestically produced biofuels increases significantly, from 1.3 quadrillion Btu in 2011 to 2.1 quadrillion Btu in 2040, and its share of total U.S. liquid fuels consumption grows from 3.5 percent in 2011 to 5.8 percent in 2040. The increases are much smaller than those in *AEO2012*, however, as a result of diminished FFV* penetration, a smaller motor gasoline pool for blending ethanol, and reduced production of cellulosic biofuels, which to date has been well under the targets set by the EISA.† (EPA issued waivers that substantially reduced the cellulosic biofuels obligation under the RFS for 2010, 2011, and 2012.) In addition, the production tax credit for cellulosic biofuels is scheduled to expire at the end of 2012."

* Flex-fuel vehicle

† Energy Independence and Security Act of 2007

# U.S. Integrated Biorefinery Projects

## U.S. Dept. of Energy Interactive Map

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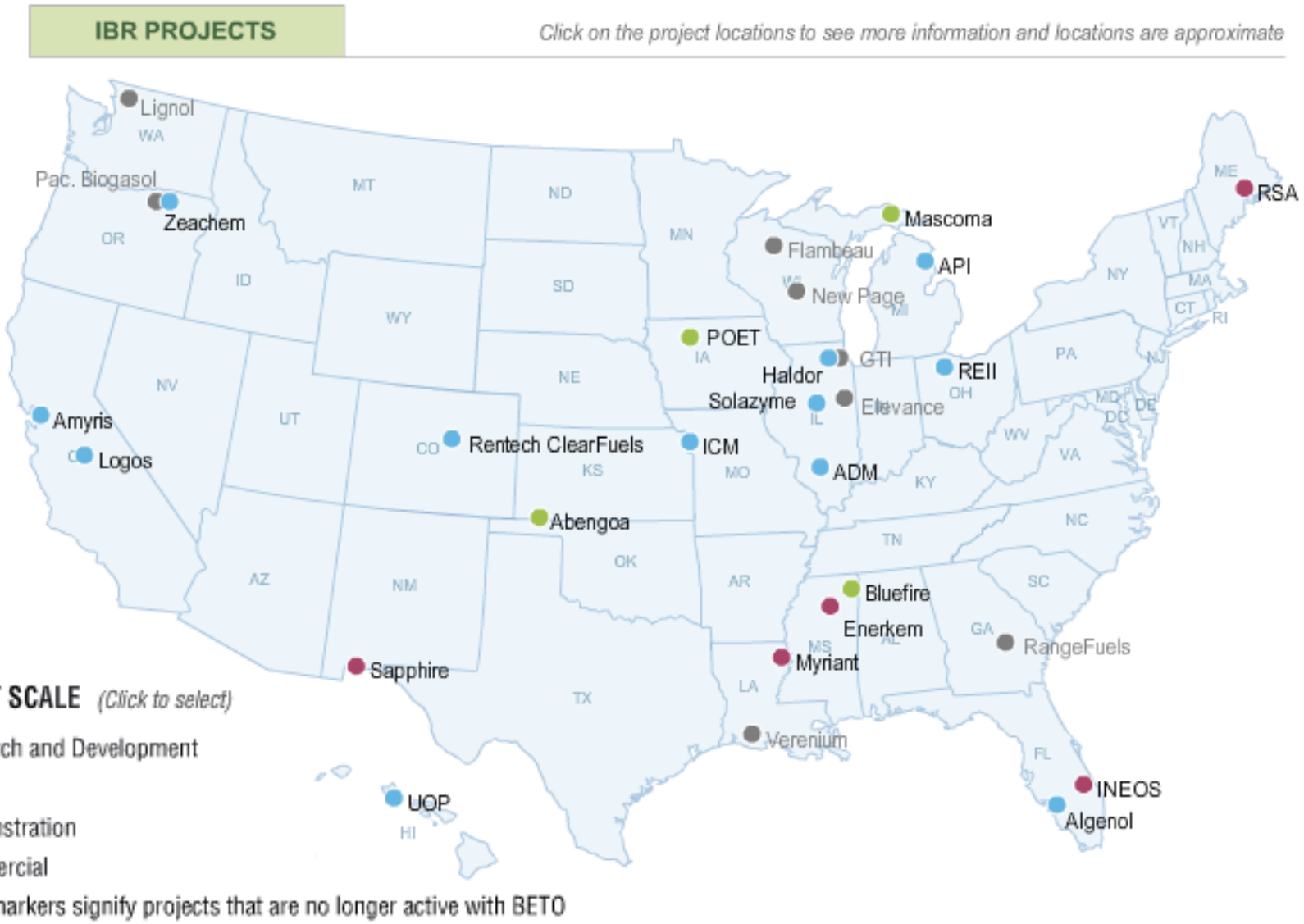
http://www1.eere.energy.gov/bioenergy/integrated_biorefineries.html



# INEOS Indian River Bioenergy Center

## INEOS Bio, Vero Beach, Florida

- Feedstock:  Vegetable and yard waste, MSW
- Products:  Ethanol and power
- Scale:  300 tons feed/day
- Gasification technology:  Proprietary oxygen-blown
- Cost:  More than $130 million
- Status:  First biofuel production July 2013

Source:  www.ineos.com

# Haldor Topsoe Pilot Plant

## INEOS Bio, Vero Beach, Florida

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- Feedstock: Wood chips
- Products: Gasoline
- Scale: 20 tons/day feed; 20 bbl/day gasoline
- Gasification technology: Carbona
- Cost: unknown
- Status: First gasoline production June 2013

Source: www.topsoe.com, www.gastechnology.org

# Zeachem Pilot Plant

## Boardman, Oregon

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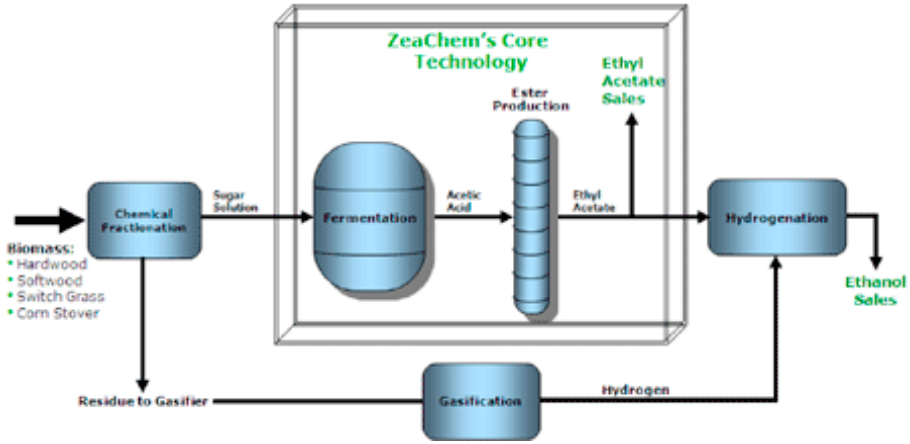
- Feedstock:  Poplar + others
- Products:  Ethanol + intermediate chemicals
- Scale:  10 tons/day feed; 250,000 gal/yr ethanol
- Gasification technology:  Proprietary; gasifies only lignin
- Cost:  unknown
- Status:  First ethanol production March 2013




Source:  www.zeachem.com

# Enerkem Pilot Plant

## Ponotoc, Mississippi

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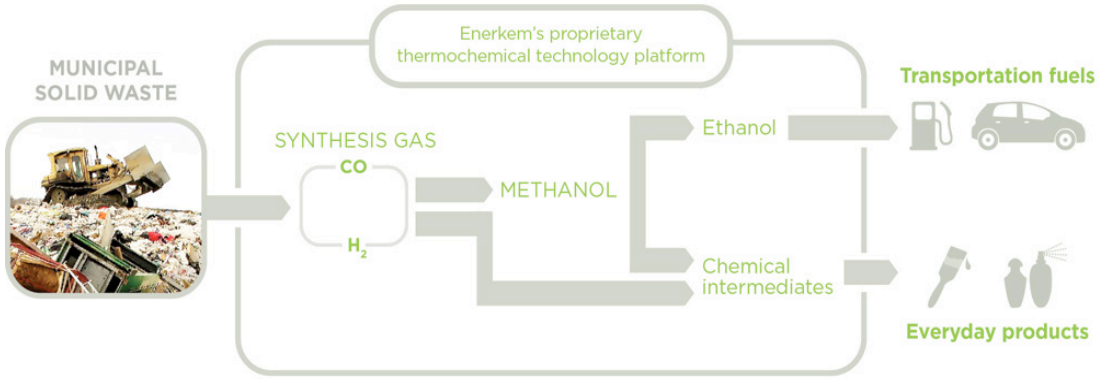
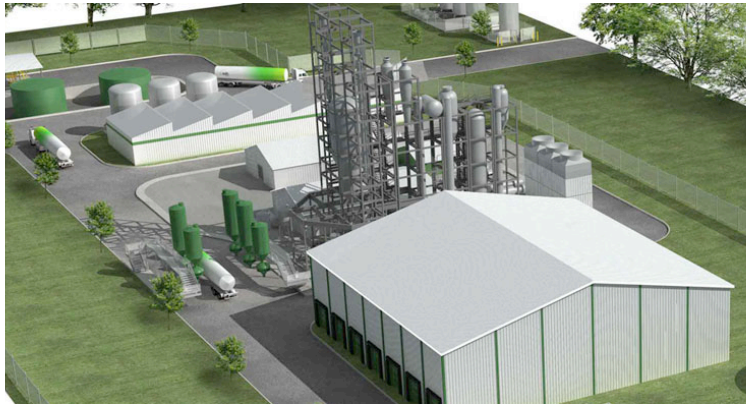
- Feedstock: MSW and wood residues
- Products: Ethanol and methanol
- Scale: 300 tons/day feed; 10 million gallons/year
- Gasification technology: Enerkem proprietary
- Cost: unknown
- Status: Under development



Source: www.enerkem.com

# Freedom Pines Biorefinery

Soperton, Georgia

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Freedom Pines Biorefinery

- Targeting biofuel production through LanzaTech's syngas fermentation technology
- Host site is old Range Fuels site in Soperton, Georgia. Acquired for Freedom Pines Biorefinery in January 2012
- Still sorting out configuration of plant
- Gasification technology has not yet been chosen

LanzaTech

Source: www.freedompines.com, lanzatec.com

# Conclusions

- Limited activity in biomass gasification in the United States
  - Only a handful of smallish plants
  - Most target biofuel production
  - Minimum power generation
- Enormous availability of inexpensive shale gas reduces interest in biomass-based energy
- Possible upcoming $CO_2$ legislation could provide a driver for more biomass energy