

Thermal Gasification of Biomass United States Update

IEA Bioenergy Task 33

Second Semiannual Task Meeting 2015

Berlin, Germany

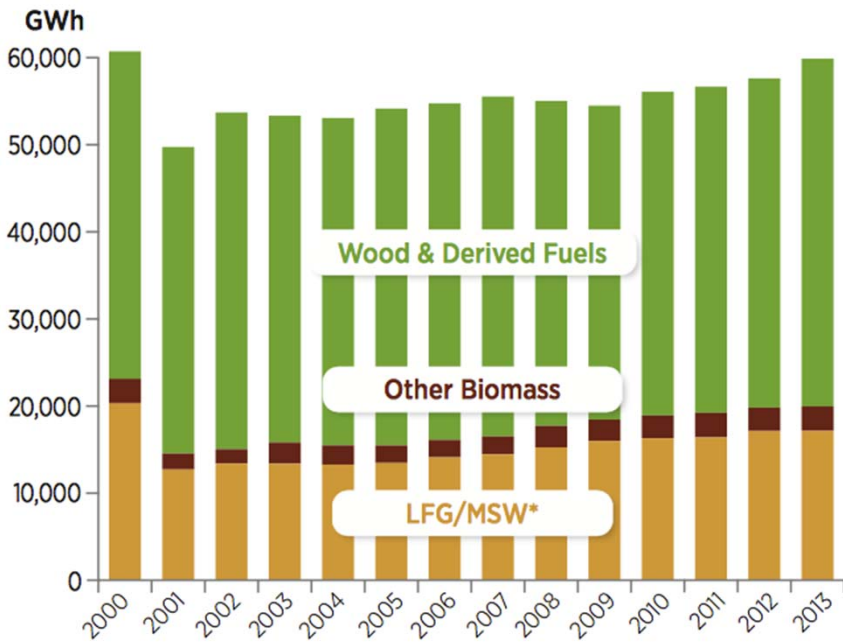
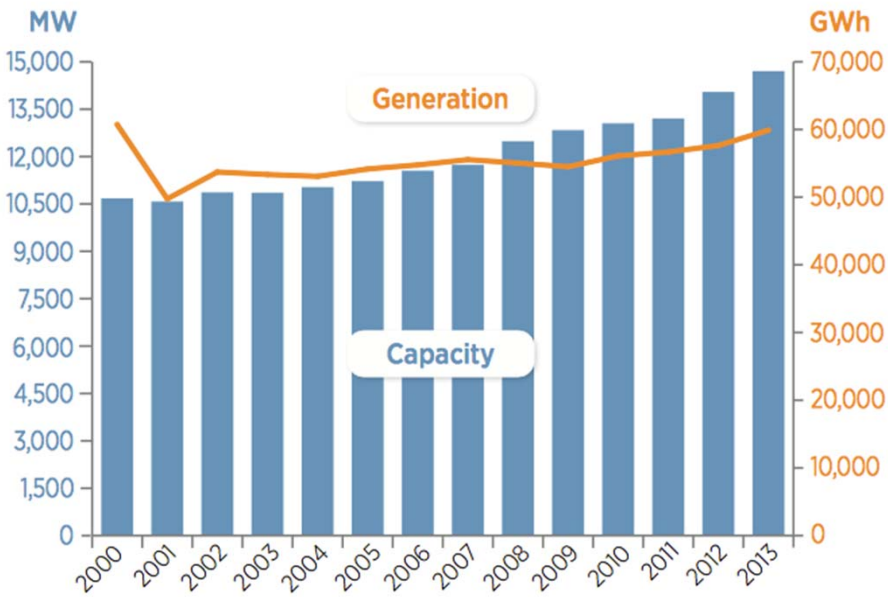
29 November 2015

Kevin Whitty

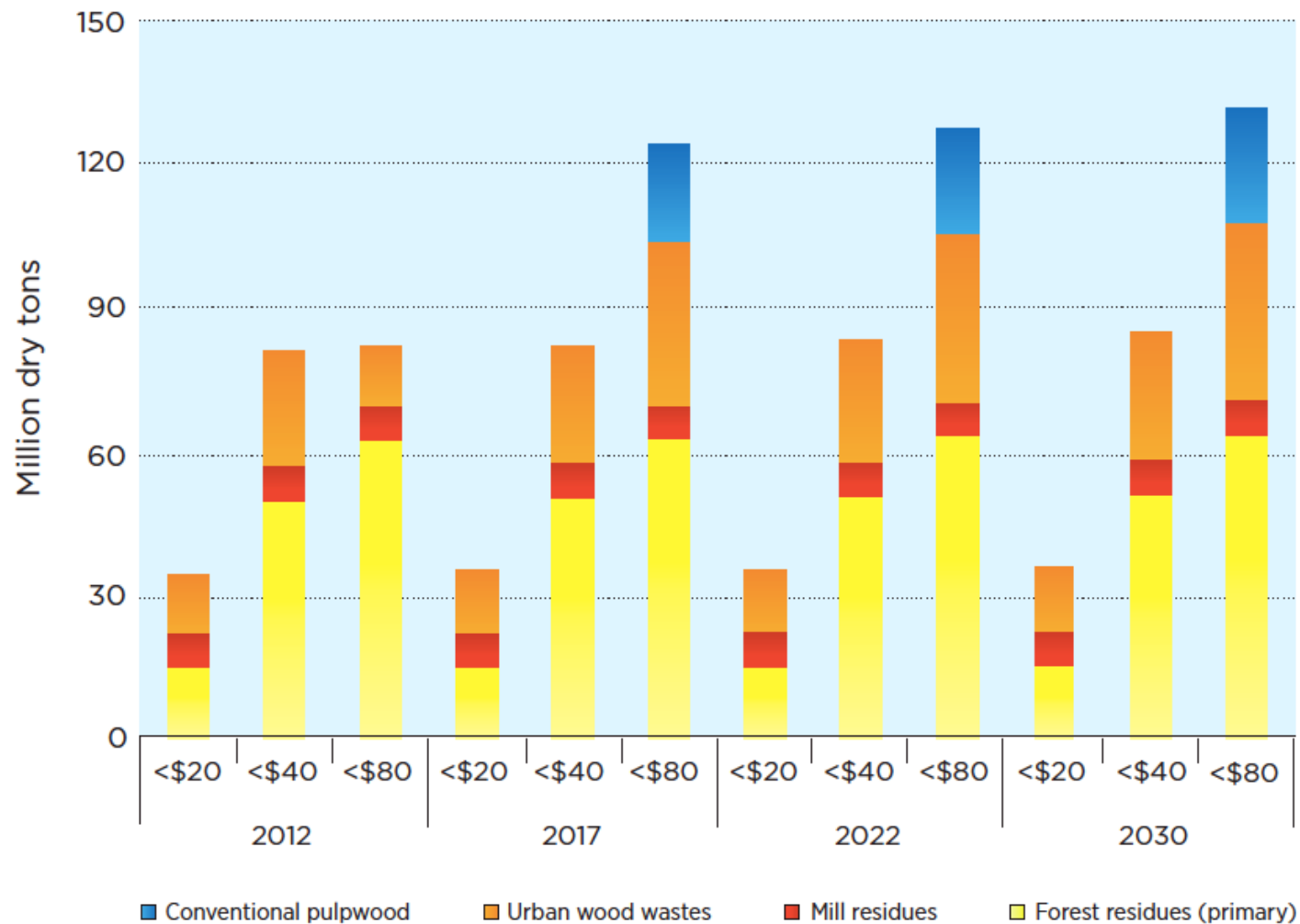
Elena Shanin

Spencer Owen

Biopower in the U.S.

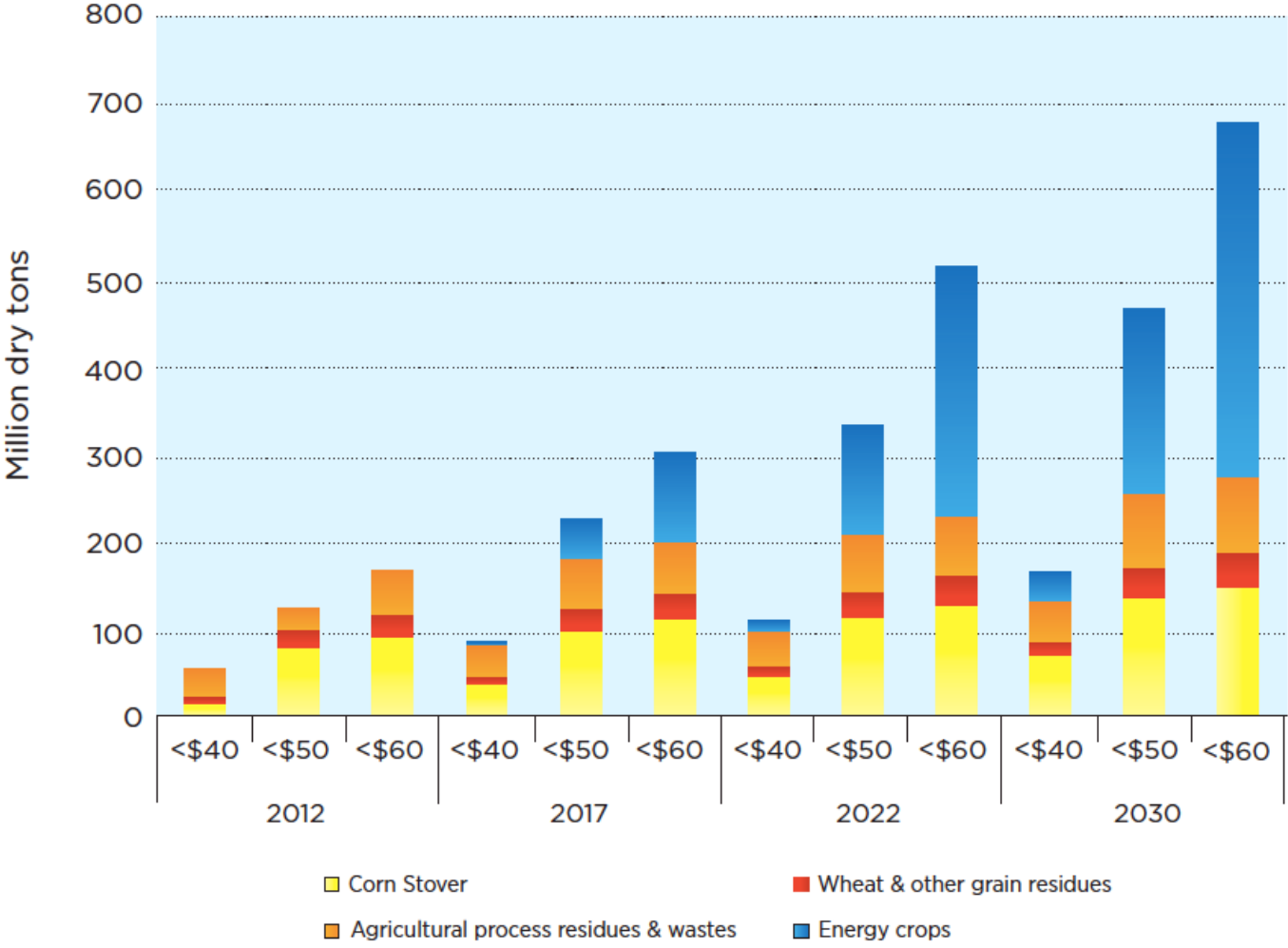


Estimated Availability of Forest Biomass



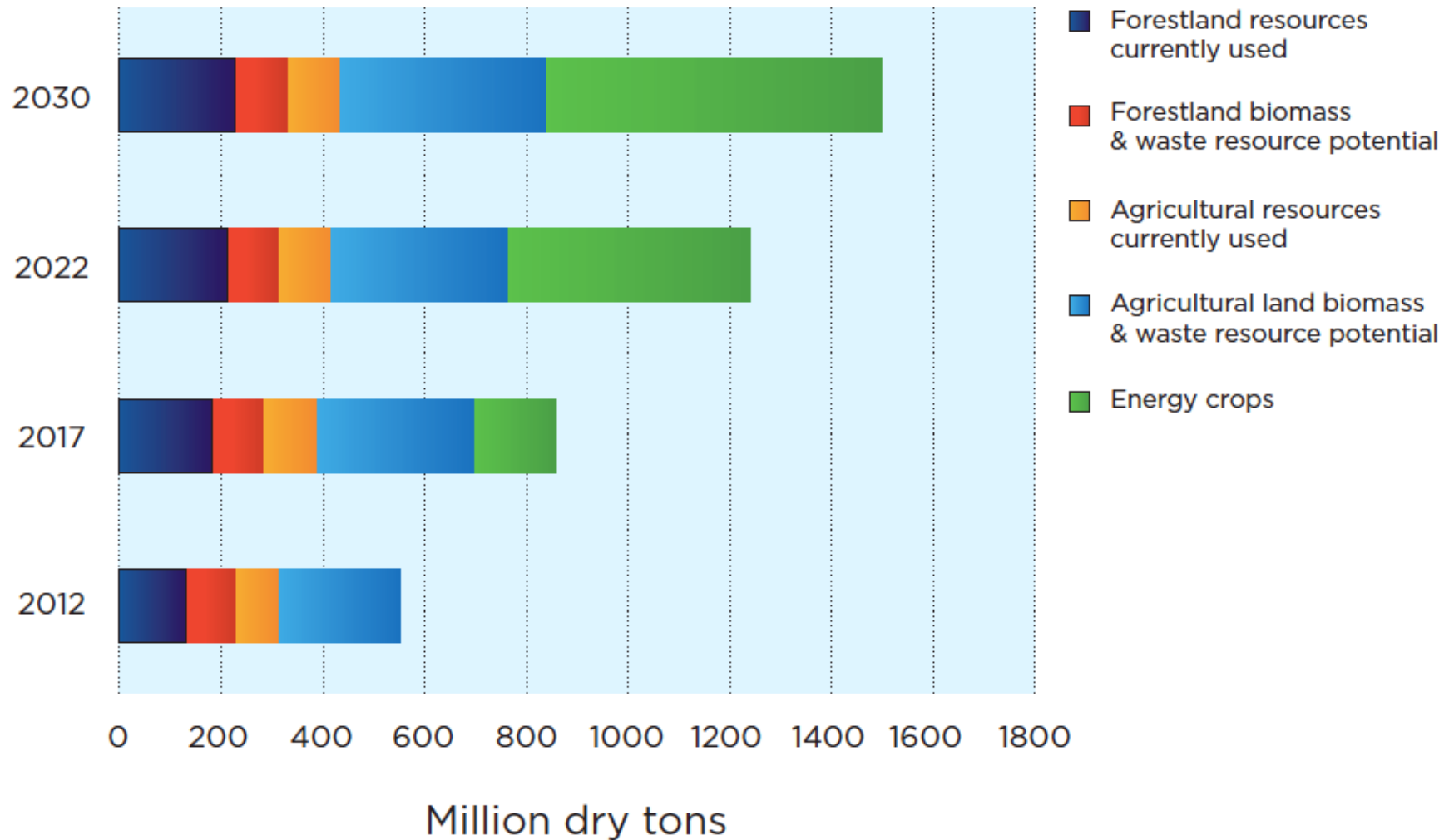
Source: U.S. DOE Billion Ton Update (2011)

Estimated Availability of Agricultural Biomass



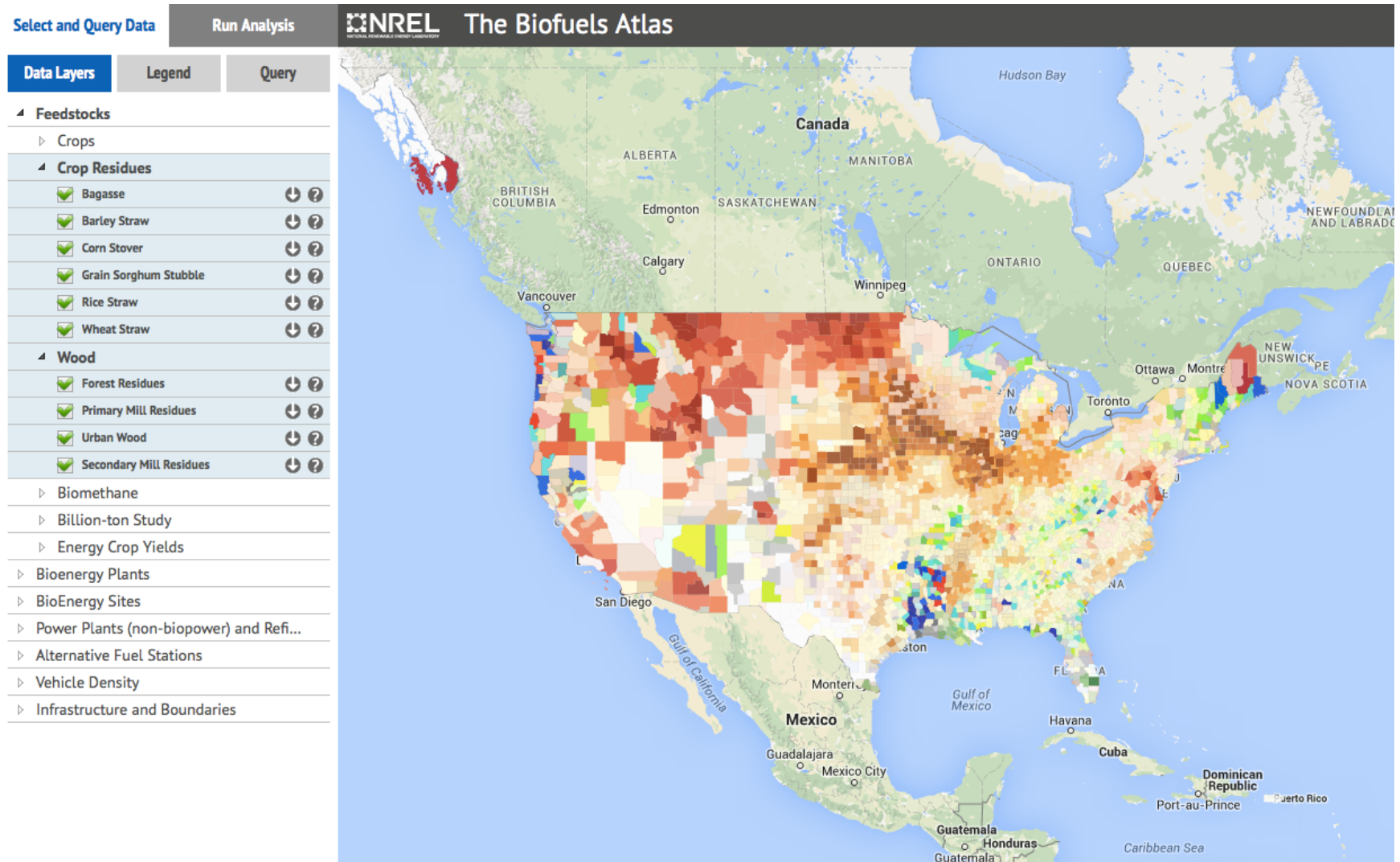
Source: U.S. DOE Billion Ton Update (2011)

Estimated Total Biomass Available (high yield case)



Source: U.S. DOE Billion Ton Update (2011)

NREL Biofuels Atlas



NREL Biopower Atlas

Select and Query Data

Run Analysis



Biopower Atlas

Data Layers

Legend

Query

Feedstocks

Crop Residues

Wood

Forest Residues

Primary Mill Residues

Urban Wood

Secondary Mill Residues

Biomethane

Billion-ton Study

Energy Crop Yields

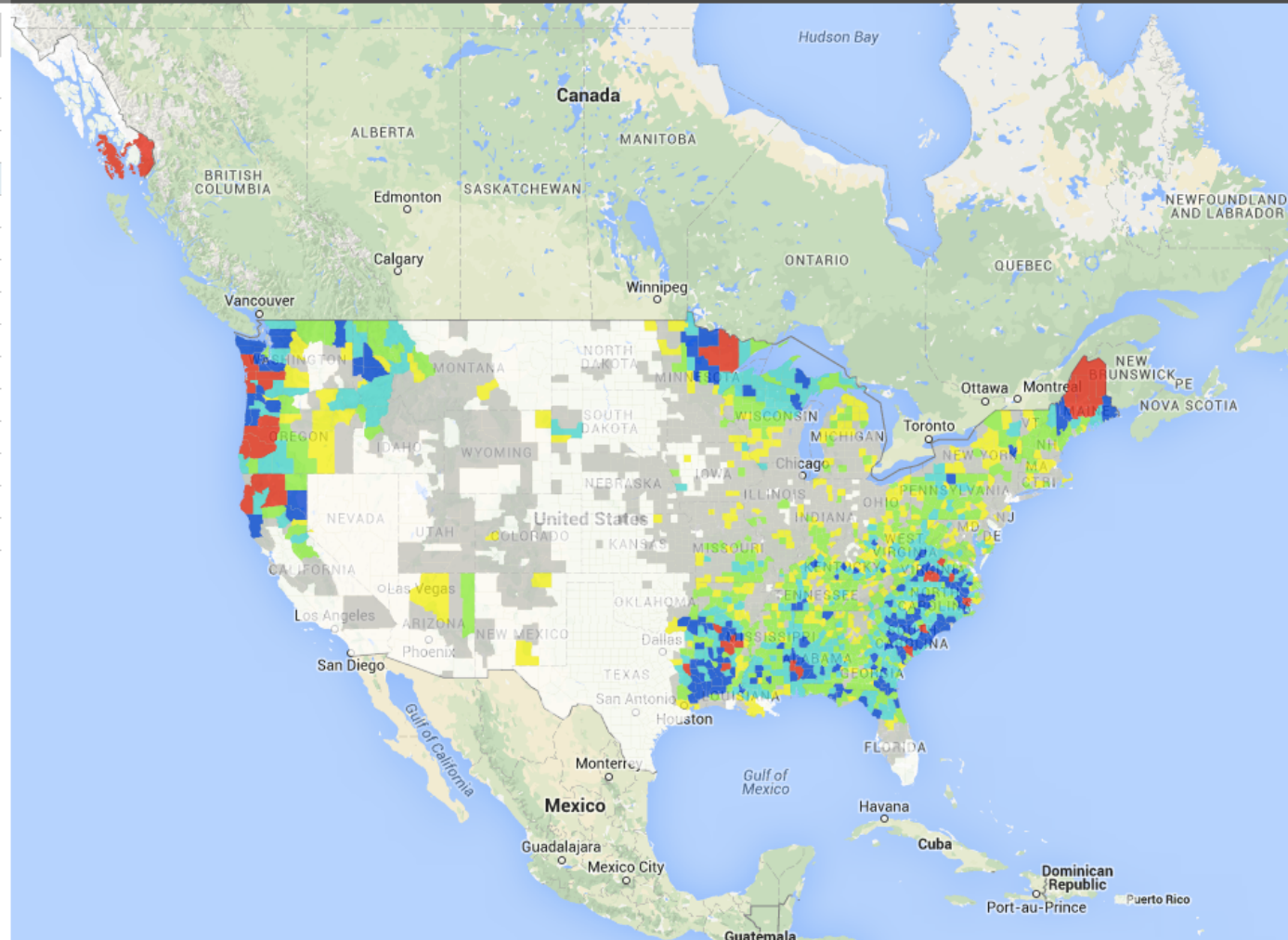
Bioenergy Plants

BioEnergy Sites

Power Plants (non-biopower) and Refi...

Environmental Impact

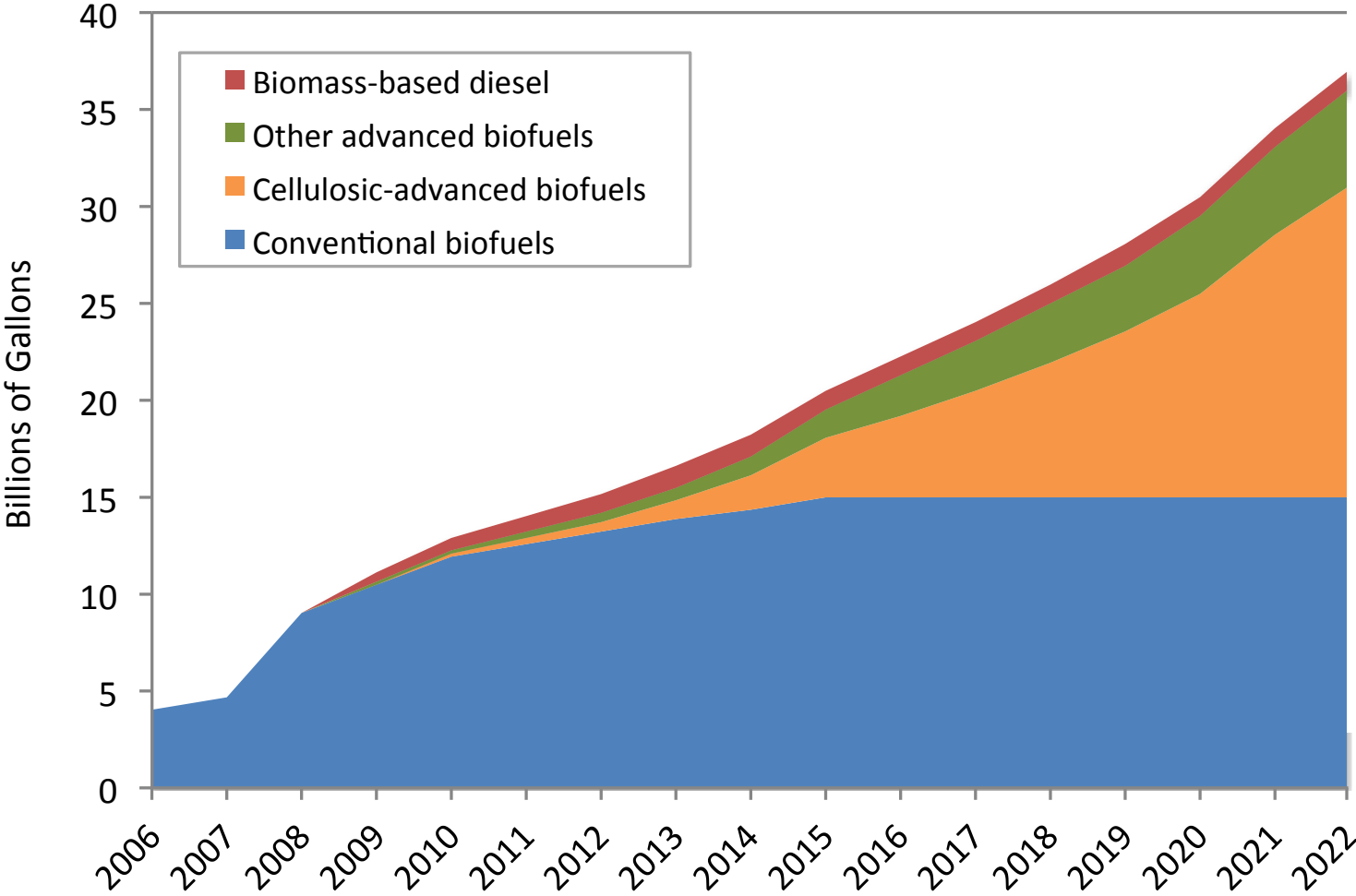
Infrastructure and Boundaries



U.S. Federal Policy and Incentives for Biomass Technologies

- Renewable Fuel Standard (EPA)
 - Establishes goals for biofuel usage in the US (36 billion gal of biofuel by 2022)
- Repowering Assistance Biorefinery Program (USDA)
 - Reimburses up to 50% of cost as incentive to convert fossil fuel refineries into biorefineries
- The Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program (USDA)
 - Loan guarantee program. 60-90% loan guarantees to incentivize development and construction of commercial-scale biofuels or bioheat/biopower plants. \$100M for FY2014, \$50M for FY2105
- Biomass Crop Assistance Program (USDA)
 - Advanced Biofuel Feedstock Incentives: annual and matching payments for producers of advanced feedstocks.
- U.S. DOE Bioenergy Technologies Office (BETO)
 - Subset of US Department of energy. RDD&D Program.

Renewable Fuel Standard



State Policies in Support of Bioenergy

- Less than 15 states have policies specifically incentivizing biomass usage
- Most common types of incentive: incentives, tax credits, rebates
- Policies encourage:
 - Use of biomass in heating (excluding wood)
 - Industry production/collection of biomass
 - Funding of equipment, businesses, or homes using biomass
 - Installation of biomass CHP plants
 - Agricultural production for use in electrical generation
- Plant Construction or Equipment Incentivized
 - New Mexico
 - South Carolina
 - Illinois
 - New Jersey
 - Michigan

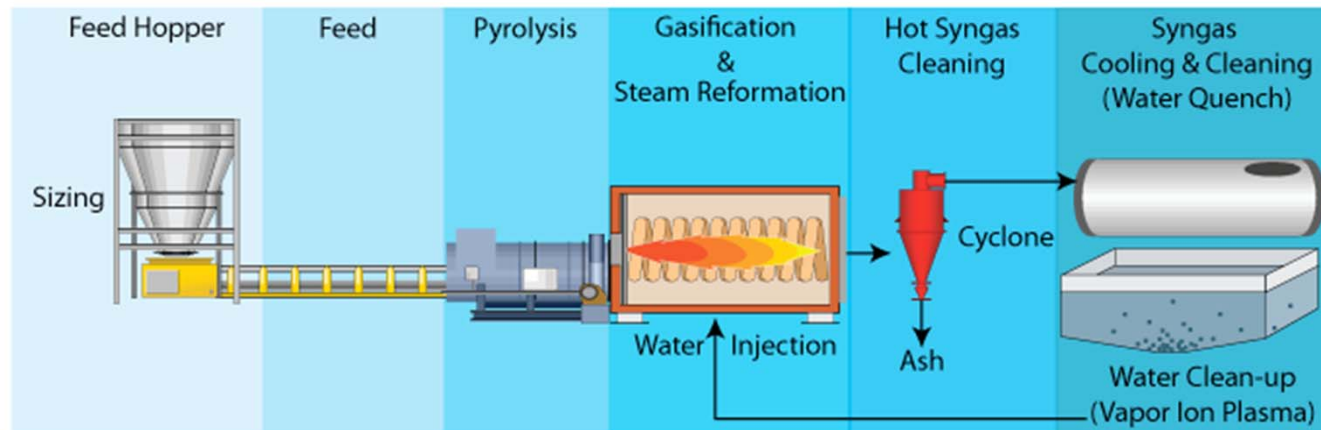
Fulcrum Bioenergy Sierra Biofuels Plant

- Waste to FT fuels
- 200,000 t/y MSW
- Designed for 10 million gallons syncrude
- TRI gasifier
- Agreement with United Airlines
- Startup expected late 2017



Red Rock Biofuels

- Biomass to FT fuels
- Lakeview, Oregon
- TCG Global gasifier
- Veolocys for FT
- Targeting jet fuel
- Target completion 2016
- \$182 million investment



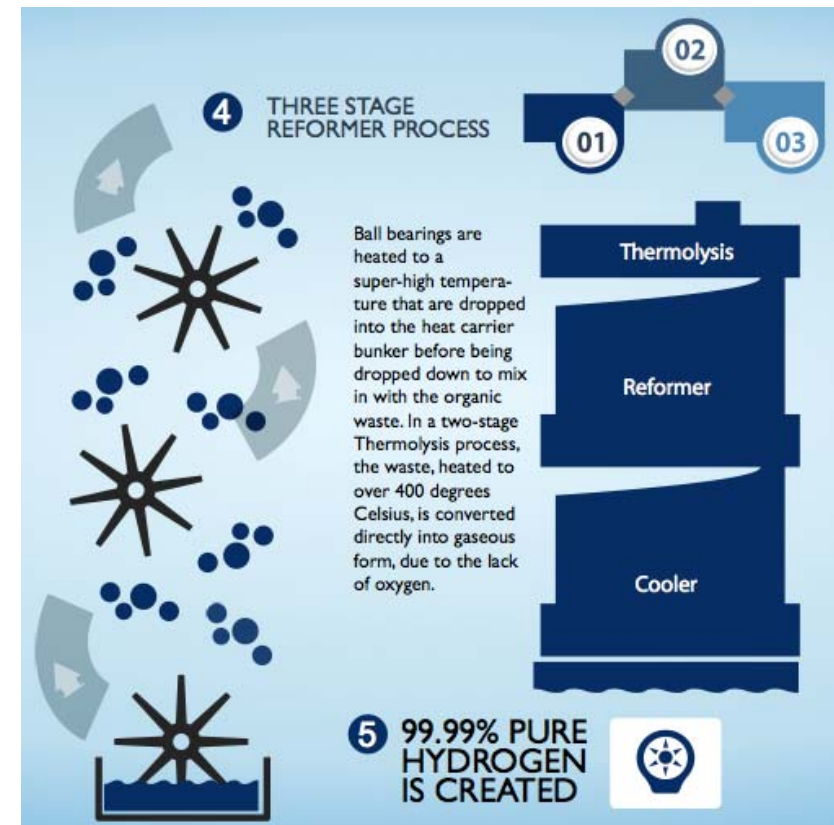
LanzaTech Freedom Pines Biorefinery

Soperton, Georgia

- Biofuel production through LanzaTech's syngas fermentation technology
- Concord Blue chosen as gasification technology provider. Gasifier installation began 2014.
- Target to combine gasifier and fermentation in 2015
- No new news of note



Freedom Pines
Biorefinery



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
- Stopped in early 2015 to address technical issues
- No new updates since May



Technology Spotlight: Phoenix Energy

- Provides on-site biomass power plants
- Small plants: 1-3 MW
- Based in San Francisco, California

Facilities:

- Lake Tahoe, NV
- North Fork, CA
 - Expected operation end of 2016

