An Overview of Wood Energy in North America




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THE PATH FORWARD FOR WOOD PRODUCTS: A GLOBAL PERSPECTIVE

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Louisiana Forest Products Development Center

School of Renewable Natural Resources
Louisiana State University

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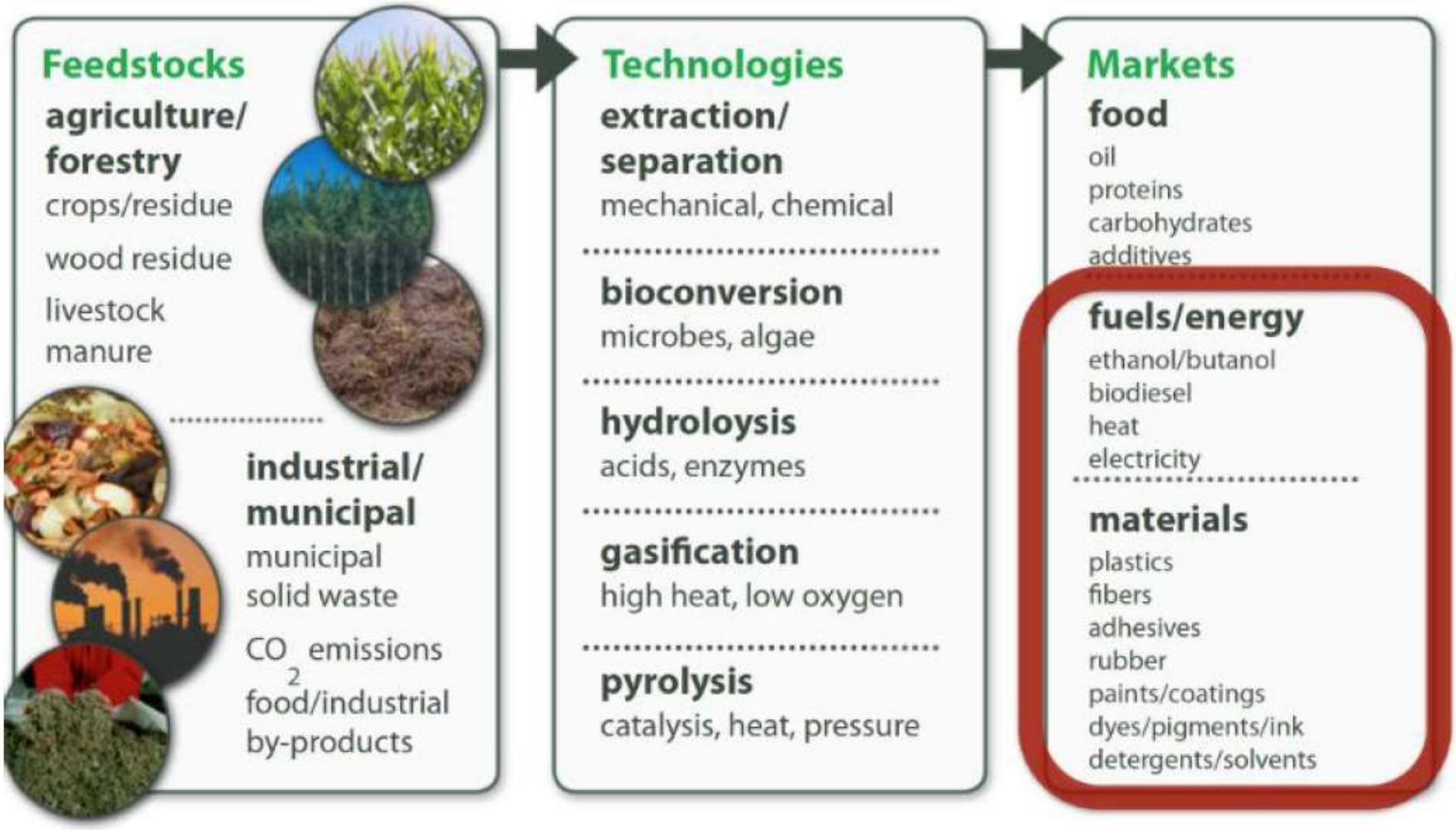
Presentation Outline

- Renewable Energy
- Where Does Wood Fit In?
- Wood Biomass Sources
- Wood Energy Options
- Successes & Failures
- Drivers & Challenges

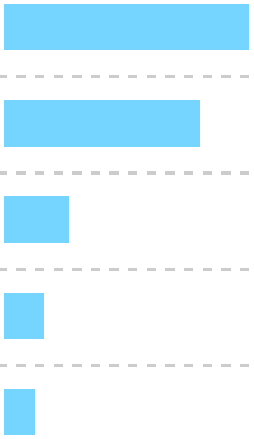
The "Advanced Bioeconomy"



Lane, Ohio State University, 2015

Total Primary Energy Consumption, 2013

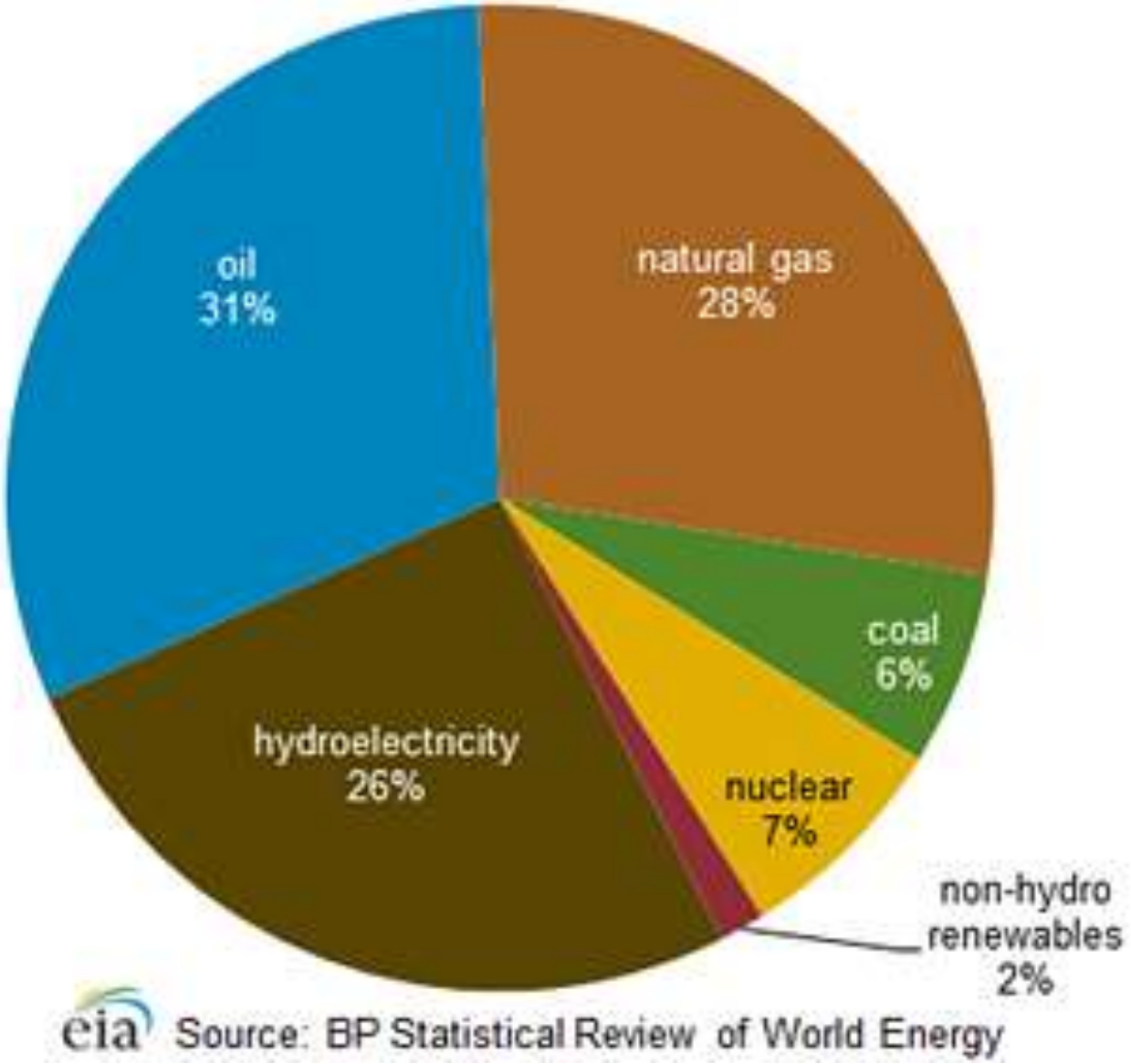
Ranking ▲	Country	Quadrillion Btu
1	China	114.62
2	United States	90.982
3	Russia	30.495
4	Japan	19.816
5	Canada	13.945



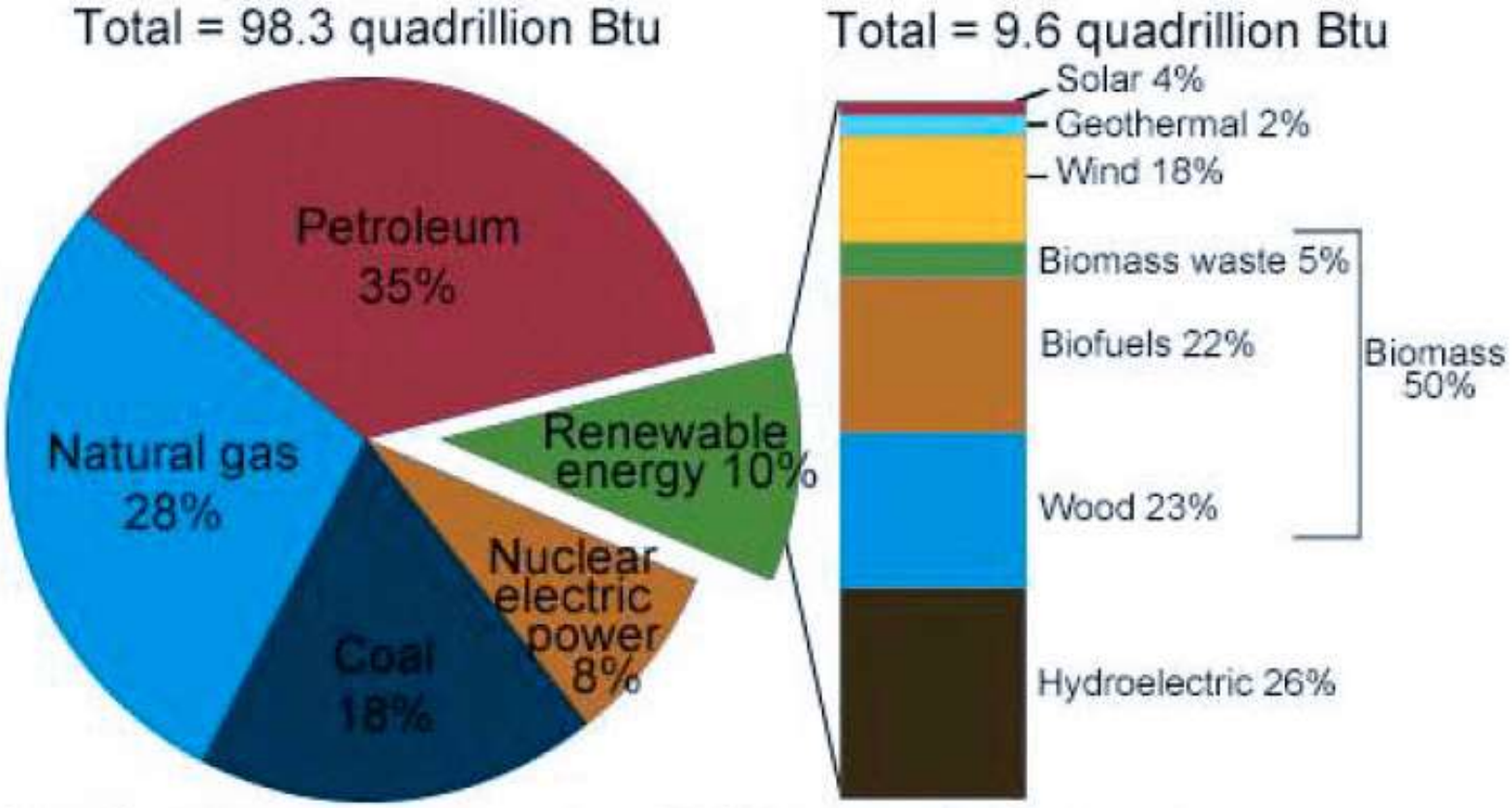
The U.S. Energy Information Administration (EIA)

Canada's total energy consumption by type, 2014

~14 Quadrillion BTUs



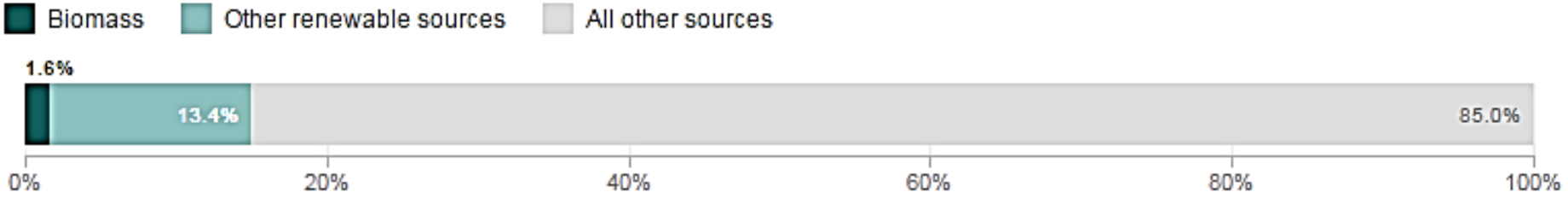
U.S. energy consumption by energy source, 2014



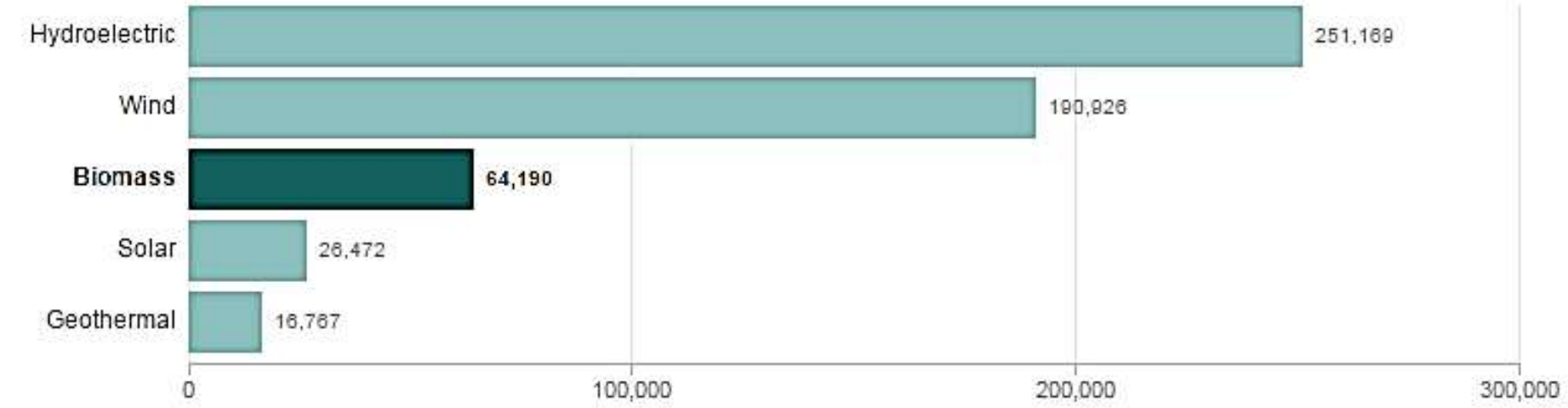
Note: Sum of components may not equal 100% as a result of independent rounding.

Source: U.S. Energy Information Administration, 2015

SHARE OF U.S. ENERGY GENERATION, 2015

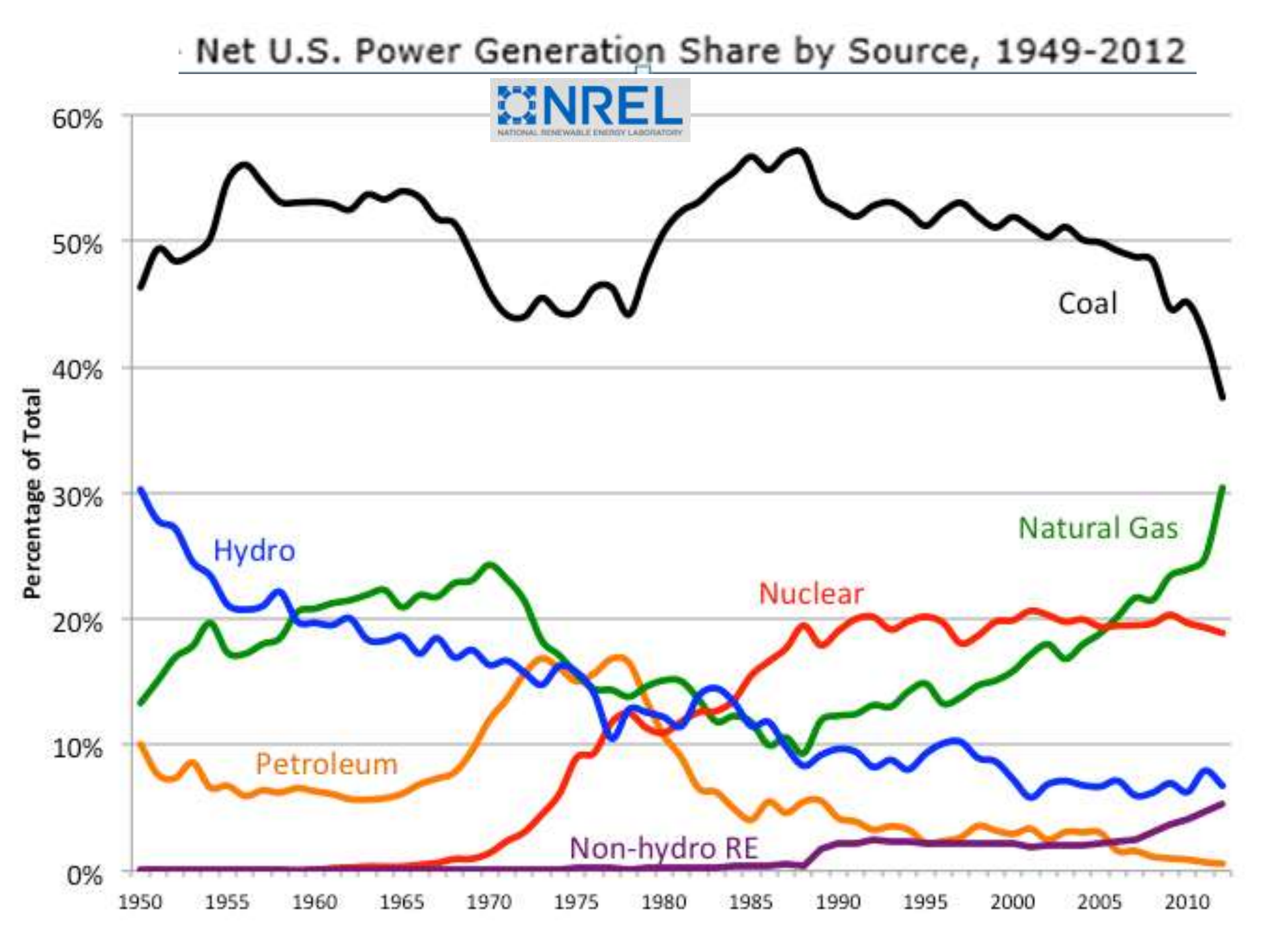


ENERGY GENERATION BY RENEWABLE SOURCES, IN GIGAWATT-HOURS



Source: Energy Information Administration

Credit: Katie Park/NPR


Net U.S. Power Generation Share by Source, 1949-2012
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
60%
50%
40%
30%
20%
10%
0%
Percentage of Total
Coal
Hydro
Natural Gas
Nuclear
Petroleum
Non-hydro RE
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

So, what are the drivers for renewable energy?

- Primarily Agriculture, Energy and Defense budgets taking the lead on development and deployment of biofuels.
- USDA and DOE supporting development of other biobased products (such as chemicals).
- Tax policy — notably, investment and production tax credits.
- Why? Reduce foreign oil dependence.

How much funding are we talking about?

- 2015 Department of Energy Budget-$253 million
  - Develop and demonstrate conversion technologies to produce advanced *biofuels*, such as “drop-in” replacements for gasoline, diesel, and jet fuel.

- *Energy Security Trust*-In addition, $2 billion over the next 10 years from Federal Oil and Gas Development Revenue

  - Mandatory funding for R&D on cost-effective *transportation* alternatives.

  - Develop *environmentally sustainable* feedstocks and *economically viable* logistics systems to sustainably supply the biofuels industry.

European Union
Mandates, Policies, Incentives & Subsidies

- European climate change policies are primarily designed to decrease carbon-dioxide emissions and increase the use of renewable energy.
- In 2011, the European Commission established an Energy Roadmap, which set a goal of reducing E.U. greenhouse gas emissions by at least 80 percent—compared with 1990 levels—by 2050.
- At the same time, several European countries are restricting the production of natural gas and, in the case of Germany, aiming to phase out nuclear energy.

e21 Economic Policies for the 21st Century AT THE MANHATTAN INSTITUTE

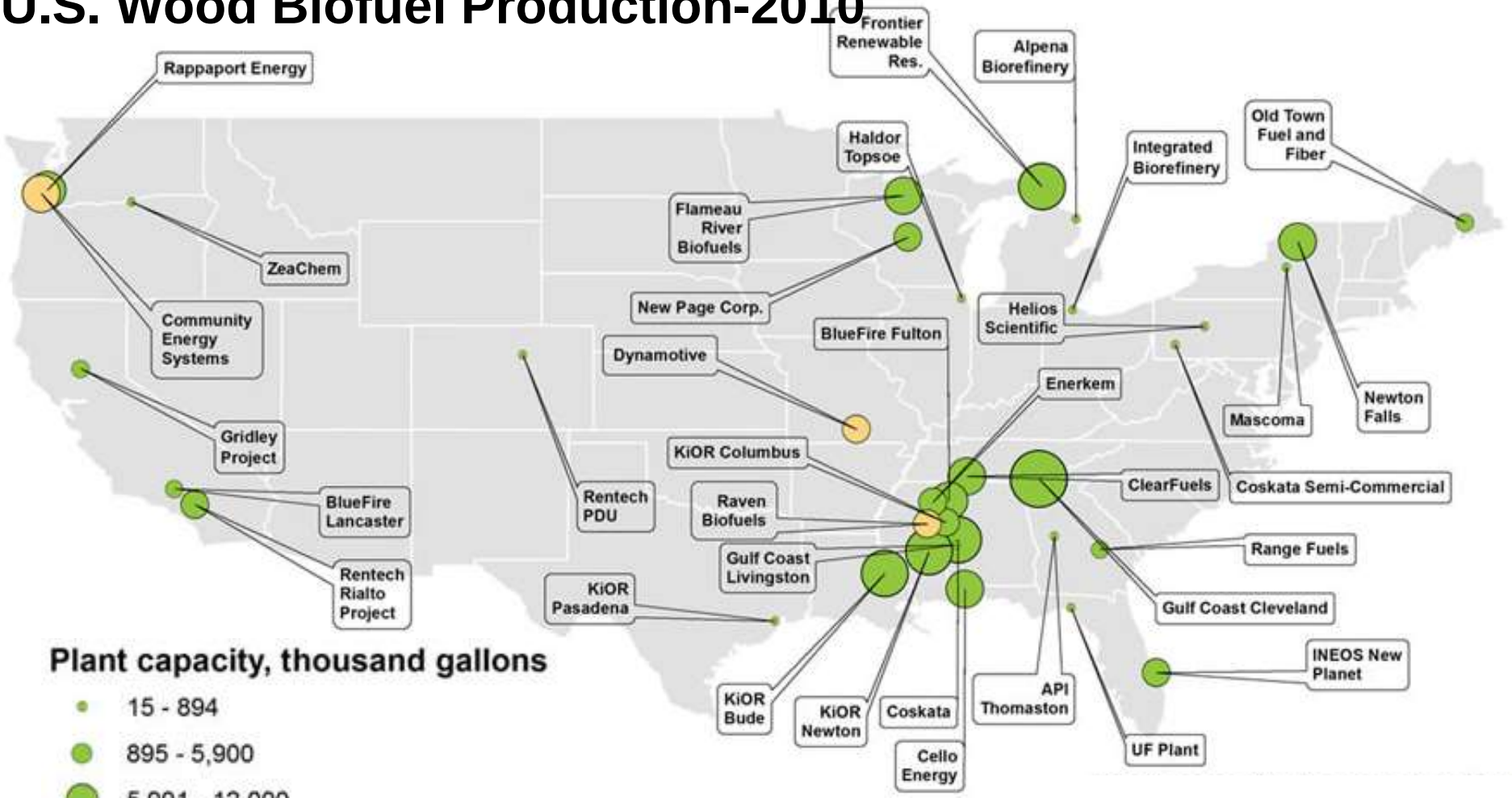
Bryce, 2016

Where Does Wood Fit into the Picture?

Wood Energy in North America

- Wood is the most commonly used biomass fuel for heat and power.
- About 84% of the wood and wood waste fuel used in the U.S. is consumed by industry, electric power producers, and commercial businesses.
- Most of this is used at wood product manufacturing facilities in cogeneration.

U.S. Wood Biofuel Production-2010



*Primarily ethanol, butanol, diesel, gasoline, and jet fuel

Source- Forisk & Schiamberg Group

Wood-based Biomass Sources

Wood-based Biomass Sources

Primary mill residues

Wood materials [illegible] nufacturing plants (primary wo[illegible]ills) when r[illegible] products are processed [illegible]nary wood prod[illegible]

Slabs, e[illegible], trimmings, sa[illegible]veneer [illegible]gs and cores, and pul[illegible]enings.

Wood-based Biomass Sources

Secondary mill r

Wood scrap ust from v ng shops, furniture factories, ntainer and pall . that use lumber, d and other "pri rials.

Wood-based Biomass Sources

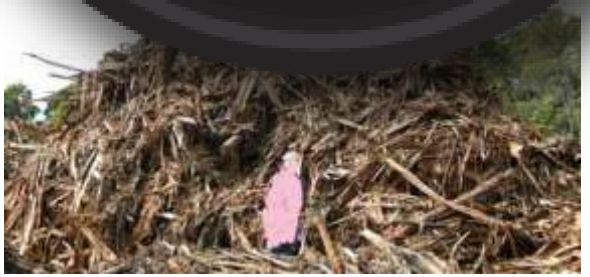
Urban wood wast

Discarded wo mings, m construction and demolition .

Wood-based Biomass Sources

Post-Harvest forest resid ng Slash

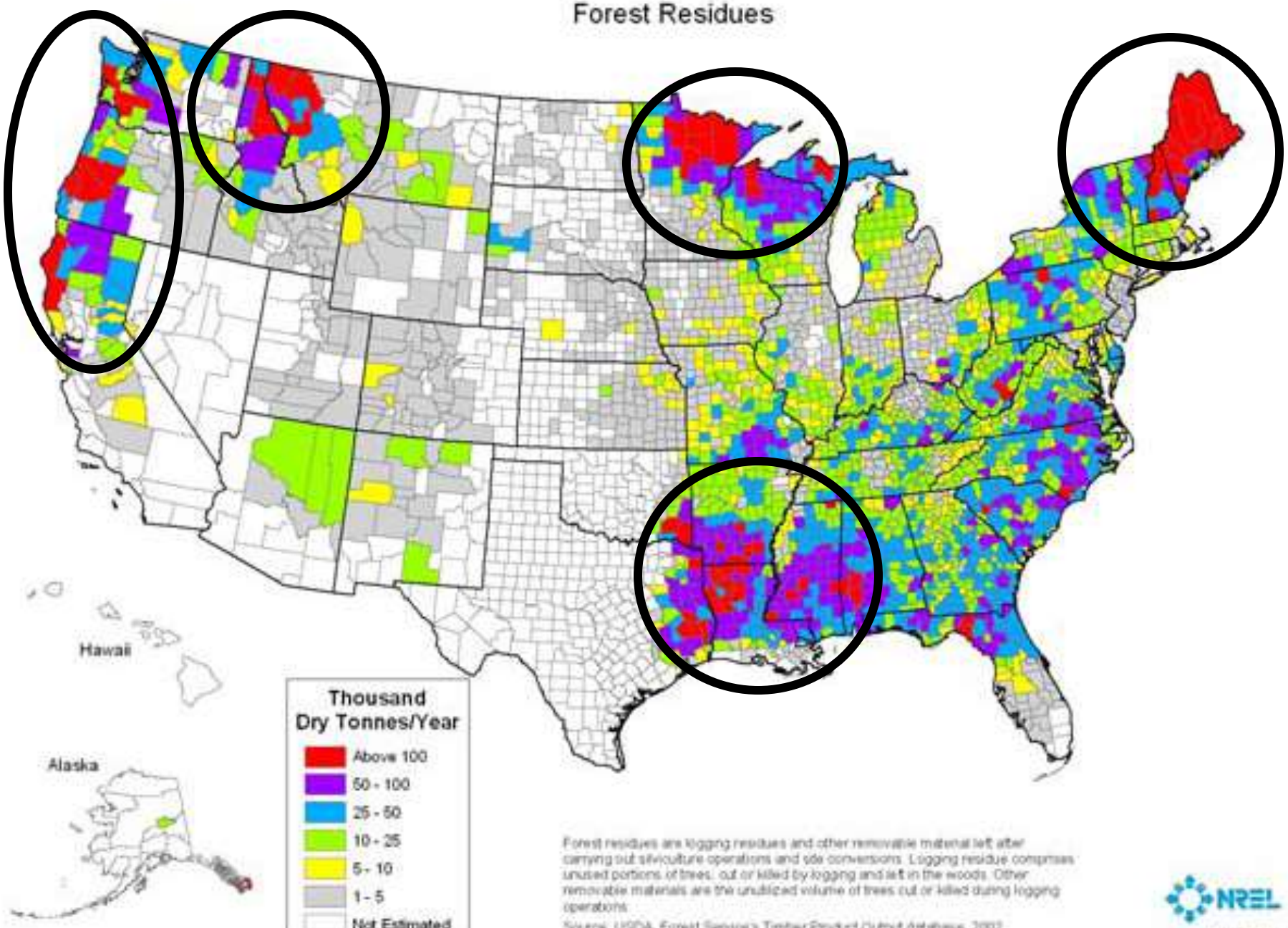
Logging residue, un cut or killed during logging or silvicu he woods; unutilized volu logging operations.



Wood-based Biomass Sources

- **Logging Slash:**
  - 3-8 tons/acre (1.2-3.2 tons/hectare from needles, branches left on site.
  - Potential
    - Chip tree tops instead of pushing it back into stand.

Forest Residues



Forest residues are logging residues and other removable material left after carrying out silviculture operations and site conversions. Logging residue comprises unused portions of trees, cut or killed by logging and left in the woods. Other removable materials are the unutilized volume of trees cut or killed during logging operations.

Source: USDA, Forest Service's Timber Product Output database, 2002

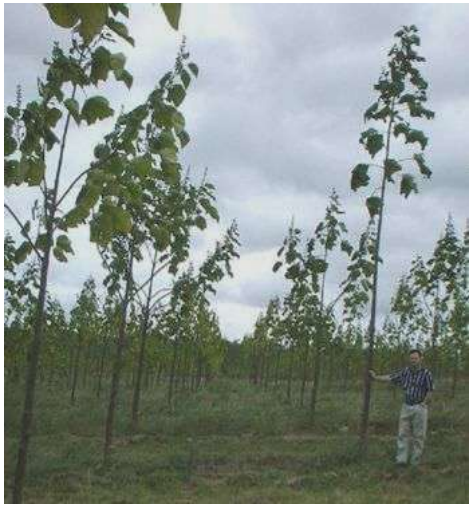
NREL

March 2005

Wood-based Biomass Sources
Short-rotation woody crops

Hybrid Poplar

Paulownia (1 year)



Eucalyptus globulus
(3 years)
Australia

Eucalyptus sp.
(6 years-rotation age)
Brazil

Wood-based Biomass Sources
Short-rotation woody crops

- Eucalyptus species can grow along Southeast U.S. coastal region
- Yields:
    - 12-20 tons/acre (5-8 tons/hectare) per year
    - Mature by age 6-9

Wood-based Biomass Sources
Genetically Modified Woody Crops

Genetically Modified Eucalyptus
(5 years)-FutureGene-Israel

Wood to Energy
What are the options?

Cogeneration

- Simultaneous production of heat and electricity, commonly called combined heat and power (CHP), from a single fuel.

- Traditionally, a steam turbine is used to produce electricity, although a wood gasification/ internal combustion unit can also be a cogeneration unit.

- Most of **U.S**. CHP capacity is in wood products manufacturing industries.

Gasification

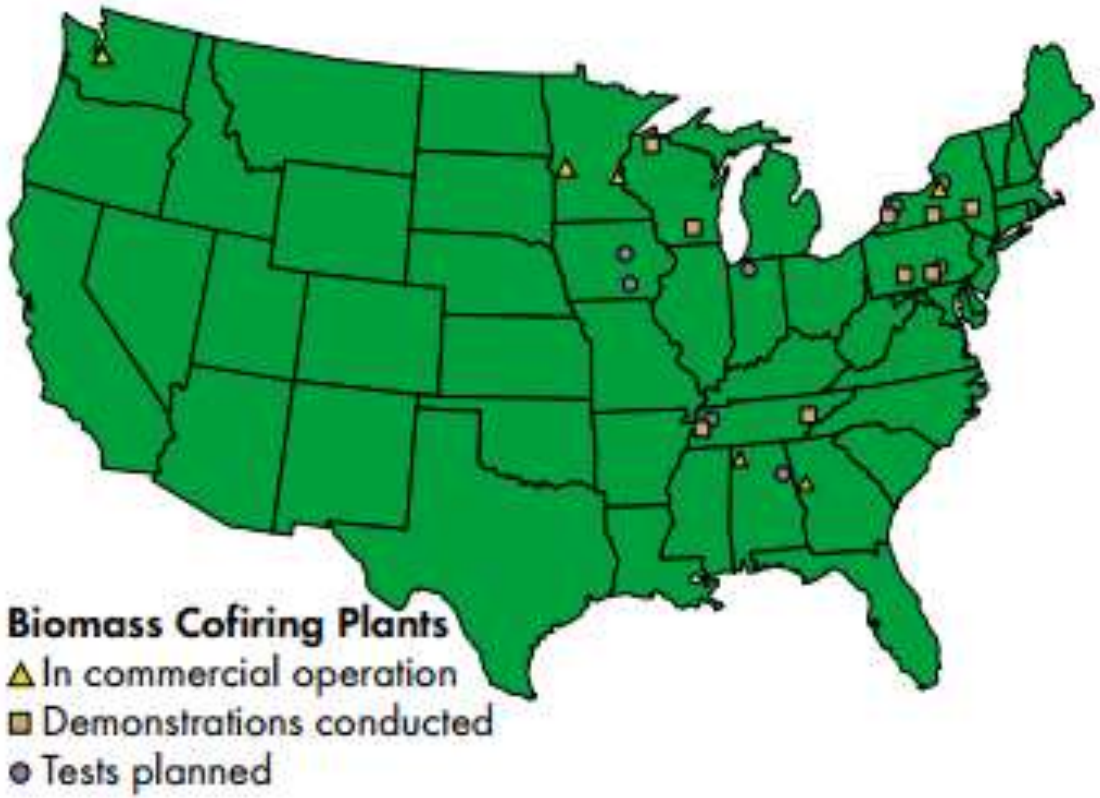
- Converts carbon-based materials, such as coal, petroleum, biofuel, or biomass…..
- into carbon monoxide and hydrogen…..
- by reacting the raw material, at high temperatures controlled *with oxygen* and/or steam.
- The resulting gas mixture is called synthesis gas or syngas and is itself a fuel.
  - Convert to steam→Electricity
  - Convert to other co-products, chemicals

Pyrolysis

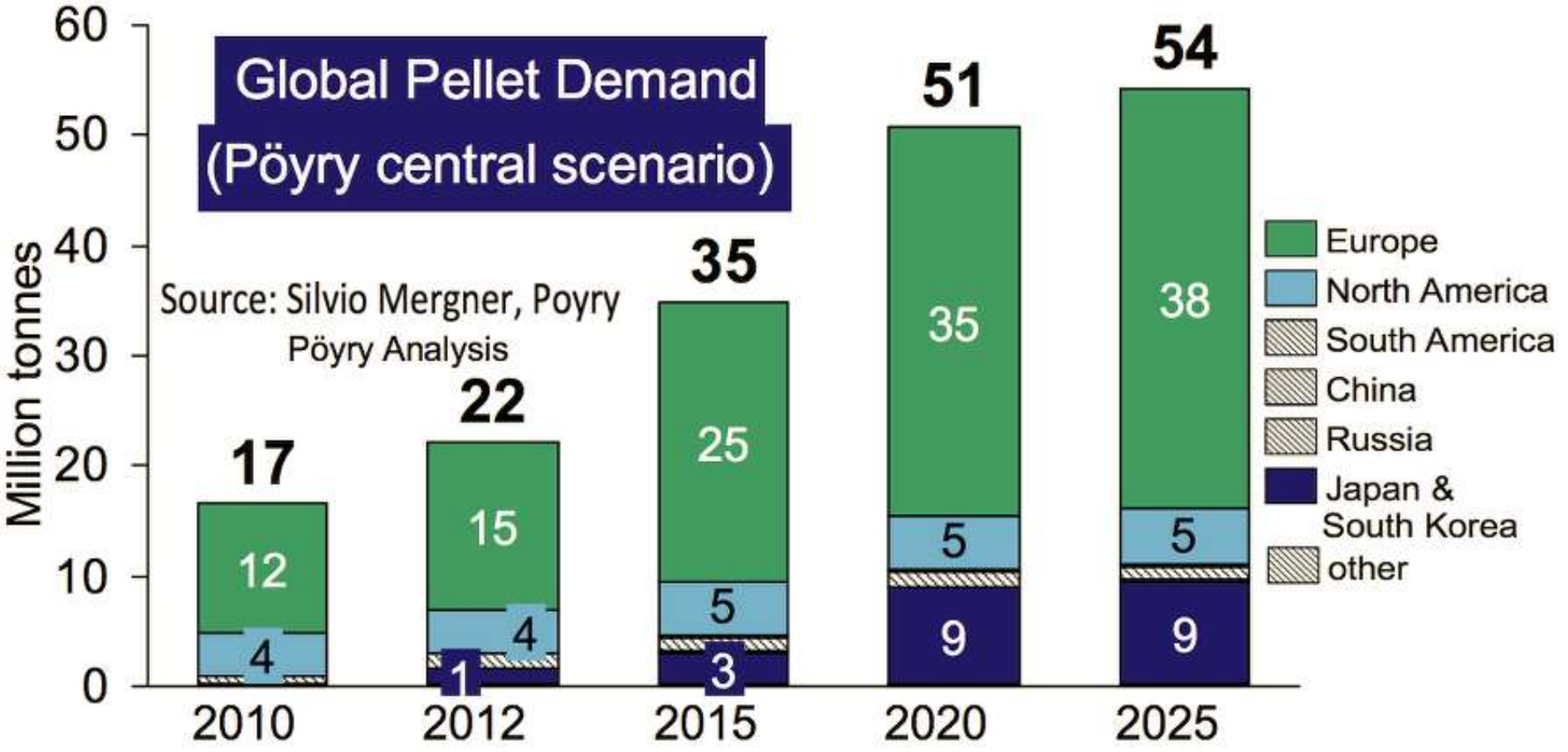
- Chemical decomposition of a condensed substance by heating.
- Does not require oxygen.
- Extreme pyrolysis, which leaves only carbon as the residue, is called *carbonization* and is also related to the chemical process of *charring*.
- Pyrolysis is used in the to produce charcoal, activated carbon, methanol and other chemicals from wood.

Co-firing Biomass and Coal

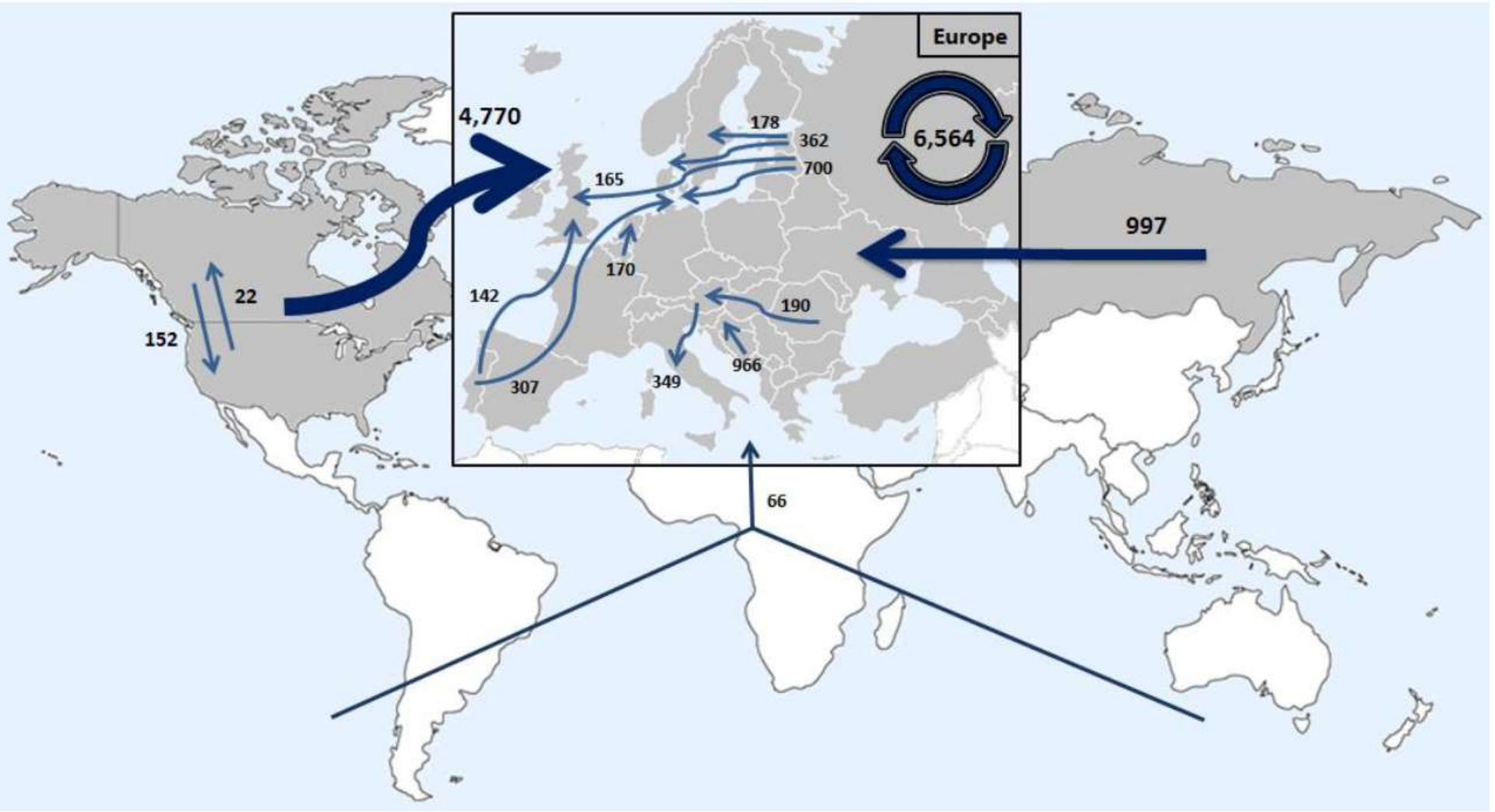
- Proven technology but…still few large-scale operations
- Percent of biomass varies widely (3%-90%)
- Challenges:
  - Biomass storage
  - Biomass moisture content
  - Boiler adaptability-retrofit
  - Ash content
  - Dust and mold



Pellets-Where the Action Is

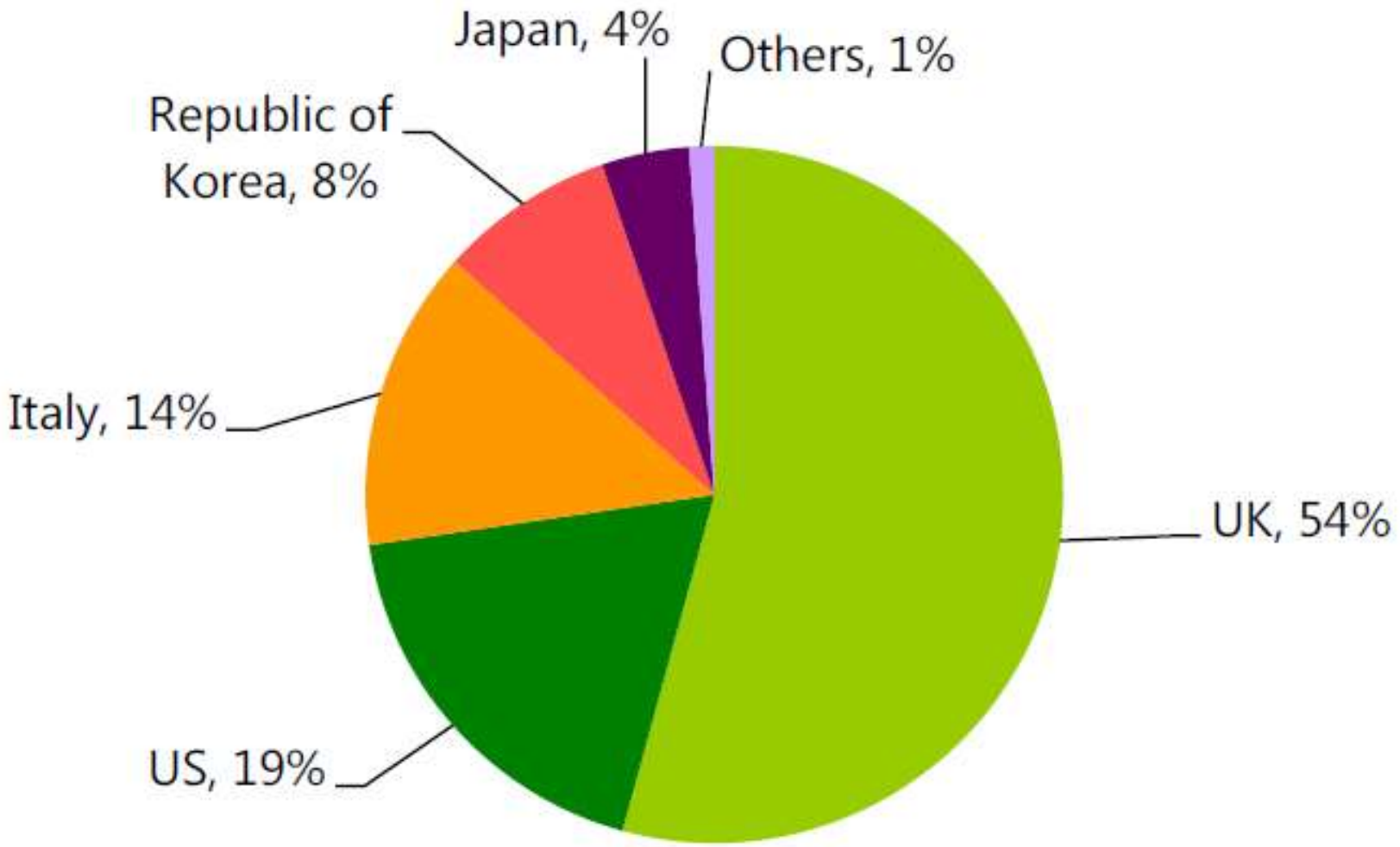


Global main trade flows of wood pellets, 2013 (thousand tonnes)



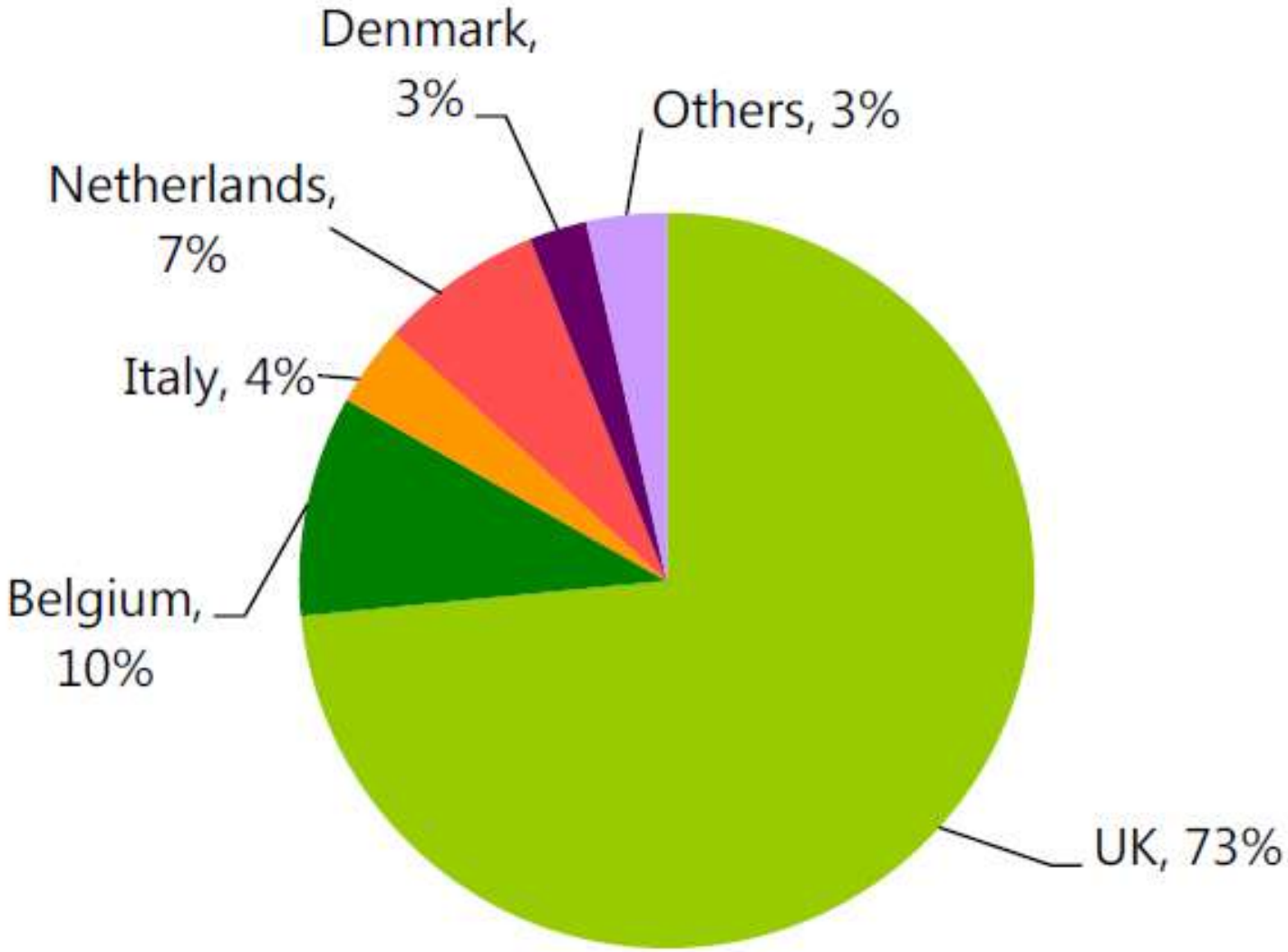
Comtrade 2015 in UNECE/FAO Forest Products Annual Market Review, 2014-2015

Top five export partners with Canada (by percentage of trade value) for wood pellets, 2014, as reported by Canada



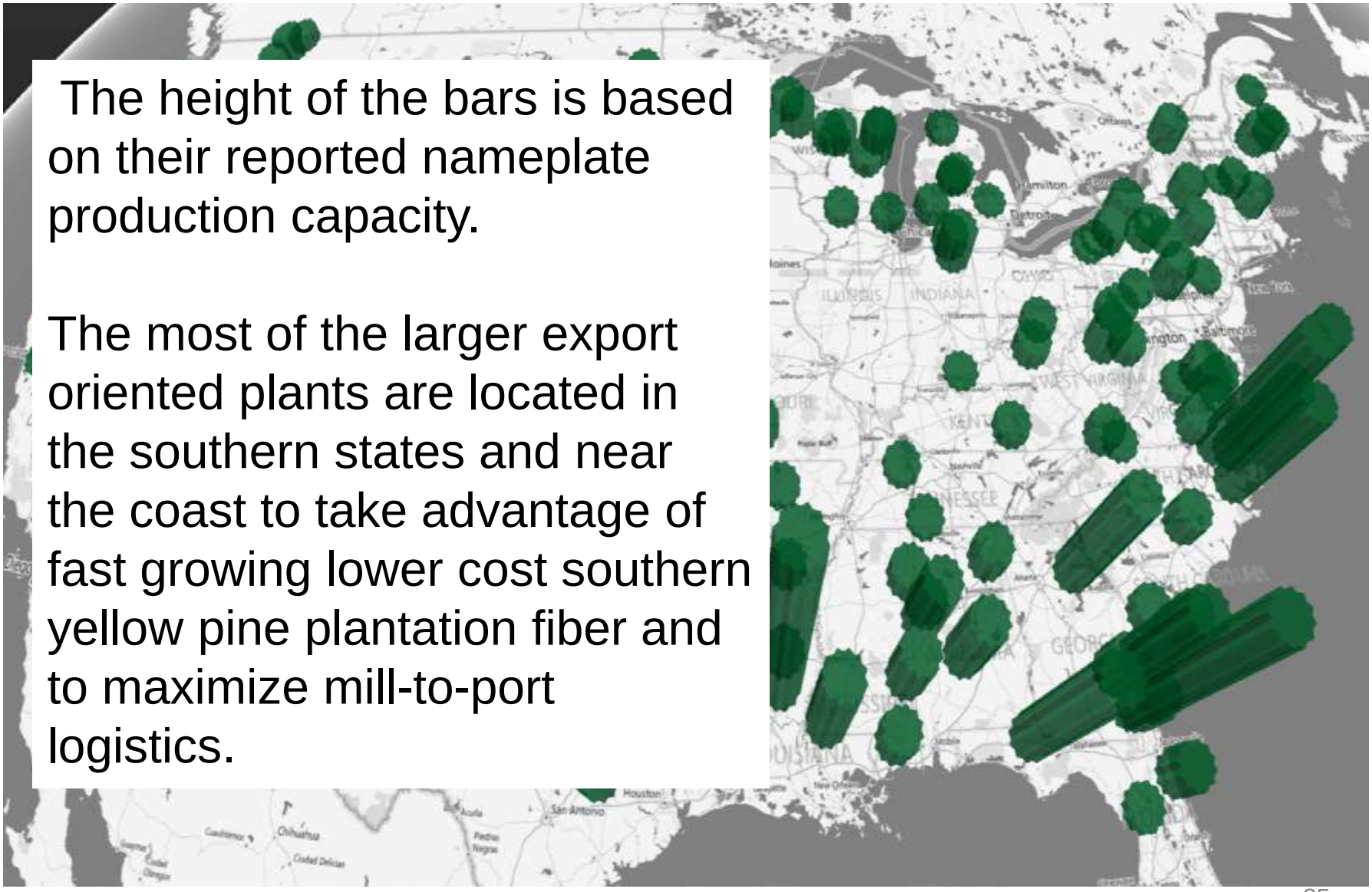
Comtrade 2015 in UNECE/FAO Forest Products Annual Market Review, 2014-2015

Top five export partners with the US (by percentage of trade value) for wood pellets, 2014, as reported by the US



Comtrade 2015 in UNECE/FAO Forest Products Annual Market Review, 2014-2015

U.S. Pellet Mills



The height of the bars is based on their reported nameplate production capacity.

The most of the larger export oriented plants are located in the southern states and near the coast to take advantage of fast growing lower cost southern yellow pine plantation fiber and to maximize mill-to-port logistics.

BBI / FutureMetrics, 2015

The U.S. South-Where the Action Is

- Over 75 percent of U.S. wood pellet production capacity is located in the southeastern U.S.
- Georgia, Florida, Alabama and Virginia produce the vast majority of American pellets.
- Approximately 98 percent of wood pellet exports ship from southeastern U.S. ports.

Capacities: Biomass Magazine December 9, 2015; Location: GTIS World Trade Atlas, US EIA Data

Successes & Failures

Successes

Typically Small-Scale

Biomass→Gasification→Electricity generation

- Schools
- Public facilities
- Test projects
- (Developing countries)

Converting Woody Biomass into Engineered Biocarbons

coolterra®

Engineered Biocarbon

Production Agriculture

FedEx Taps Biofuel Supplier for Jet Fleet

- Red Rock Biofuels-jet fuel from forest wastes in the Pacific Northwest from refinery in Lakeview, Oregon.
- FedEx and Southwest Airlines have committed to buy the refinery's 15-million-gallon annual output.
- The first delivery to FedEx is expected in 2017, and the agreement runs through 2024, Red Rock said.
- *The refinery would be funded in part by a $70 million grant from the federal departments of Agriculture, Energy and Navy.*

Source: The Commercial Appeal 2015


FAILURE

- 100-MW Southern Energy wood-fired power plant in Nacogdoches, Texas
- 20-year power purchase agreement with Austin (Texas) Energy
- Completed in 2012
- Idled in 2012-----→Re-started 2015

Logging slash bundled to support power plant

KiOR Goes Double or Nothing on Platform

At their peak (nameplate) both KiOR facilities in Mississippi will convert 500 tons of biomass per day into annual production of 13 million gallons of product -- a combination of cellulosic gasoline, diesel, and oil.

September 27, 2013

Kior Inc., Biofuel Company, Files Bankruptcy, Plans Sale

November 10, 2014

A Sad Note for the State of Louisiana

LOGGING NEWS

German Pellets improved EBITDA to Euro 38 million

German Pellets proceeds with plan to double production at LA wood pellet mill to approx. 1.2 million tons/yr. (July 2015)

Mega Perspectives

National Security

Economy

Environmental

Brent Bailey-25x25, 2014

National Security Issues

- Energy goals set in 2009 for the Department of the Navy-increased use of alternative and renewable energies in marine operations and ashore facilities.

- Goals of the energy initiative was to have the Navy's fleet reduce its overall petroleum use by 50% compared to 2009 amounts.

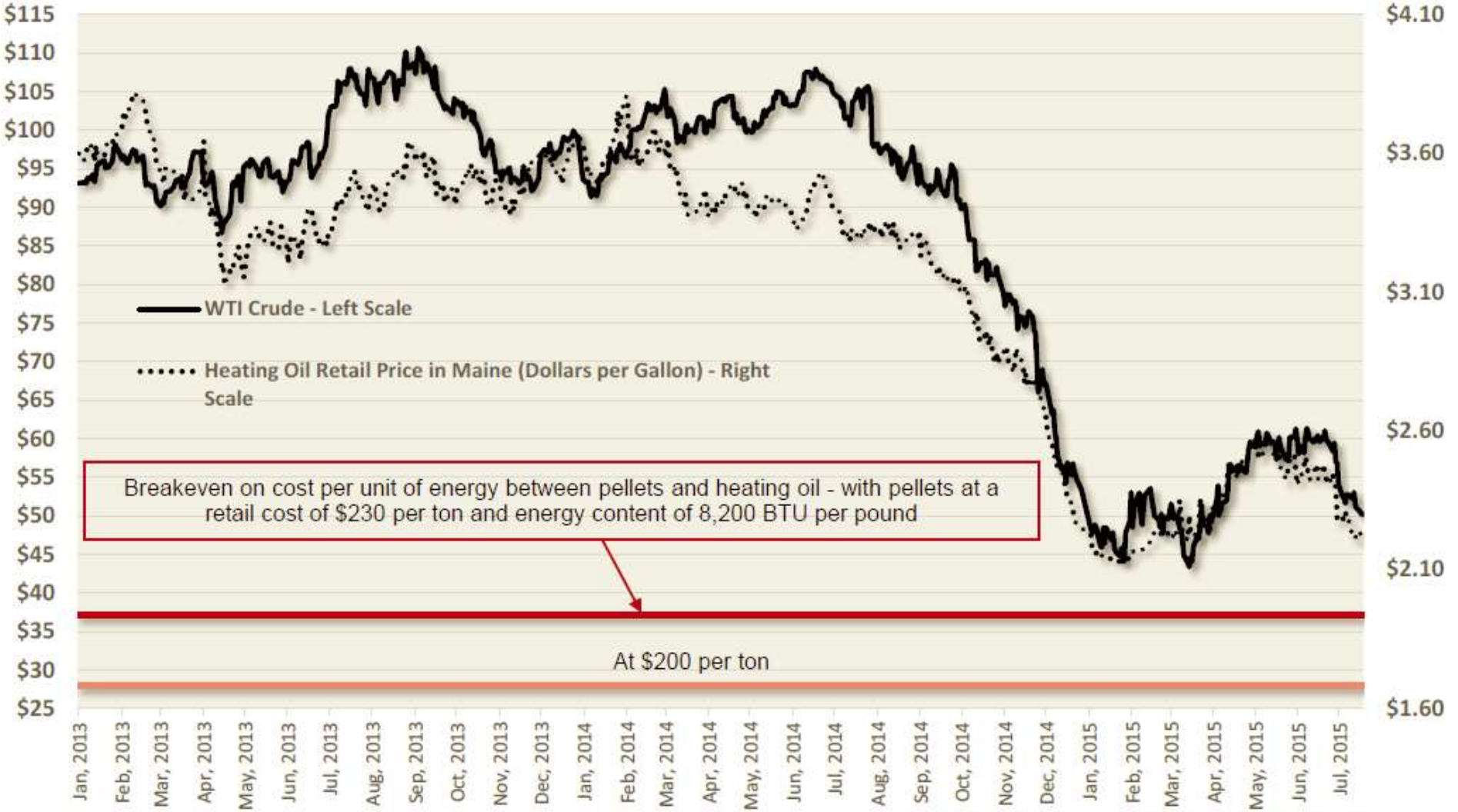
- On January 20th, 2016-the missile destroyer USS Stockdale officially became the first US Navy ship to use a biofuel mixture for regular military operations.

Economic Issues

- Subsidies/incentives, natural gas/oil prices, wood fiber prices.
- Harvesting, collecting and transporting cellulosic post-harvest biomass residues can be difficult and expensive.
- Transportation costs.


Natural Gas Price
1.72 USD/mmBTU
7 Mar '16
Natural Gas Price (USD/mmBTU)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jun 6
2008
Sep 24
2010
Jan 11
2013
May 1
2015
InfoMine.com

<== Crude and Heating Oil ===> Prices



source: EIA, July, 2015; Analysis by FutureMetrics

Environmental Issues

- Sustainability – Removals > Growth
- Biodiversity – harvest of lowland hardwoods
- Soil Quality – Organic matter removal
- Air Quality – Emissions
- Water Quality – Poor forest practices
- Carbon – Carbon neutrality (disagreement)
- Forest Health – Lack of forest management

Other Challenges/Issues

- **Infrastructure**
  - Transmission lines need to be modernized and expanded to tap into rural sources of electricity, especially wind.
  - Biofuels need expanded pipelines, rail, ports and other shipping facilities to get to urban consumers; expansion of blender pumps and flex fuel vehicles are also needed.
- Significant long term **public and private investment** is needed to achieve a new, renewable energy future.
- **Regulatory actions** and proposals from government agencies (on both the supply and demand side).

Changes in UK Renewable Energy Incentives May Affect Pellet Demand

- Eurostat reported that the United Kingdom is in danger of not meeting its renewable energy targets by 2020.
- The U.K government announced it would stop issuing *Climate Change Levy Exemption Certificates (LEC)* beginning August 1, 2015.
- Will require electricity generators to pay a climate change tax on renewable electricity that significantly reduces climate change impacts.

Wood Energy Subsidies On The Chopping Block In The Netherlands

February 19, 2016

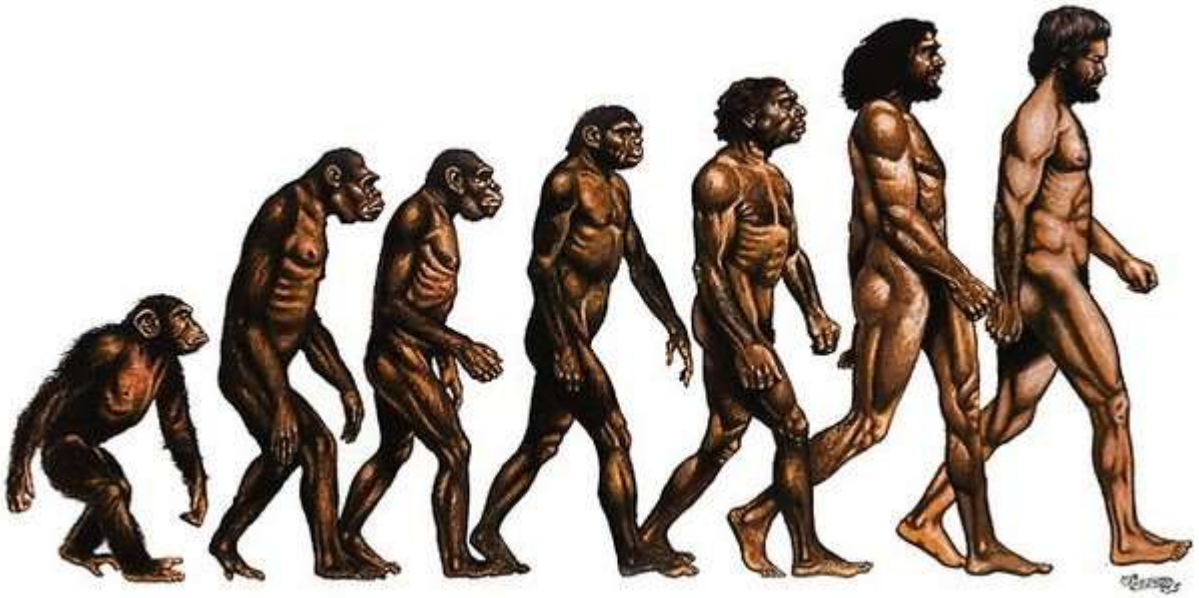
Clean Technica

German Lawmakers Vote to Reduce Renewable-Energy Subsidies

June 27, 2014

BloombergBusiness

The Situation is Evolving



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Thank You!

Questions???

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