An Update of the Wood-based Energy Sector in North America




Richard Vlosky, Ph.D.
Director and Crosby Land & Resources Professor in Forest Sector Business Development
Louisiana Forest Products Development Center
Louisiana State University Agricultural Center
Baton Rouge, Louisiana USA

Louisiana Forest Products Development Center

WOOD BIOENERGY CONFERENCE & EXPO

LSU AgCenter Research · Extension · Teaching

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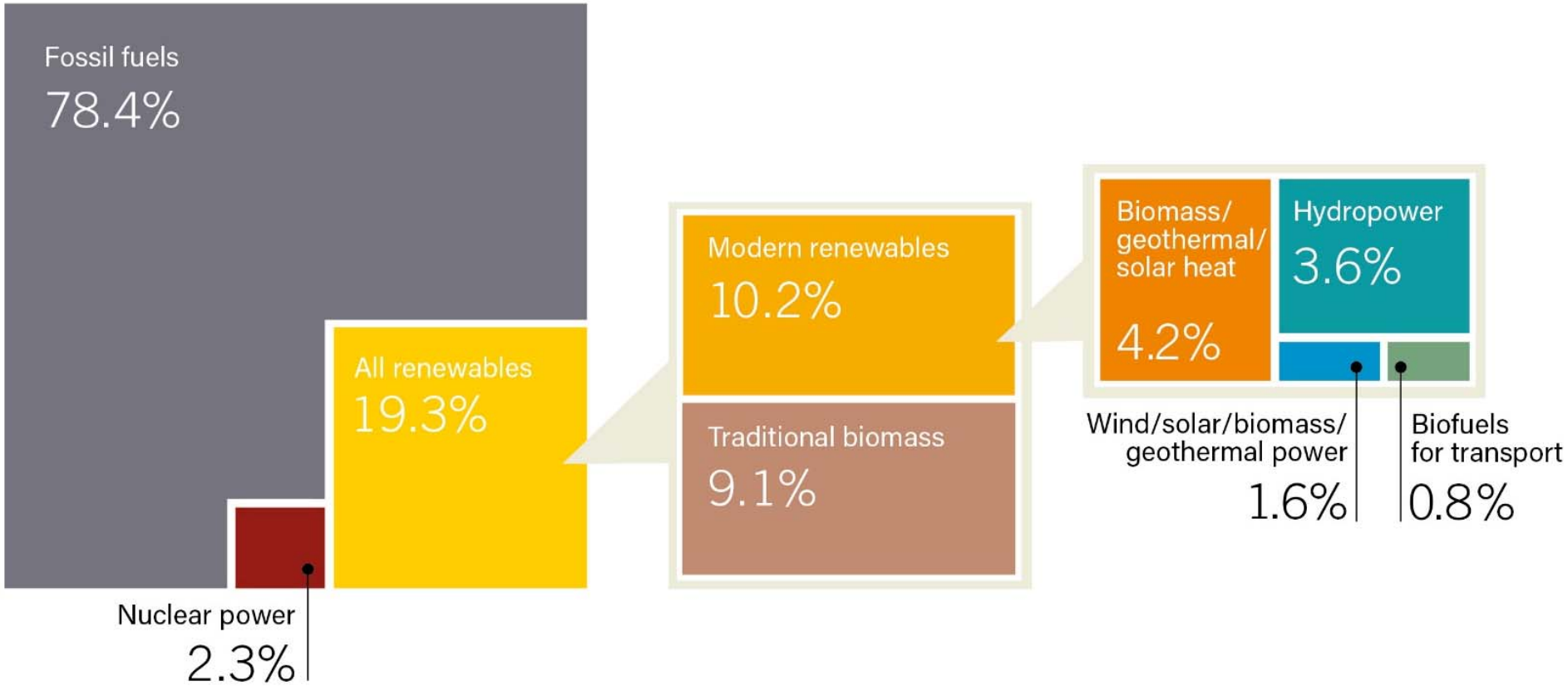
Presentation Outline

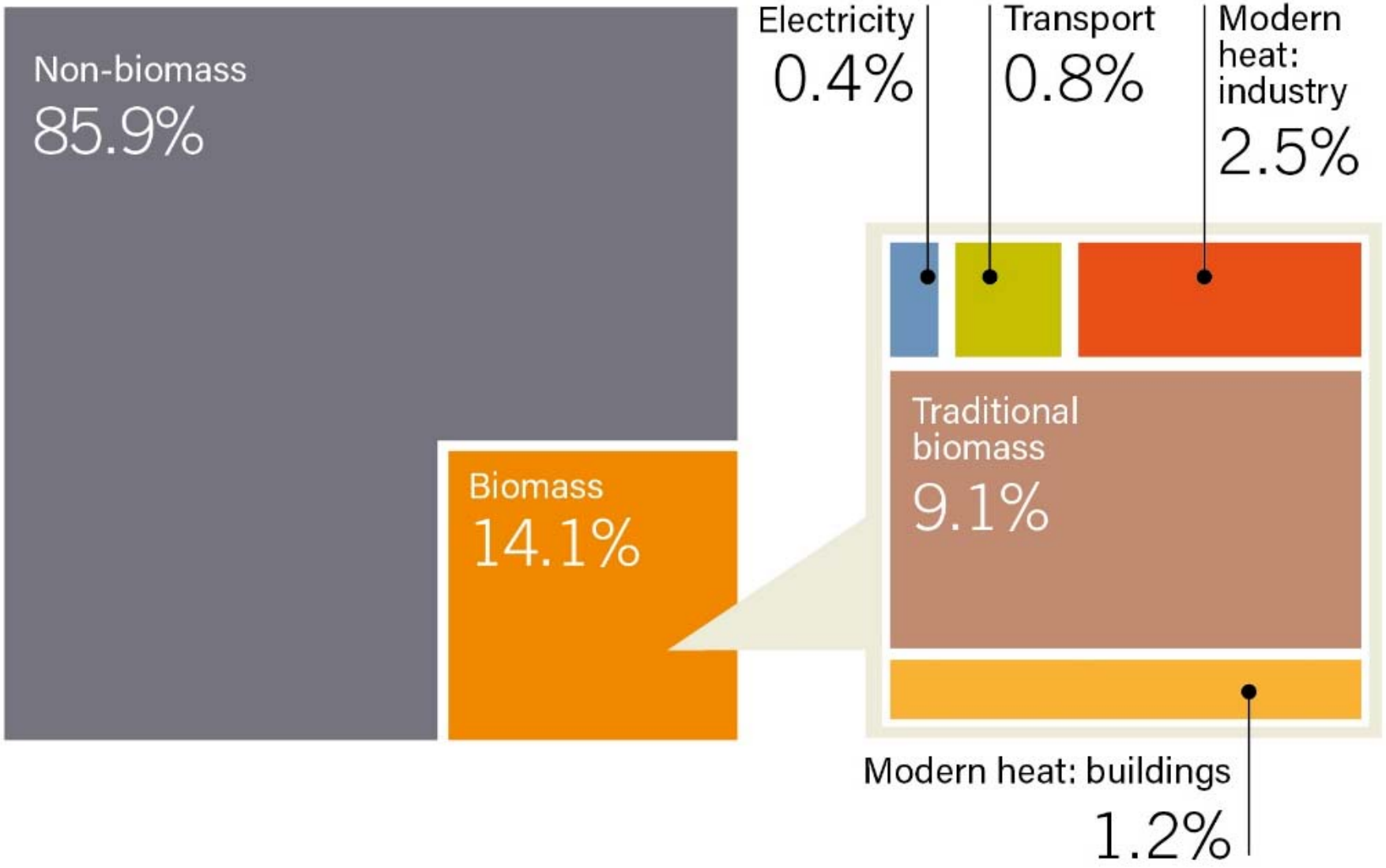
- Renewable Energy
- Global Perspective
- Energy Generation by Type
- Where Does Wood Fit In?
- Wood Biomass Sources
- Wood Energy-What's Happening?
- Conversion Options
- Pellets
- Wrap Up

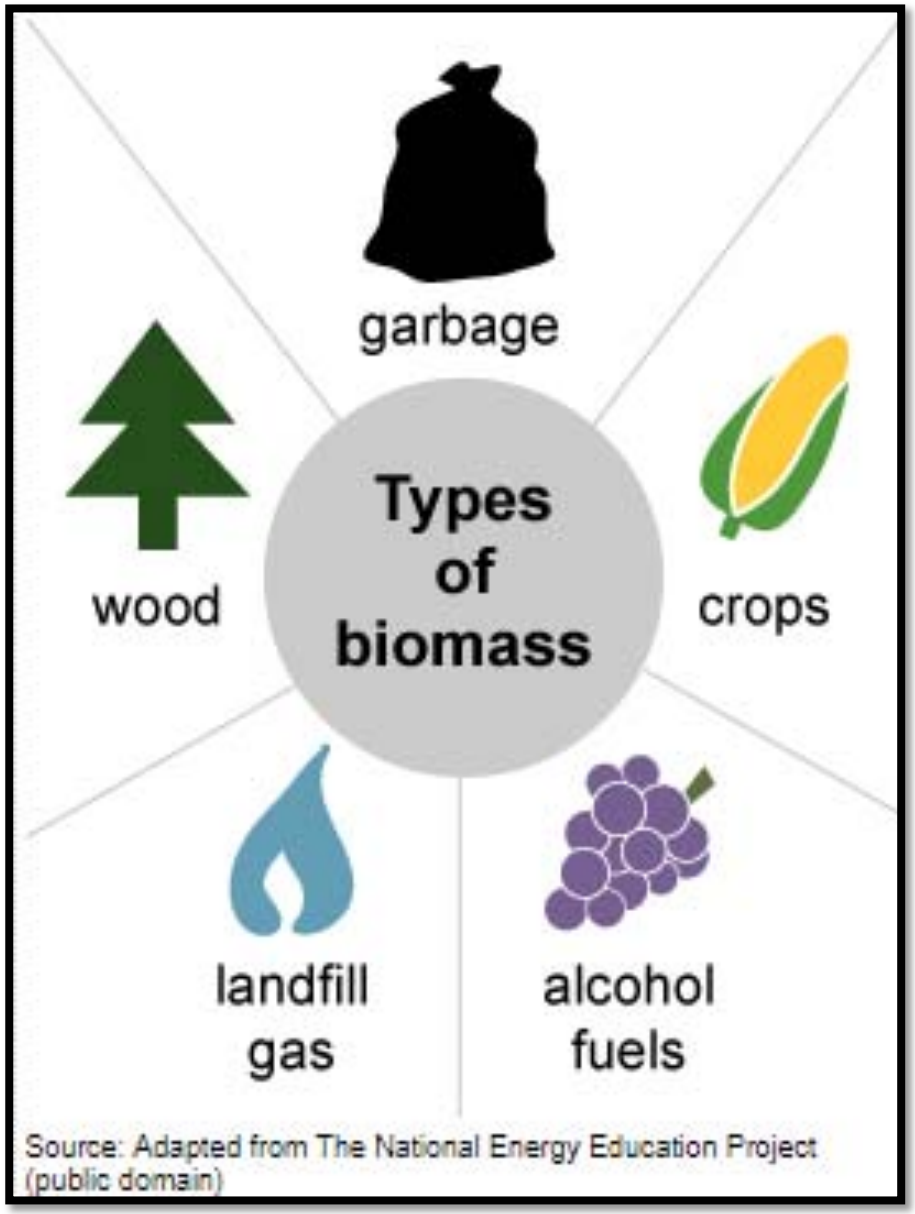
Estimated Renewable Energy Share of Total Final Energy Consumption, 2015



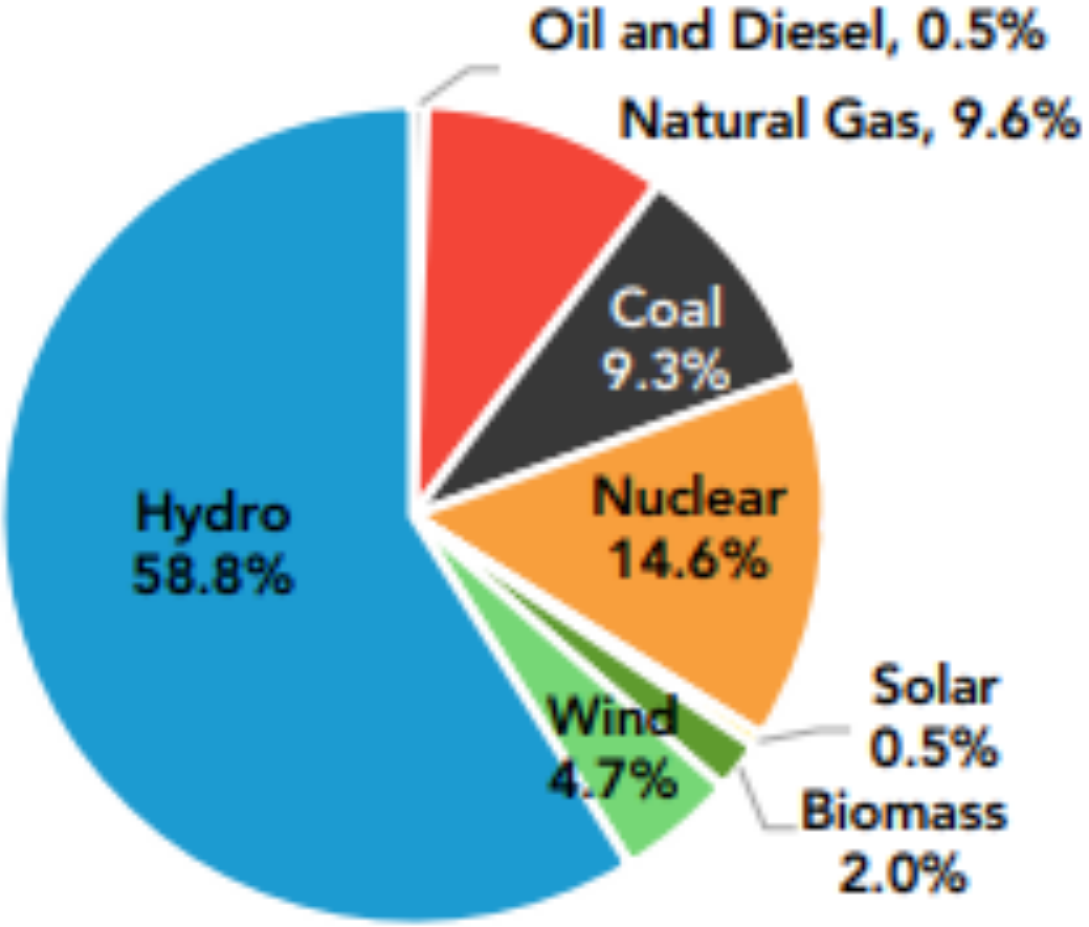
Shares of Biomass in Total Final Energy Consumption

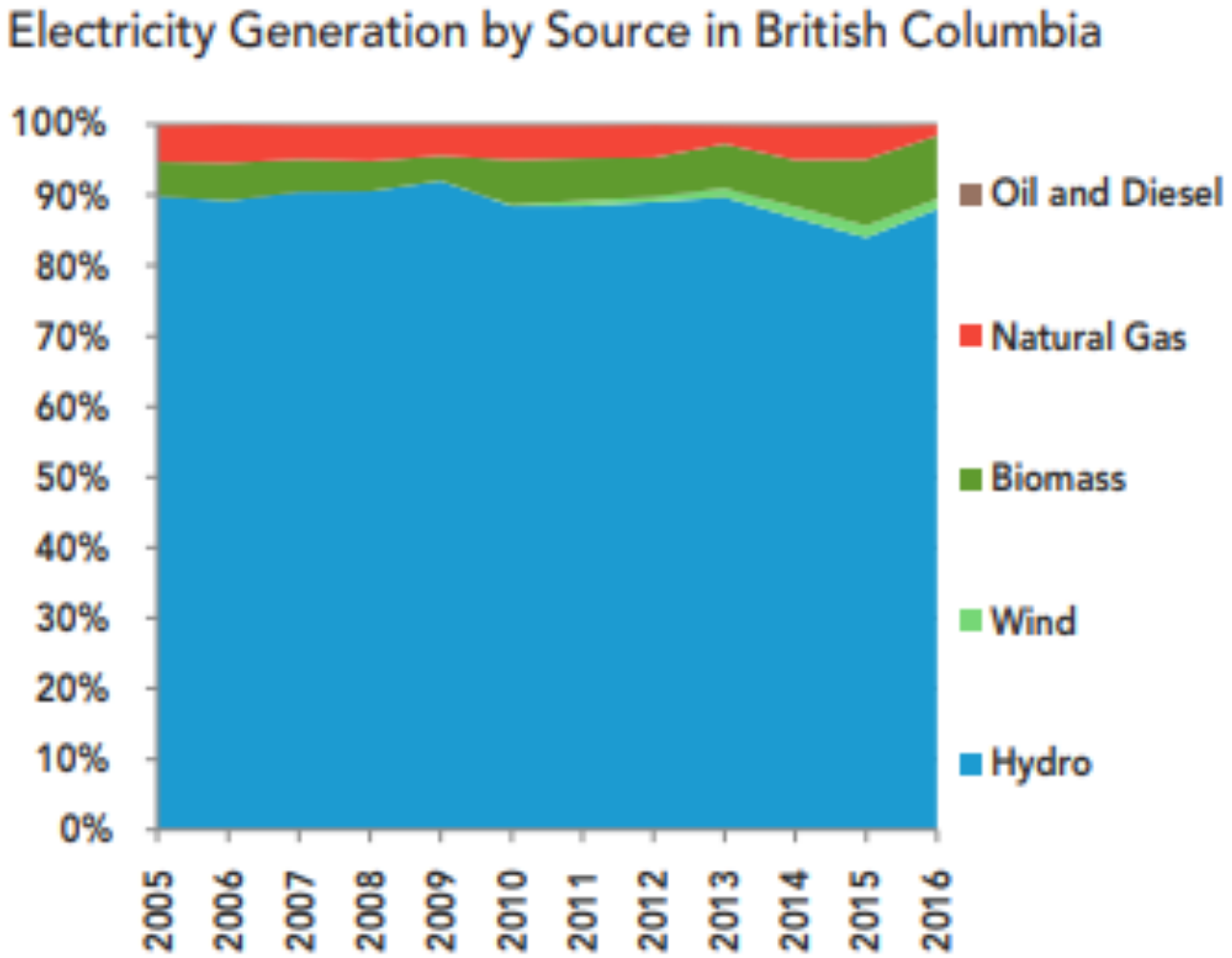
2015




garbage
wood
Types of biomass
crops
landfill gas
alcohol fuels
Source: Adapted from The National Energy Education Project (public domain)

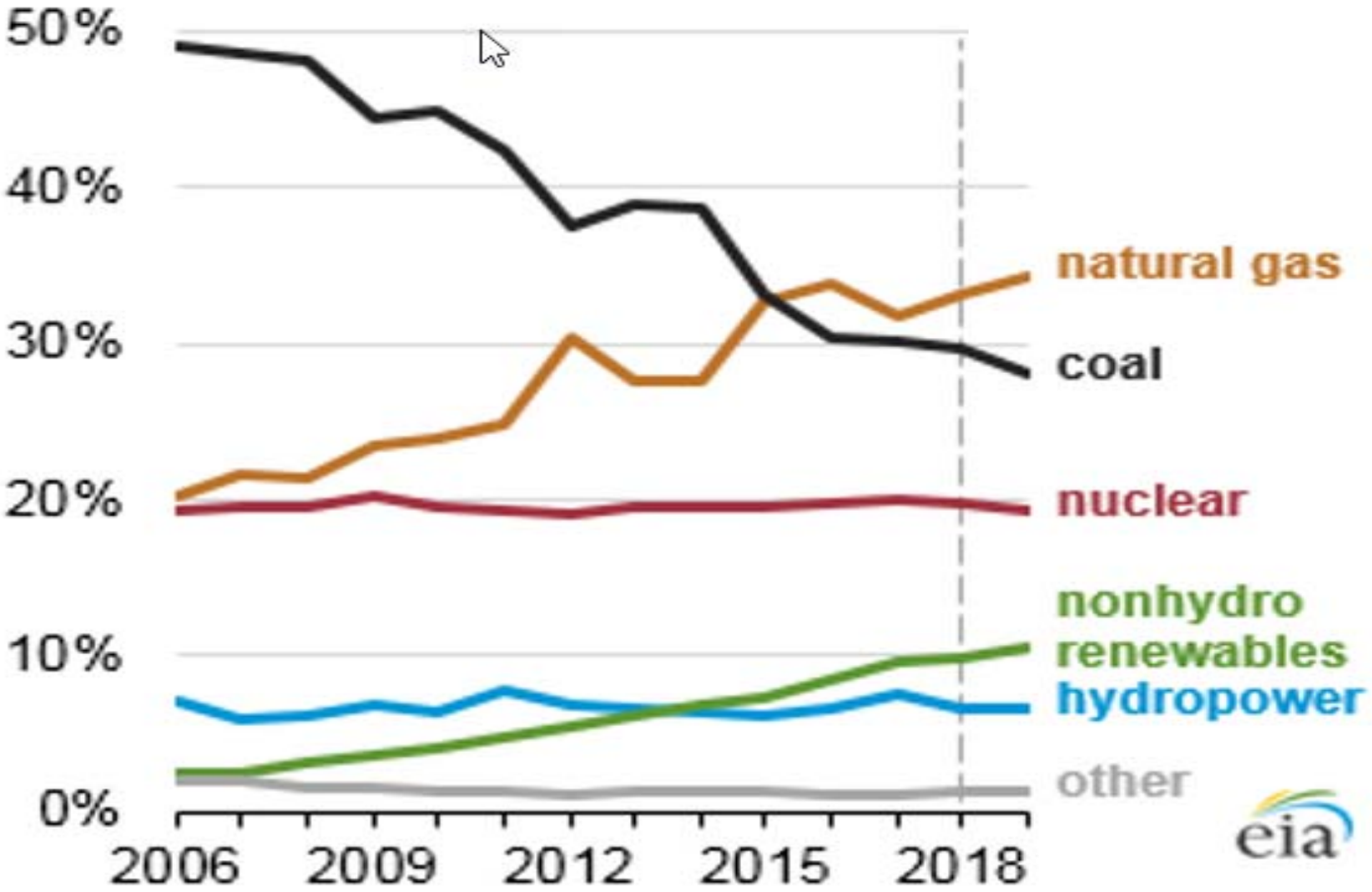
Canada
Electricity Generation by Fuel Type in 2016



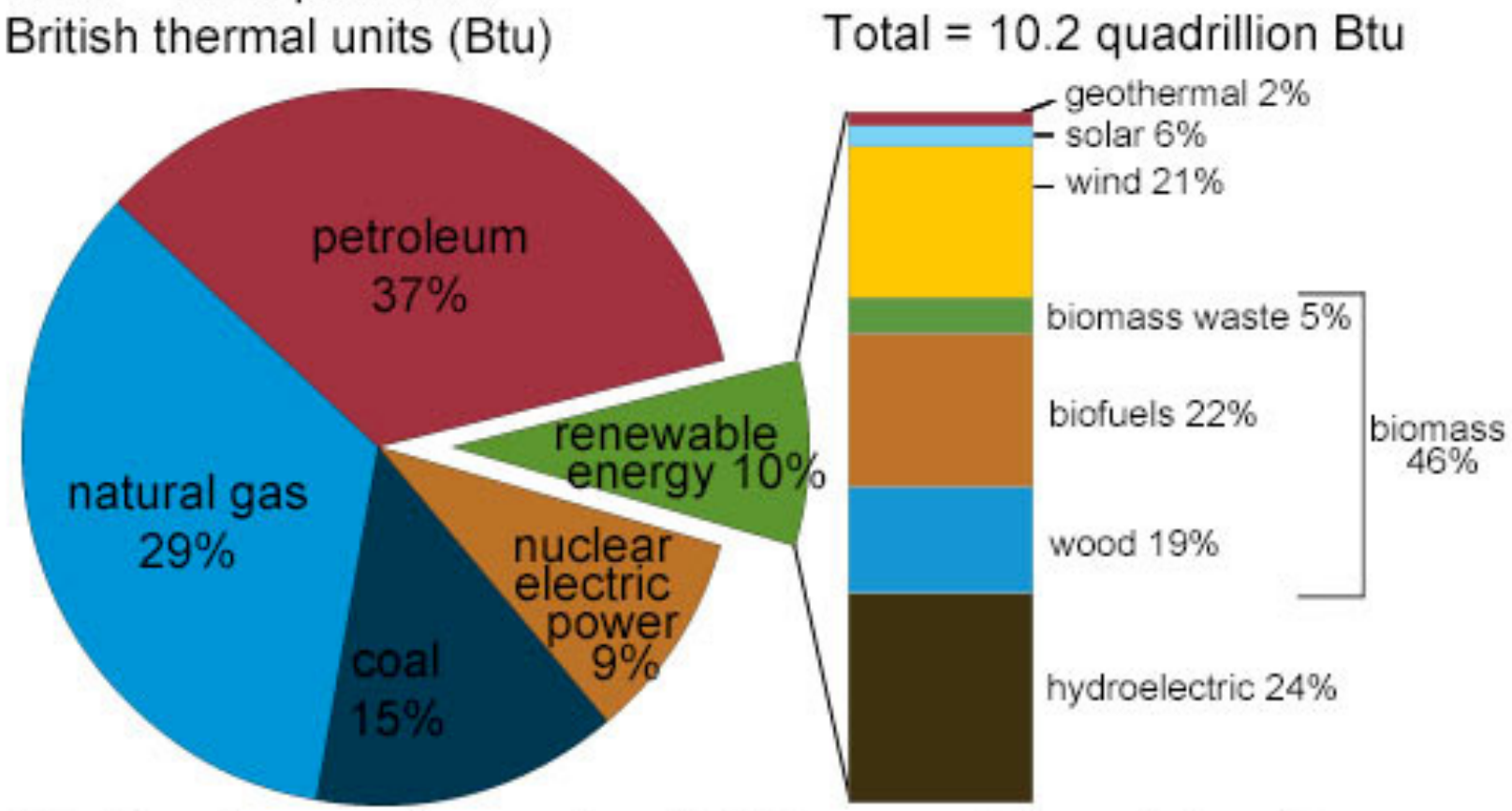


Biomass was the second largest source of electricity, mainly consuming wood waste from the forestry, and pulp and paper industries. Biomass generated 9.0% of generation in 2016. This is the highest biomass share of any province or territory.

U.S. Electricity Generation by Energy Source (2006-2019)



U.S. energy consumption by energy source, 2016

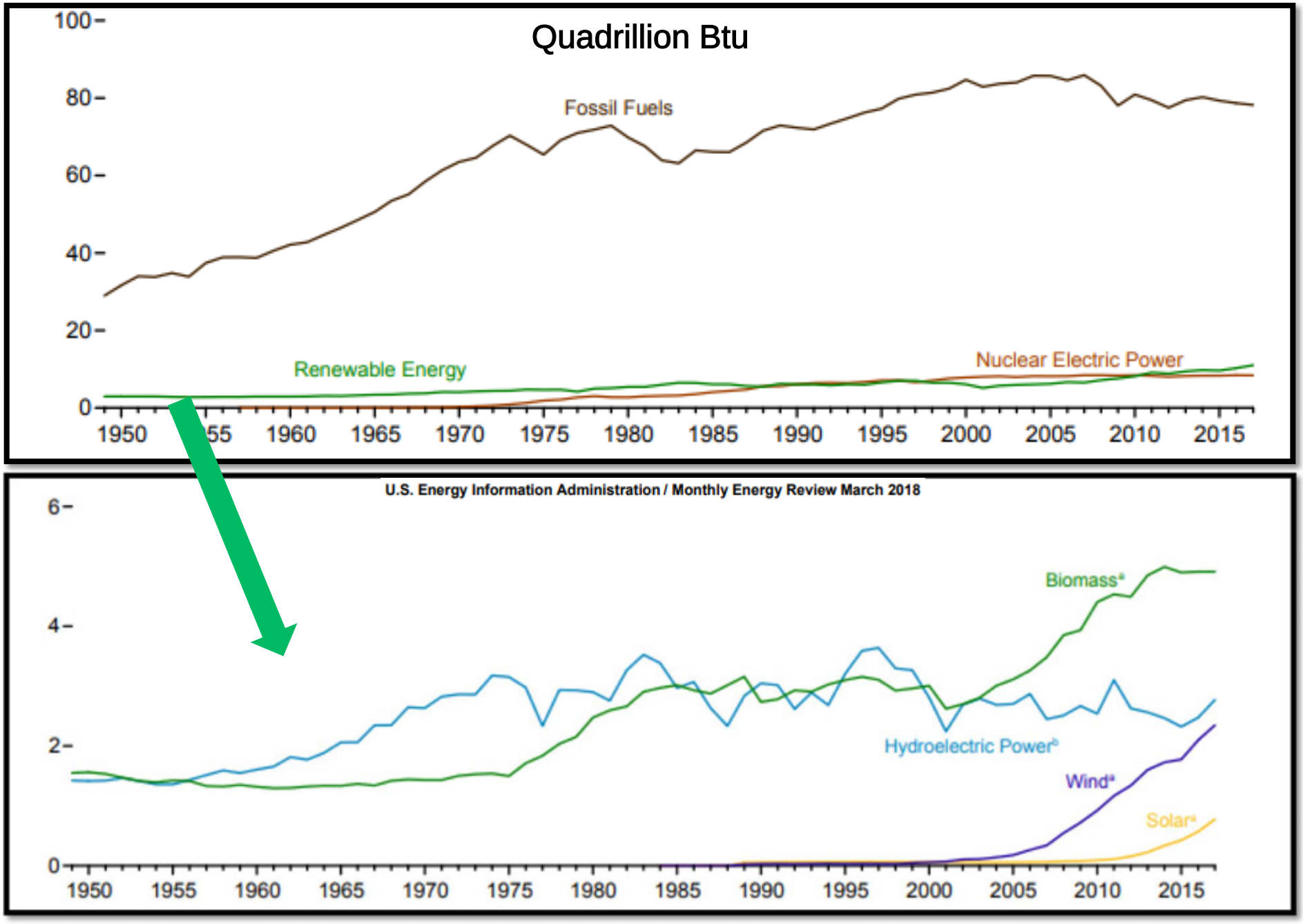


Note: Sum of components may not equal 100% because of independent rounding.

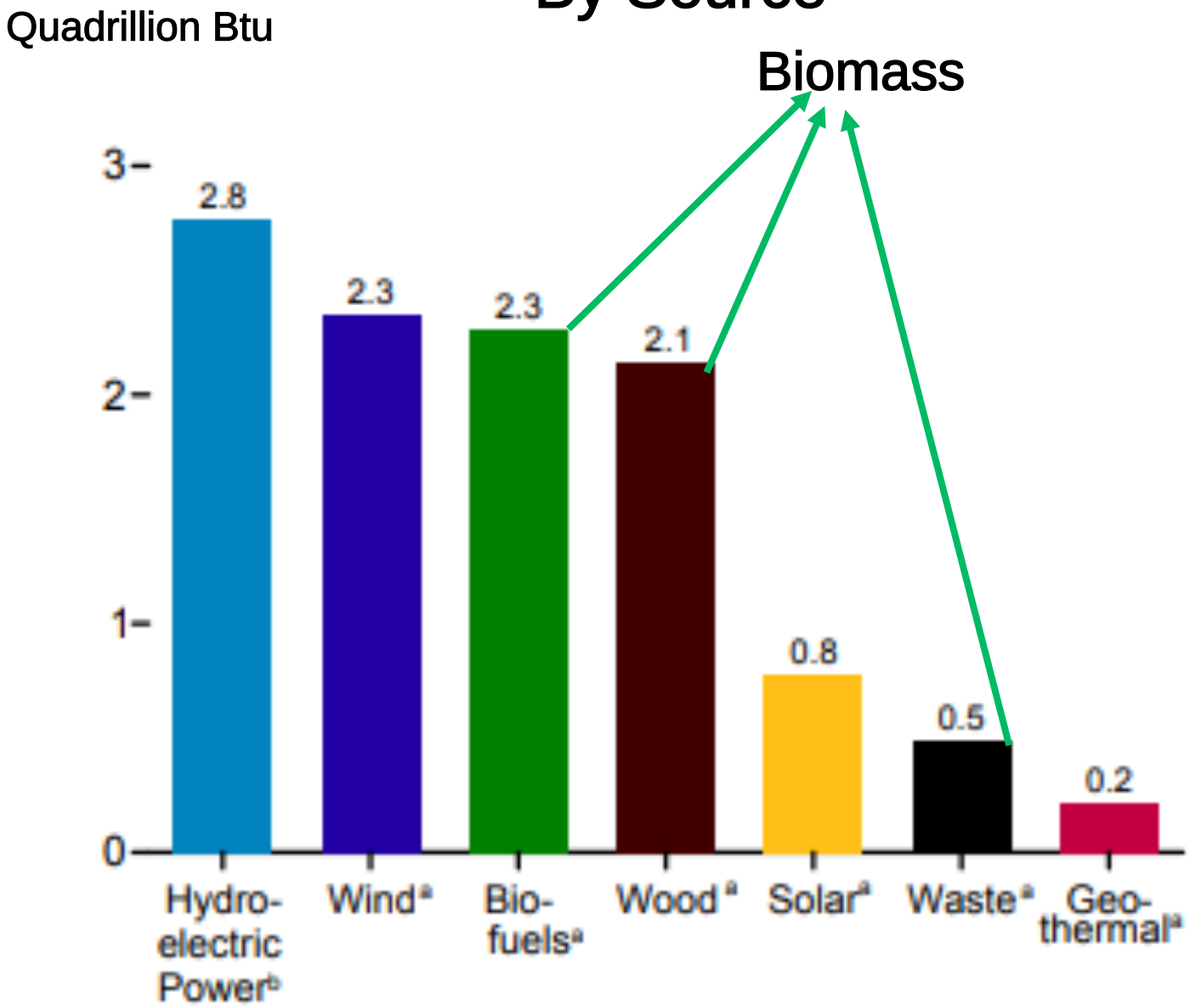
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2017, preliminary data

eia

U.S. Renewable Energy Consumption (1949-2017)



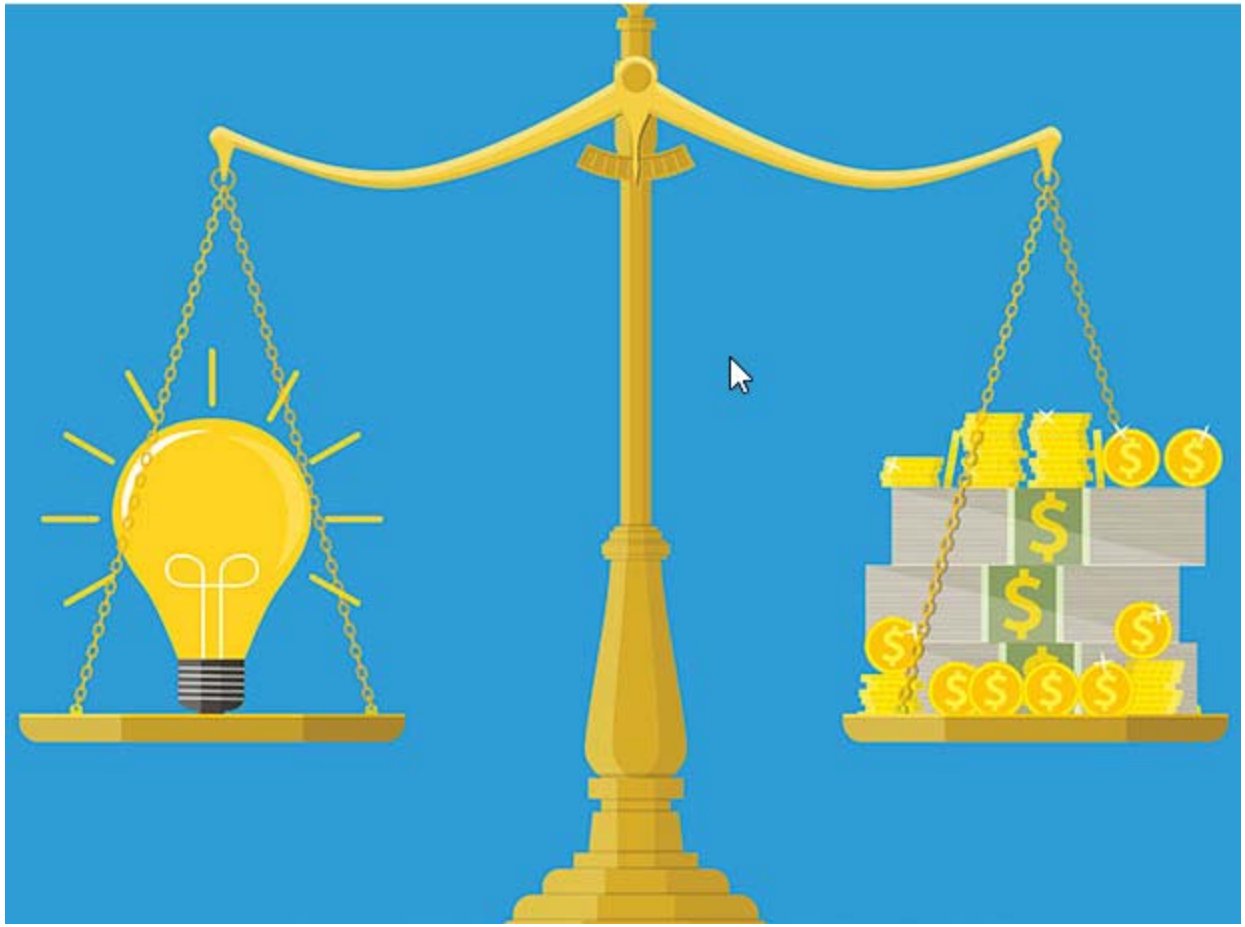
U.S. Renewable Energy Consumption (2017) By Source



U.S. Energy Information Administration / Monthly Energy Review March 2018

So, what are the drivers for bioenergy?

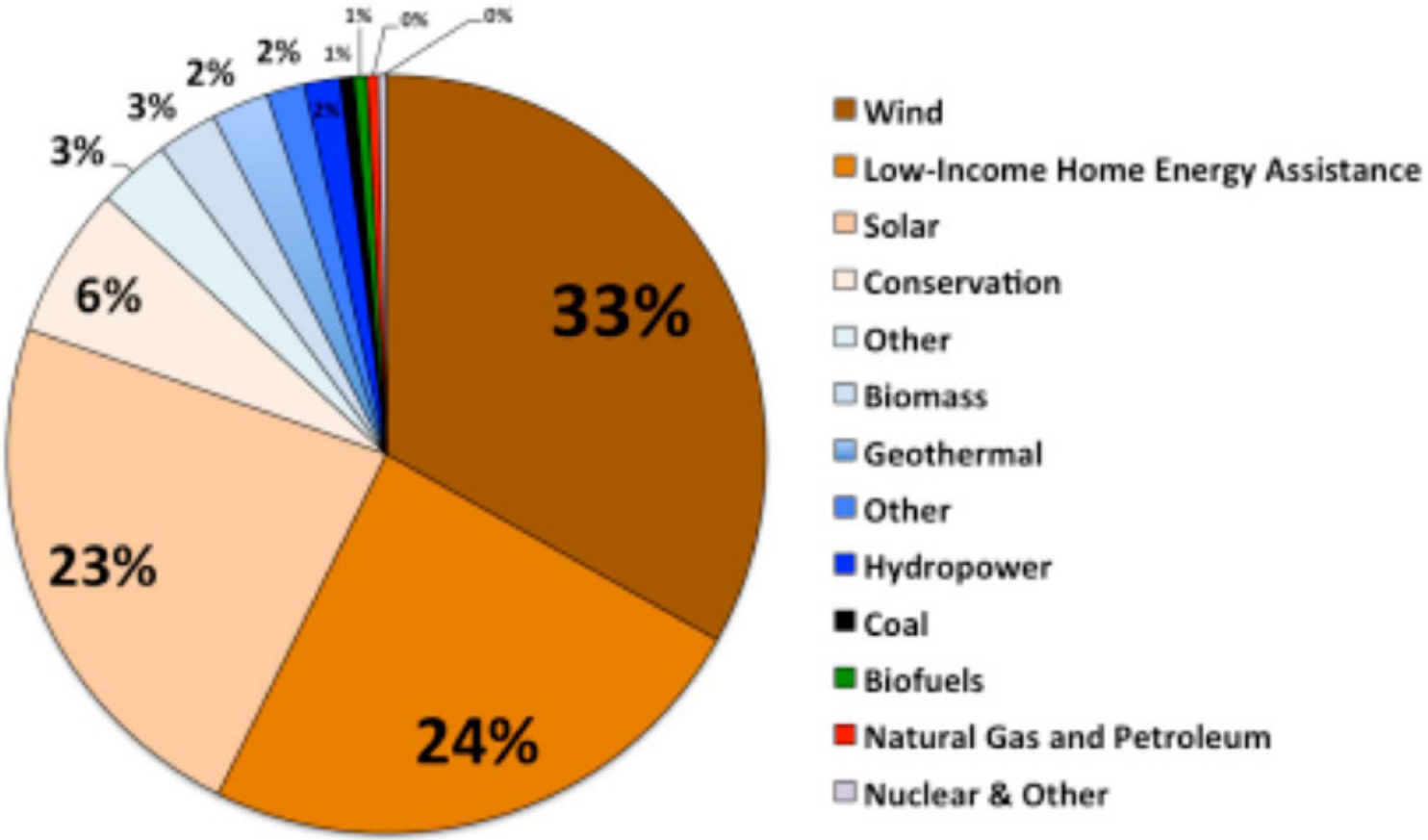

RE Cost Reduction
Drivers
Power Markets
Carbon Pricing



Supply Side

- U.S mandates, policies, incentives & subsidies.
- Tax policy — notably, investment and production tax credits.
- Primarily Agriculture, Energy and Defense-development and deployment of *biofuels*.
- USDA and DOE supporting development of other *bio-based products* (e.g. *chemicals*).
- Support for renewables will decline under the Trump administration.
- Shift to coal and other fossil fuels.

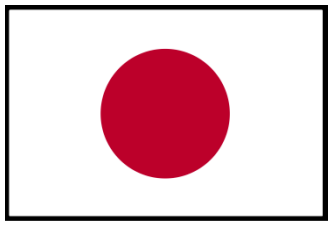
Federal Energy Subsidies, 2013

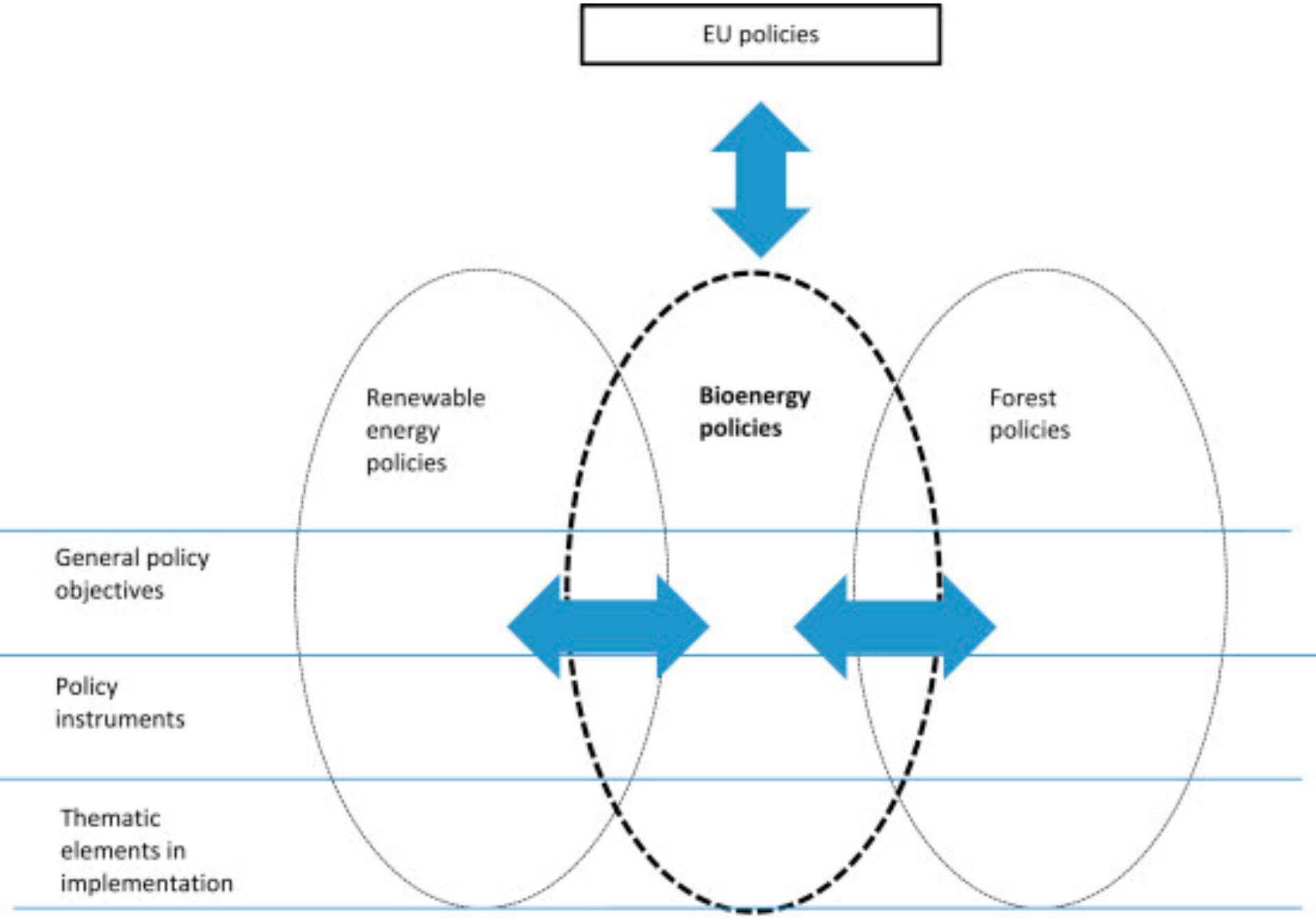


Source: Energy Information Administration (EIA)

Demand Side

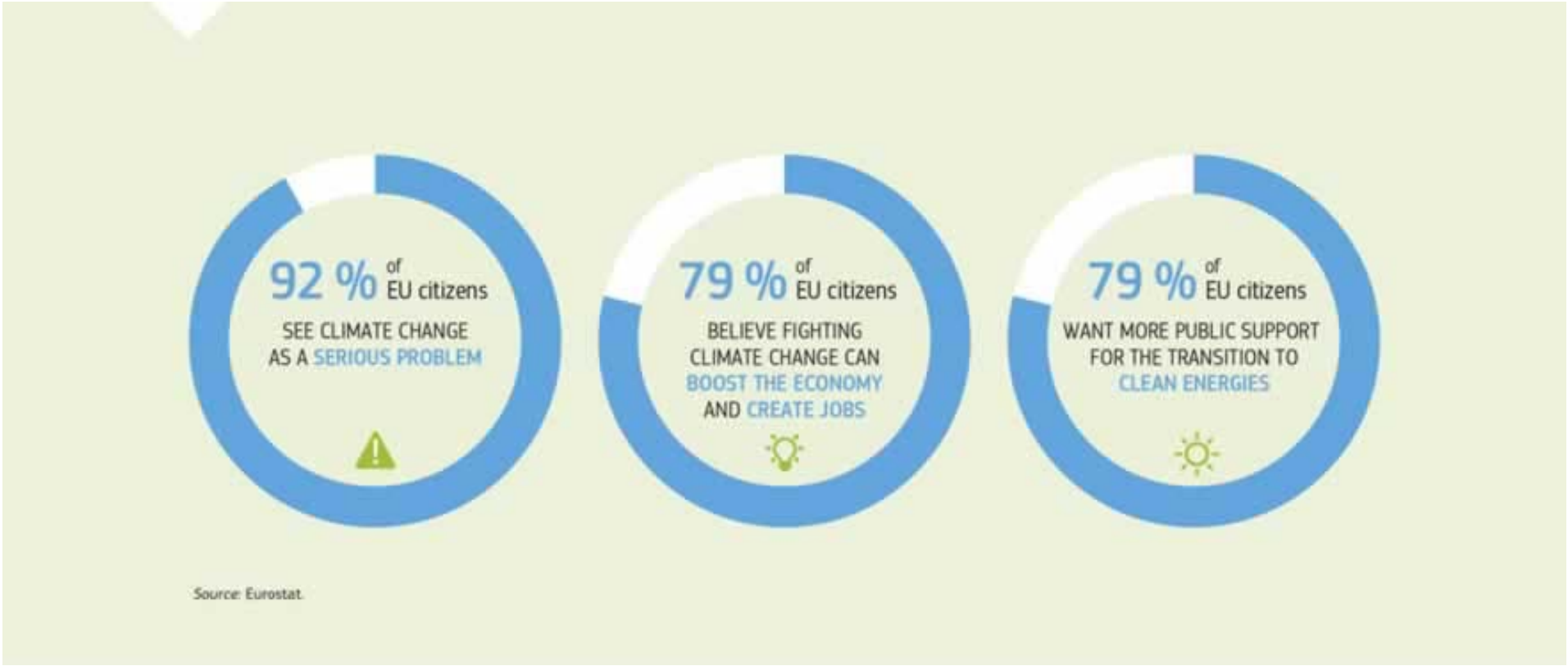
- European Union mandates, policies, incentives & subsidies
- Climate change policies:
  - decrease carbon-dioxide emissions
  - increase the use of renewable energy.
- EU has committed to cut CO2 emissions by at least 40% by 2030.
- At the same time, several European countries are restricting the production of natural gas and, in the case of Germany, aiming to phase out nuclear energy.
- Emerging Demand: Japan & South Korea



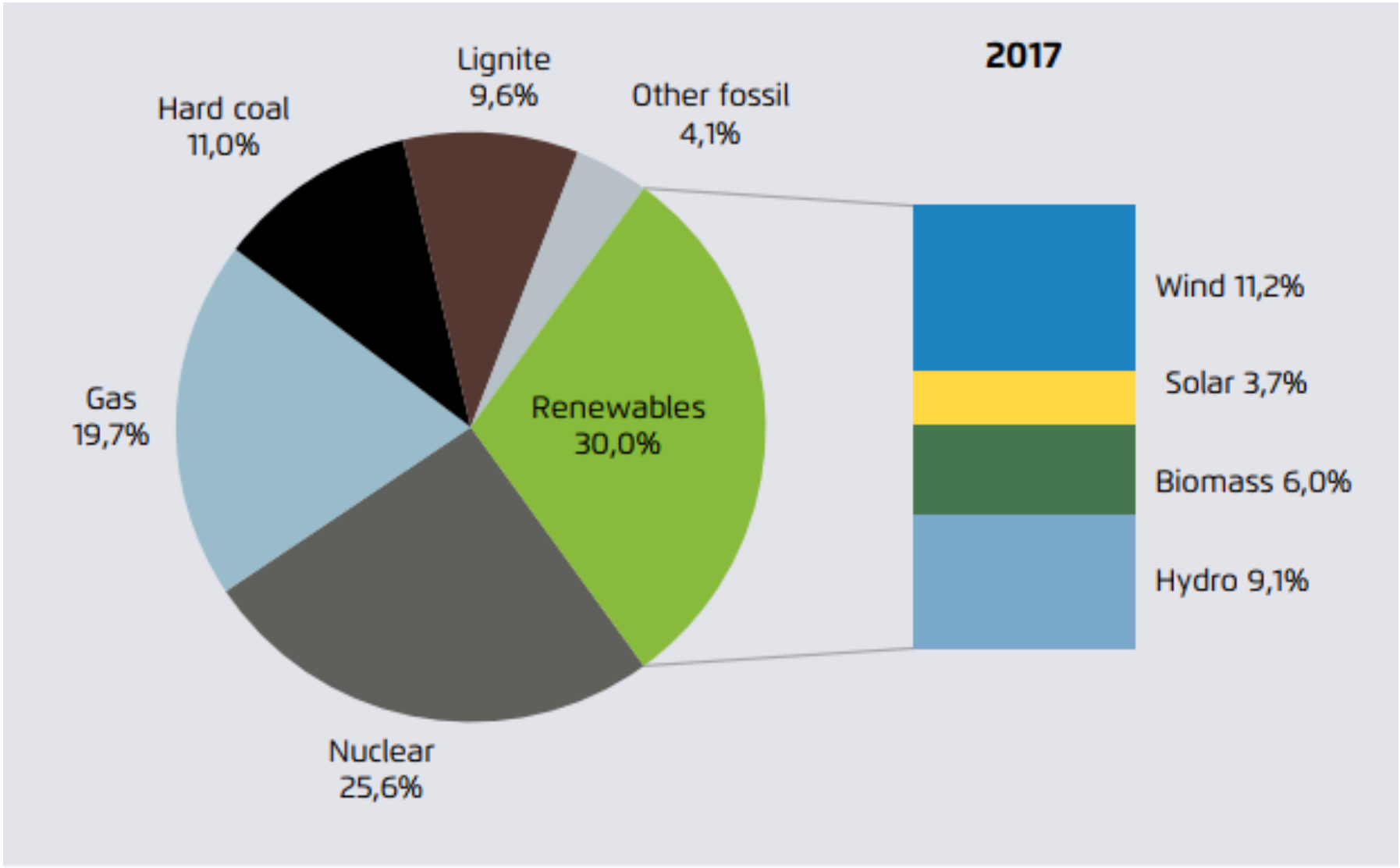

EU policies
Renewable energy policies
Bioenergy policies
Forest policies
General policy objectives
Policy instruments
Thematic elements in implementation

EU - Power to the People

2017



EU Power Generation by Type

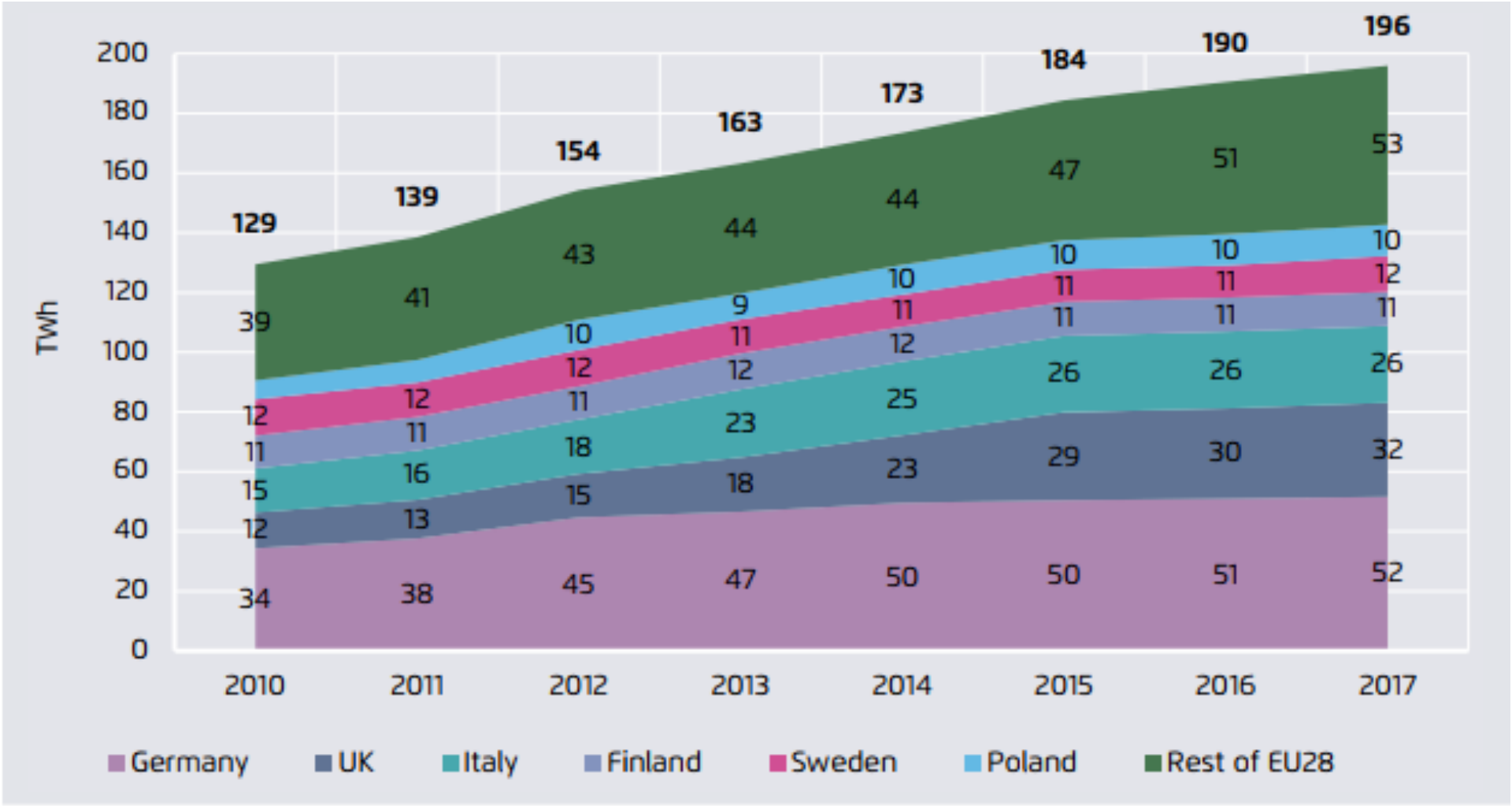


Agora Energiewende | The European Power Sector in 2017

EUROSTAT data to 2015, 2016 and 2017 are own calculations

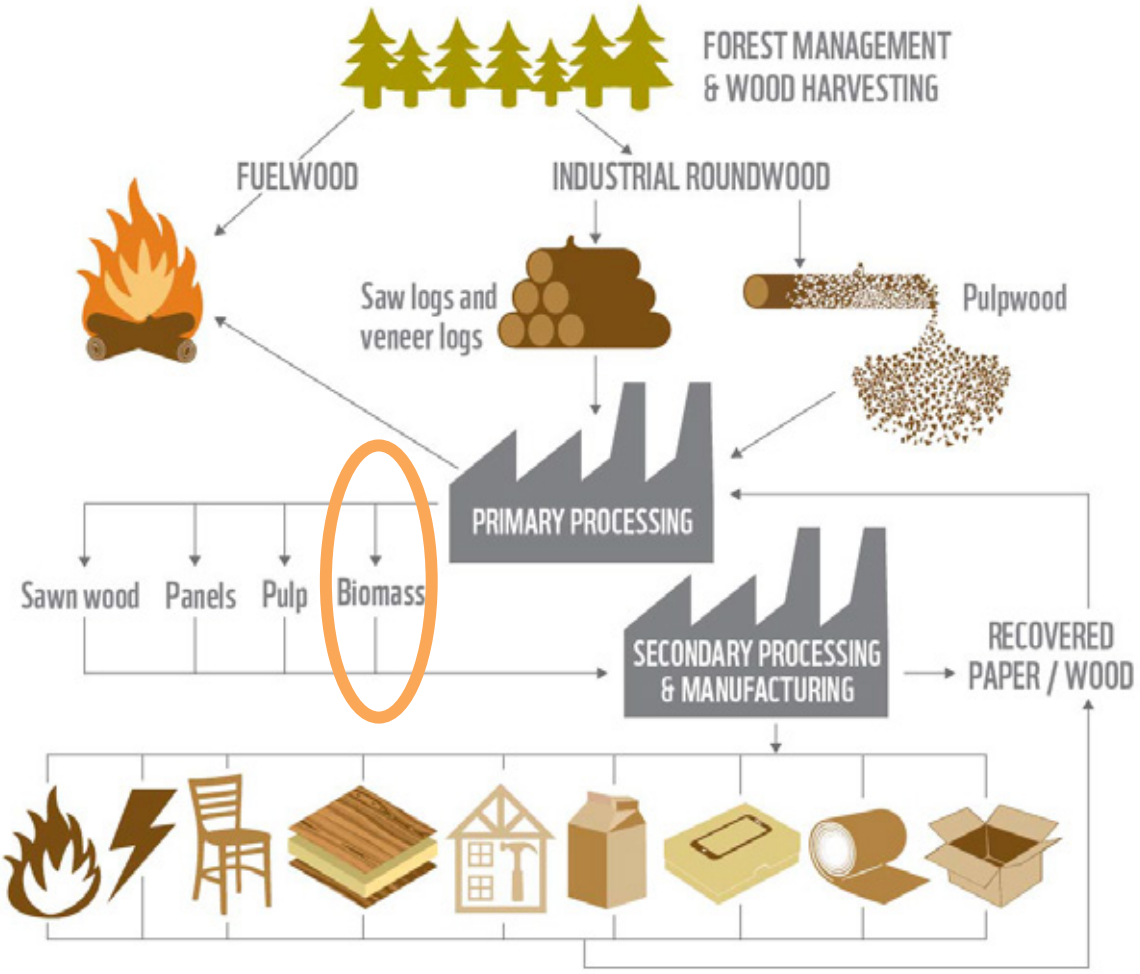
EU Biomass Electricity Generation by Type

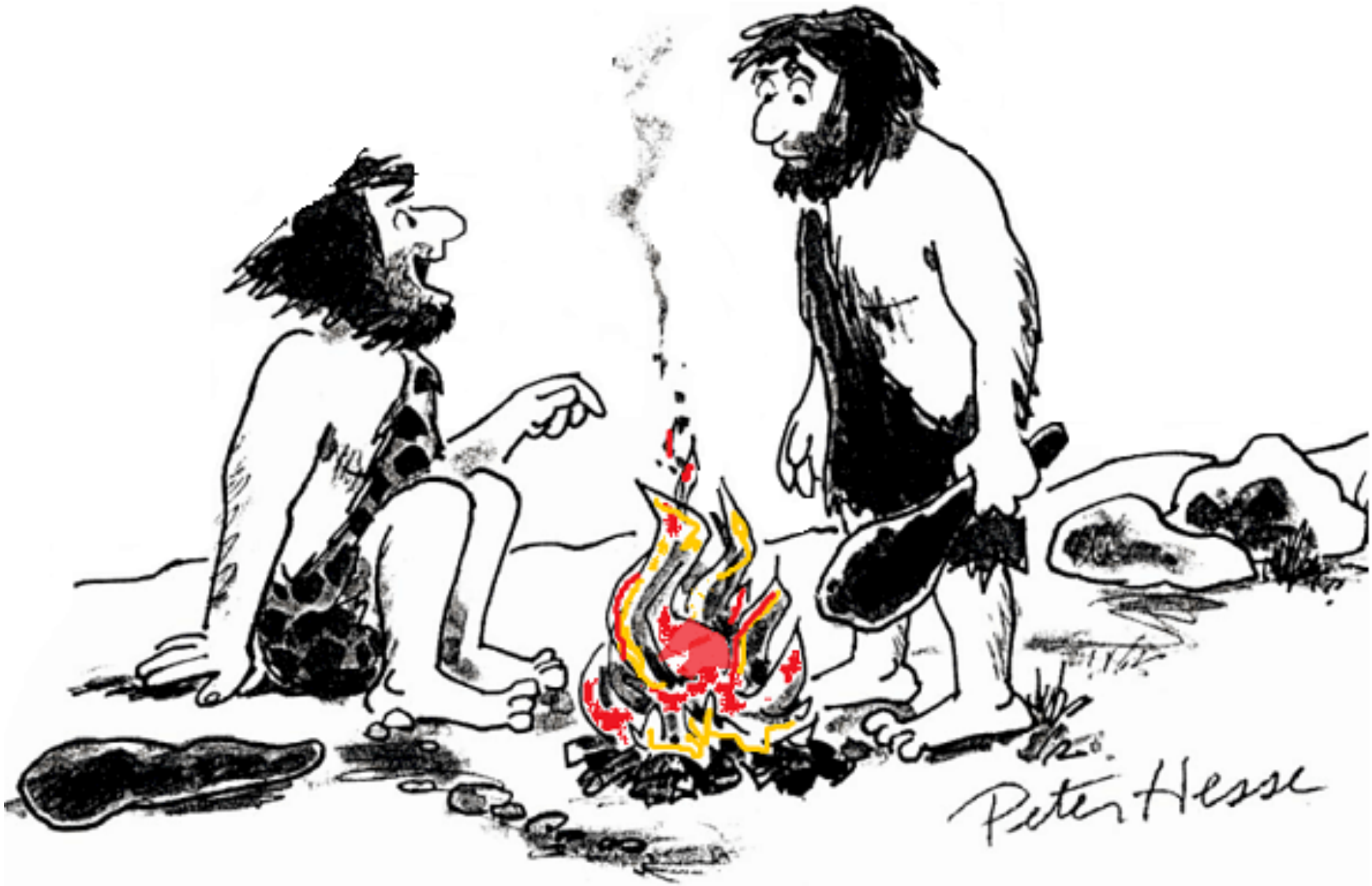
(Including Top 5 Countries)



EUROSTAT data to 2015, 2016 and 2017 are own calculations

Where Does Wood Fit into the Picture?





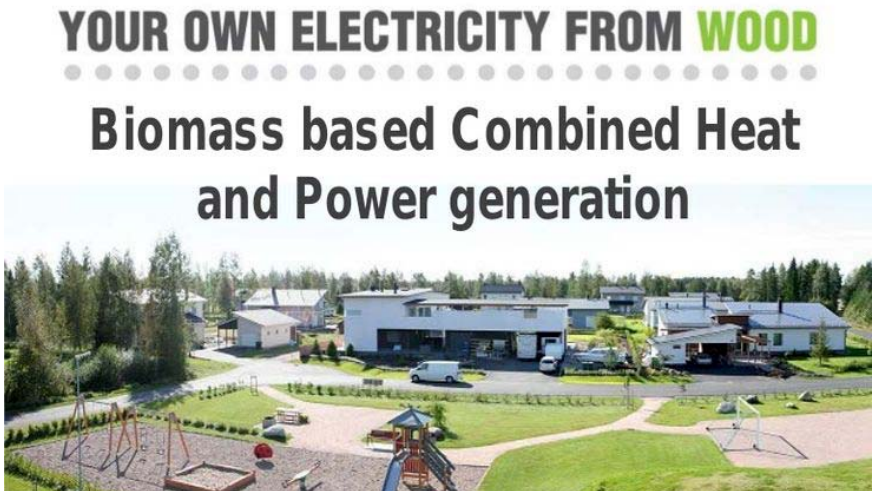
"Its a new way to recycle biomass, its called Fire "

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.



Potential Wood-based Biomass Sources

Wood-based Biomass Sources

Primary mill residues

Wood materials and bark generated at manufacturing plants (primary wood-using mills) when round wood products are processed into primary wood products.

Slabs, edgings, trimmings, sawdust, veneer clippings and cores, and pulp screenings

Wood-based Biomass Sources

<u>Secondary mill residu</u>

Wood scraps and rking shops, furniture factories, wood ainer and pa etc. that use lumber, plywo nd other "p y" aterials.

Wood-based Biomass Sources

<u>Urban wood waste</u>

Discarded wood, tre[illegible]rom construction and demolition sites,

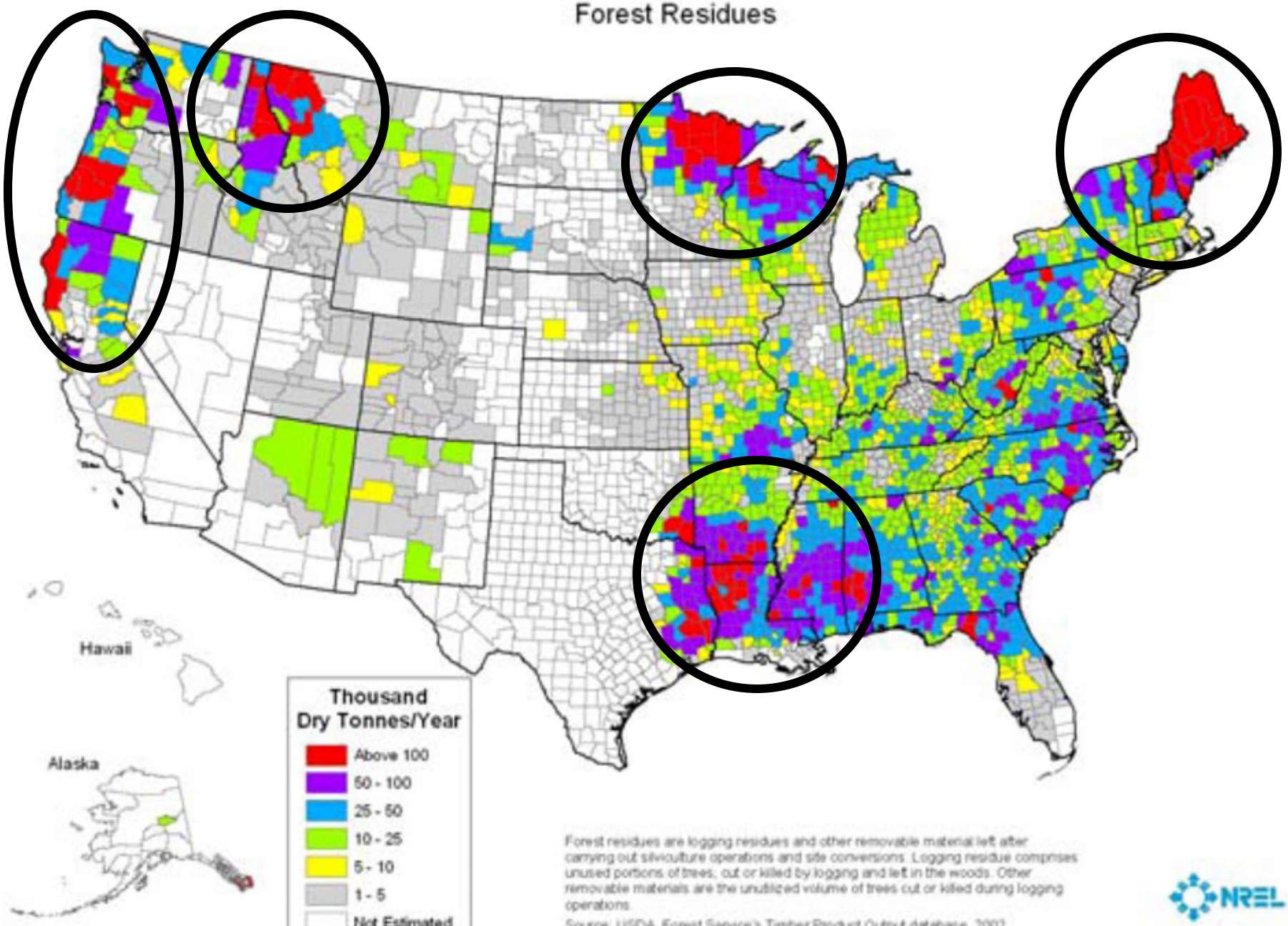
Wood-based Biomass Sources

Post-Harvest forest residues/Logging Slash

Logging residue, unused portions of tre… during logging or silvicultural activities and l… woods, volume of trees cut or killed durin… operatio…

Different Ty… Slash

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 (U.S.)

Paulownia (3 years)

Eucalyptus globulus
(3 years) Australia

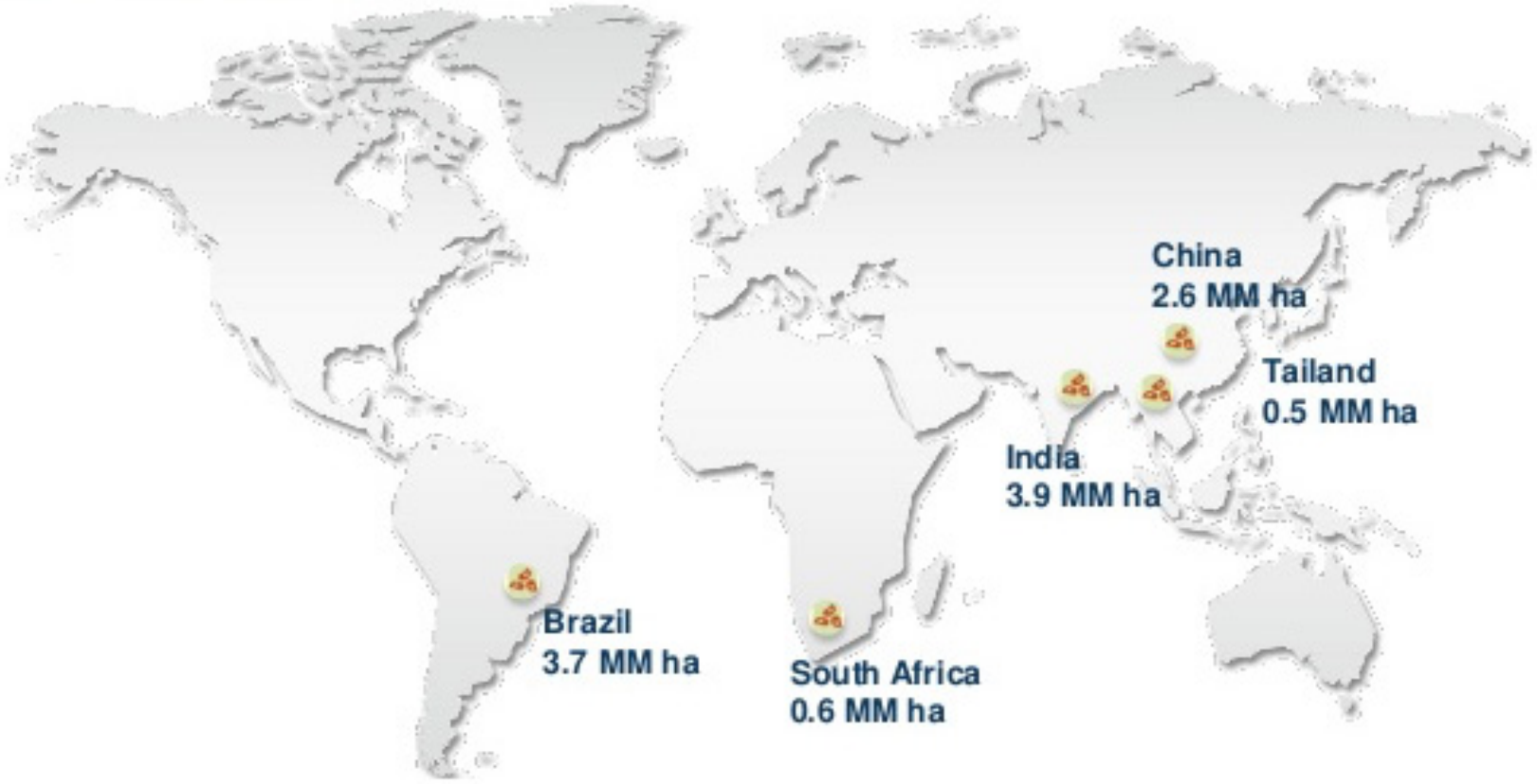
Eucalyptus sp.
(6 years-rotation age) Brazil

Wood-based Biomass Sources
Genetically Modified Woody Crops

Genetically Modified Eucalyptus
(*5 years*)-FuturaGene-Israel

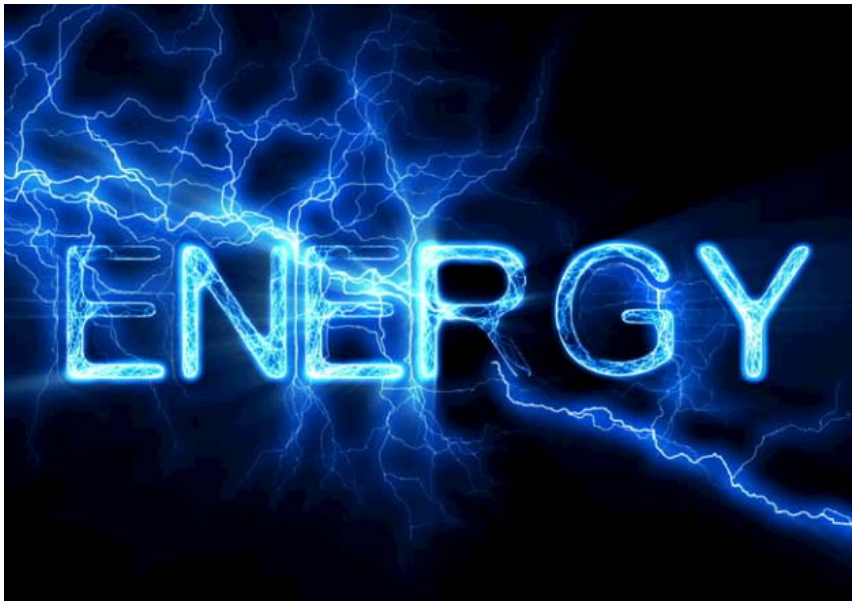
FuturaGene
Yielding the Future™

Global Eucalyptus Forest Map



- FuturaGene is present in 60% of the eucalyptus market
- Well positioned to be world leader in forest biotechnology

Wood to Energy



Wood to Energy:
Possible & Realistic Options

Solid Biofuels	Liquid Biofuels	Gaseous Biofuels
Wood Pellets Wood Chips Briquettes Firewood	Biodiesel Bioethanol Advanced Biofuels	Biogas Biomethane Syngas

Things were looking good for (non-ethanol) wood-based liquid biofuels until……

Natural Gas Prices - 10 Year Chart

WTI Crude Oil Prices - 10 Year Chart

macrotrends

What Else Can We Do With Wood Energy?

Cogeneration

- Traditionally, a steam turbine is used to produce electricity.
- 84% of U.S. CHP capacity is in wood products manufacturing industries.

Gasification

- 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

Gasification Holds Promise

Biomass → Gasification → Electricity generation

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

Entrade Energiesysteme
E3 Micro-Scale Biomass CHP Plant

The micro-CHP boiler:

- Produces up to 60 kilowatts of heat (about 205,000 BTU/hour)
- Up to 5 kilowatts of electricity.

Pyrolysis

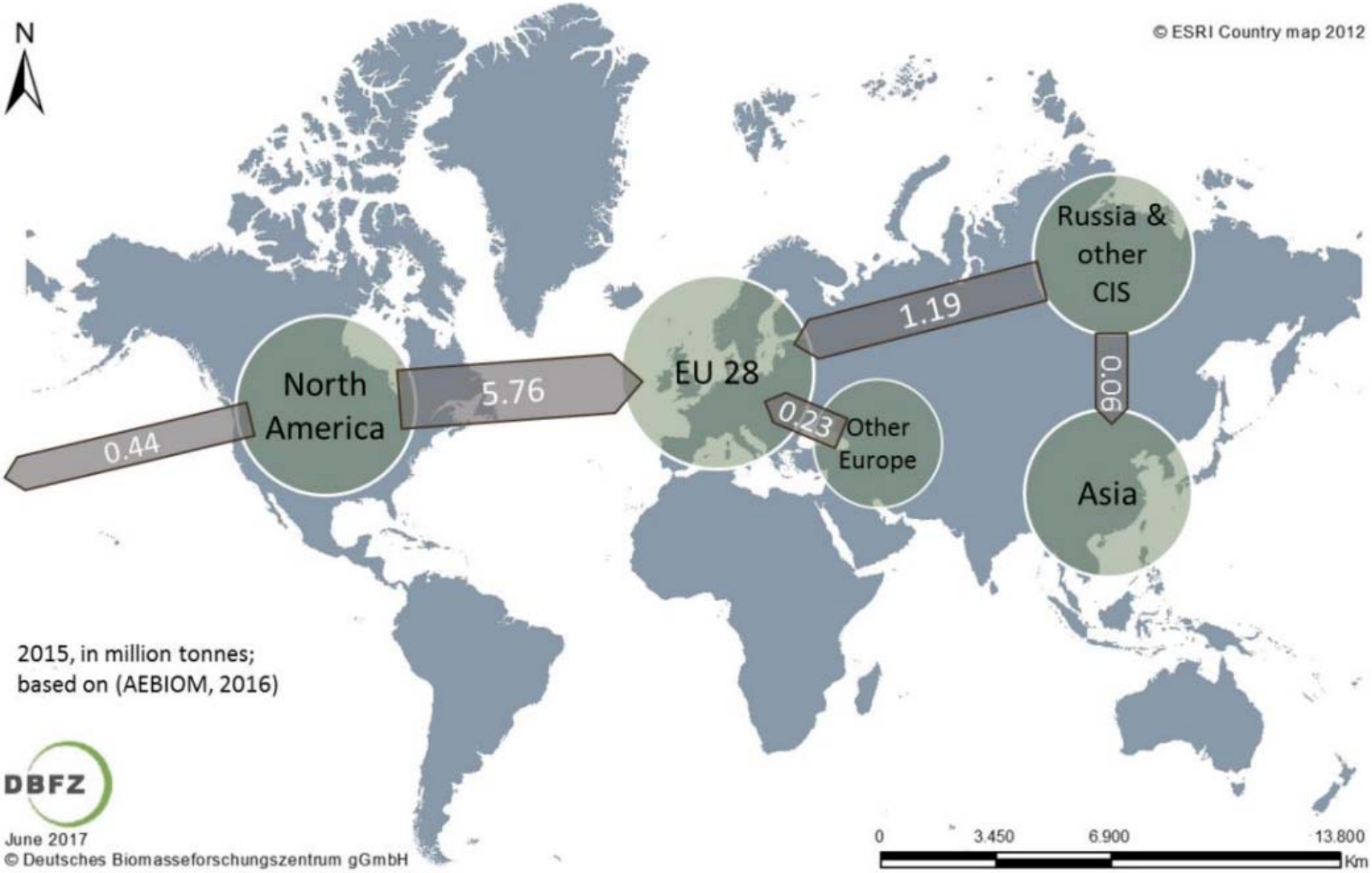
- Chemical decomposition of a condensed substance by heating.
- Extreme pyrolysis, which leaves only carbon as the residue, is called carbonization.
- Pyrolysis is used to produce bio-char, charcoal, torrefied wood, activated carbon, methanol and other chemicals from wood.

Co-firing Biomass and Coal

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

Pellets-Where the Action is!

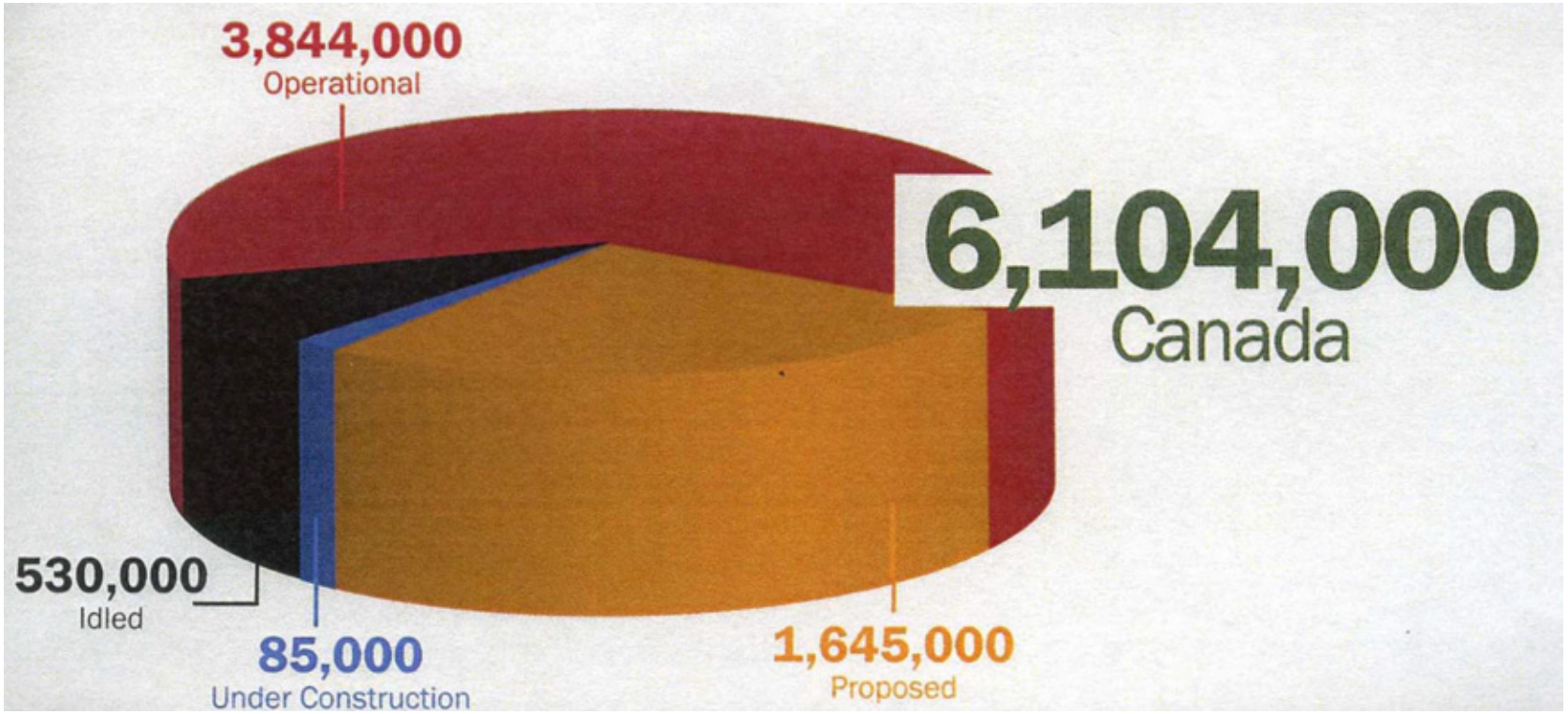
World pellet trade flows (2015)



Main Pellet Consumers (1,000 MT)							
Calendar Year	**2011**	**2012**	**2013**	**2014[e]**	**2015[e]**	**2016[e]**	**2017[e]**
UK	1,000	1,400	3,700	4,900	6,700	7,300	7,800
Italy	1,950	2,200	2,500	3,400	3,300	3,400	3,400
Denmark	1,600	2,100	2,400	2,100	2,100	2,100	2,300
Germany	1,400	1,700	2,000	1,800	1,850	2,000	2,200
Sweden	1,880	1,700	1,860	1,650	1,650	1,605	1,600
Belgium	1,200	1,700	1,500	900	1,250	1,250	1,100
France	450	550	640	1,040	860	1,005	1,030
Austria	720	790	880	950	975	1,000	1,000
Spain	200	250	380	700	700	475	475
Netherlands	1,000	1,250	1,200	500	100	100	300
Total	**12,500**	**15,000**	**18,300**	**19,100**	**20,800**	**22,200**	**23,500**

Source: AEBIOM and Member State sector organizations, e = estimate EU FAS Posts

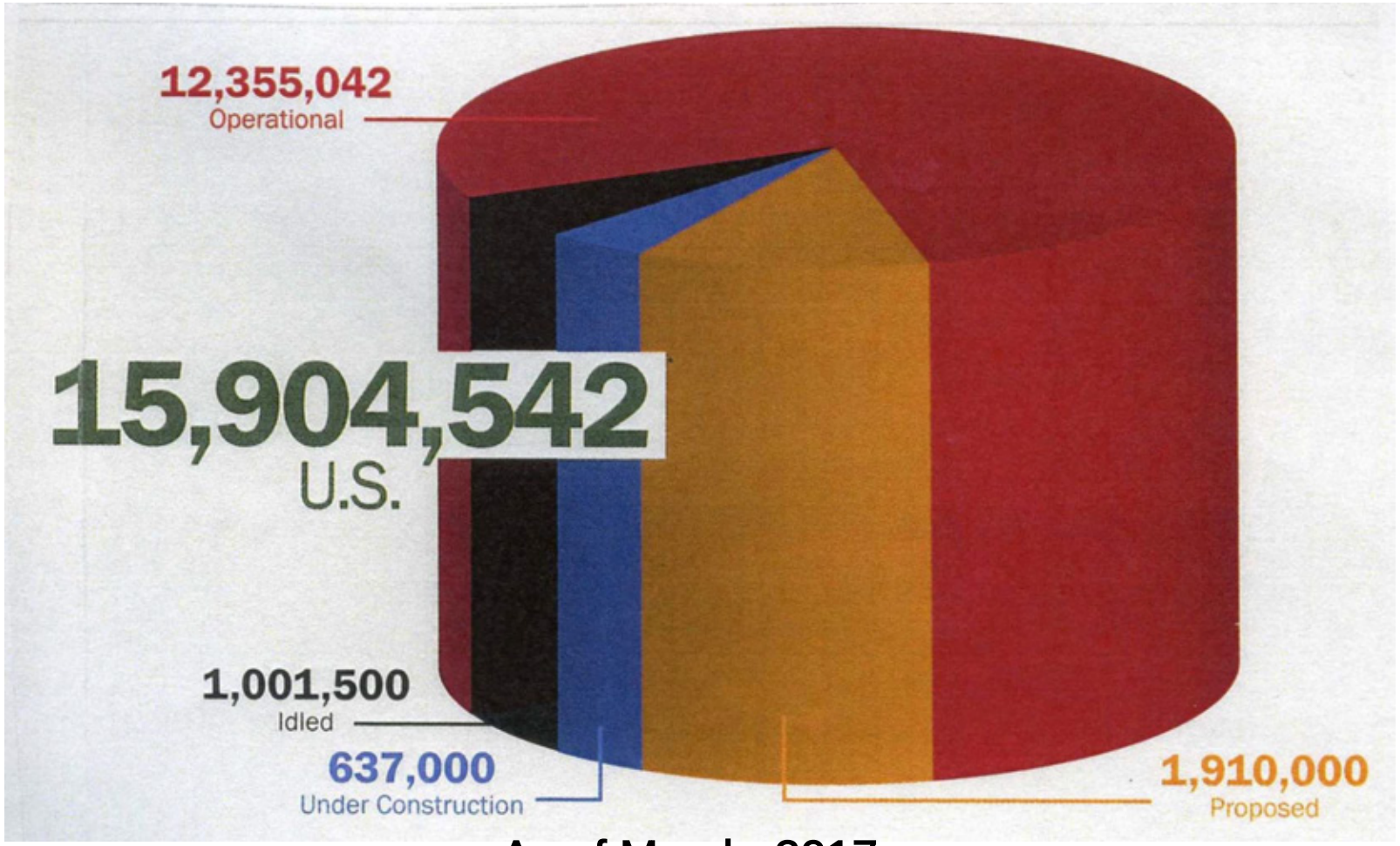
Canada
Metric Tons



As of March, 2017

BBI INTERNATIONAL

U.S.
Metric Tons



As of March, 2017

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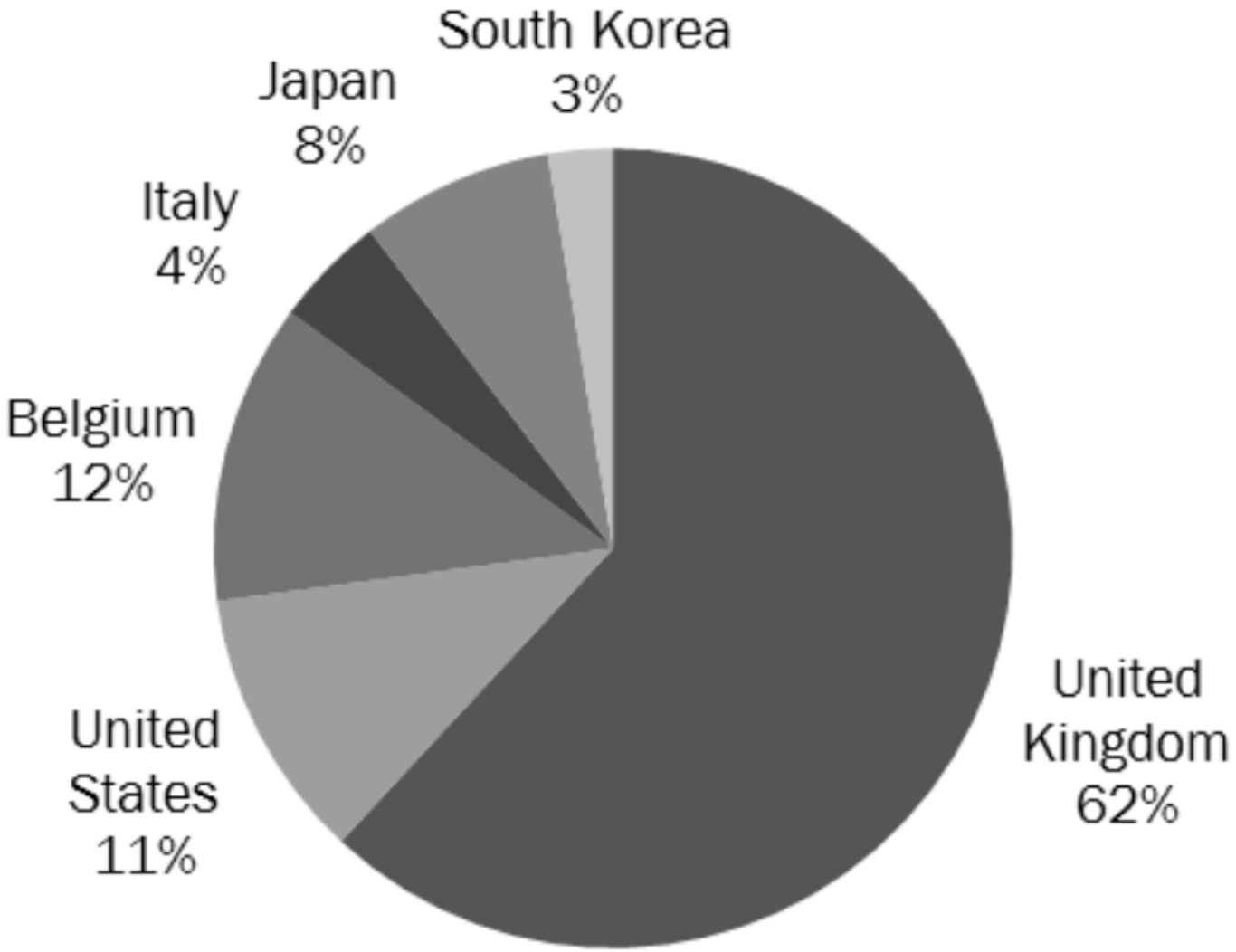
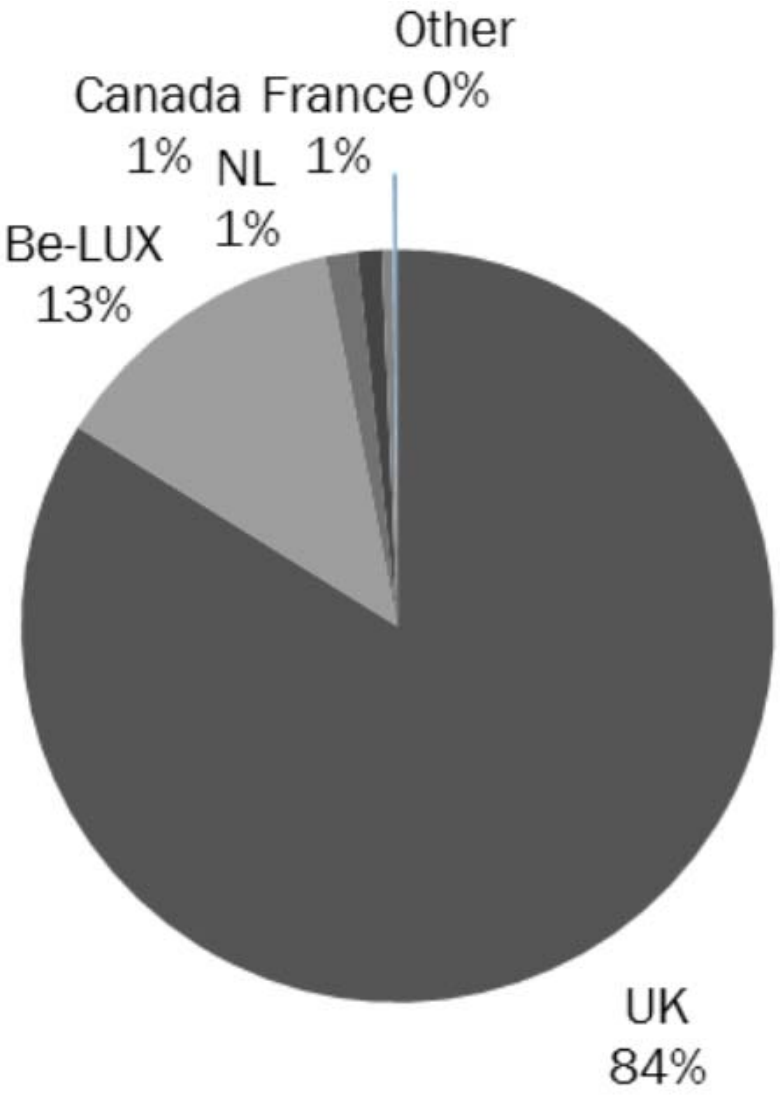
Canadian wood pellet exports by destination (Statistics-Canada 2016)

metric tonnes	2012	2013	2014	2015
United Kingdom	794,379	1,026,527	982,809	1,205,928
United States	86,665	152,271	218,889	205,743
Italy	85,238	219,551	204,528	85,513
Japan	105,640	76,018	61,807	80,203
South Korea	2,084	113,077	150,004	49,029
OTHER	295,171	52,787	19,355	1,366
TOTAL	**1,369,177**	**1,640,231**	**1,637,393**	**1,627,784**

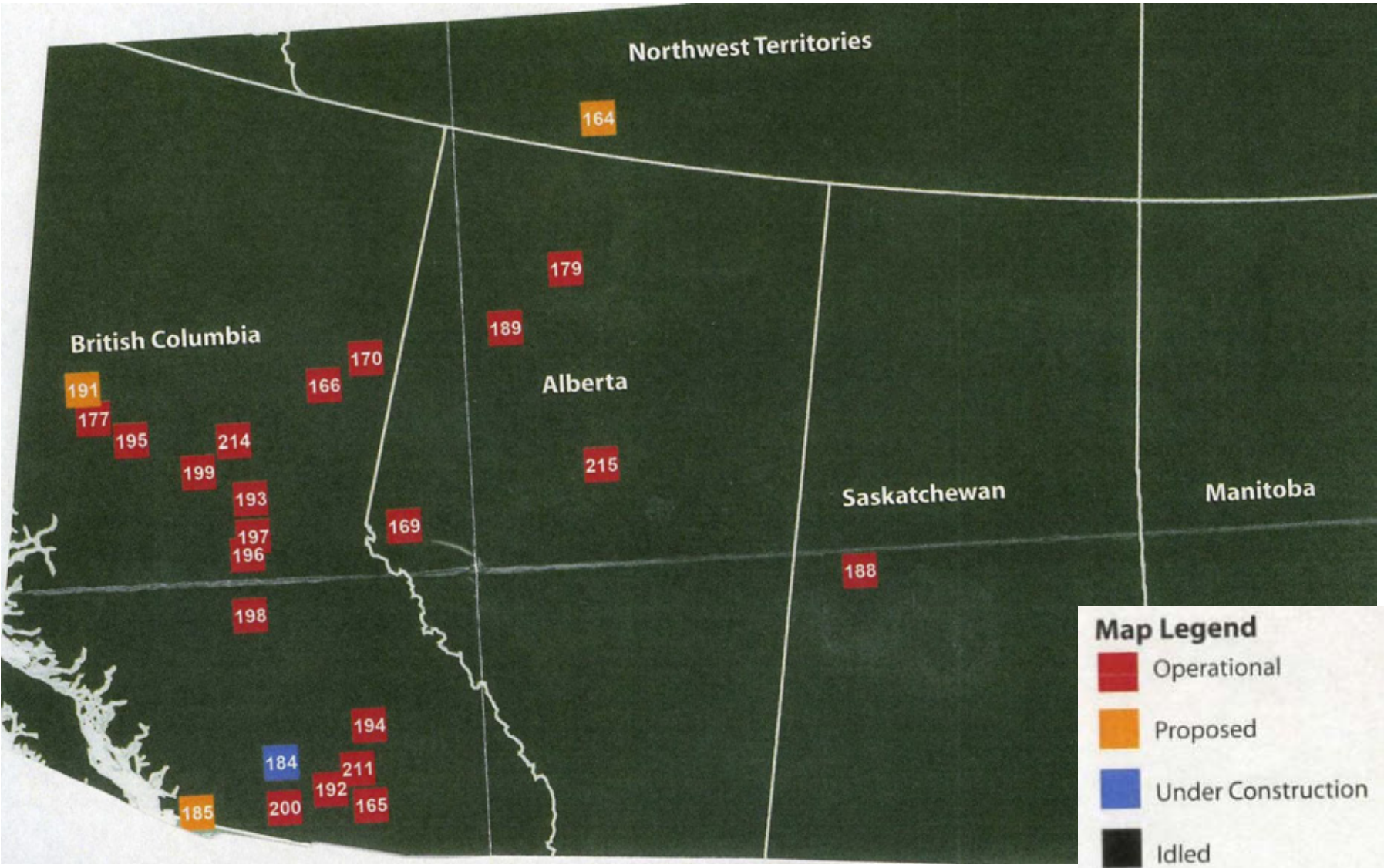
Canadian Wood Pellet Exports by Top Partners (2015)



U.S. Wood Pellet Exports by Top Partners (2015)



Western Canada



As of March, 2017

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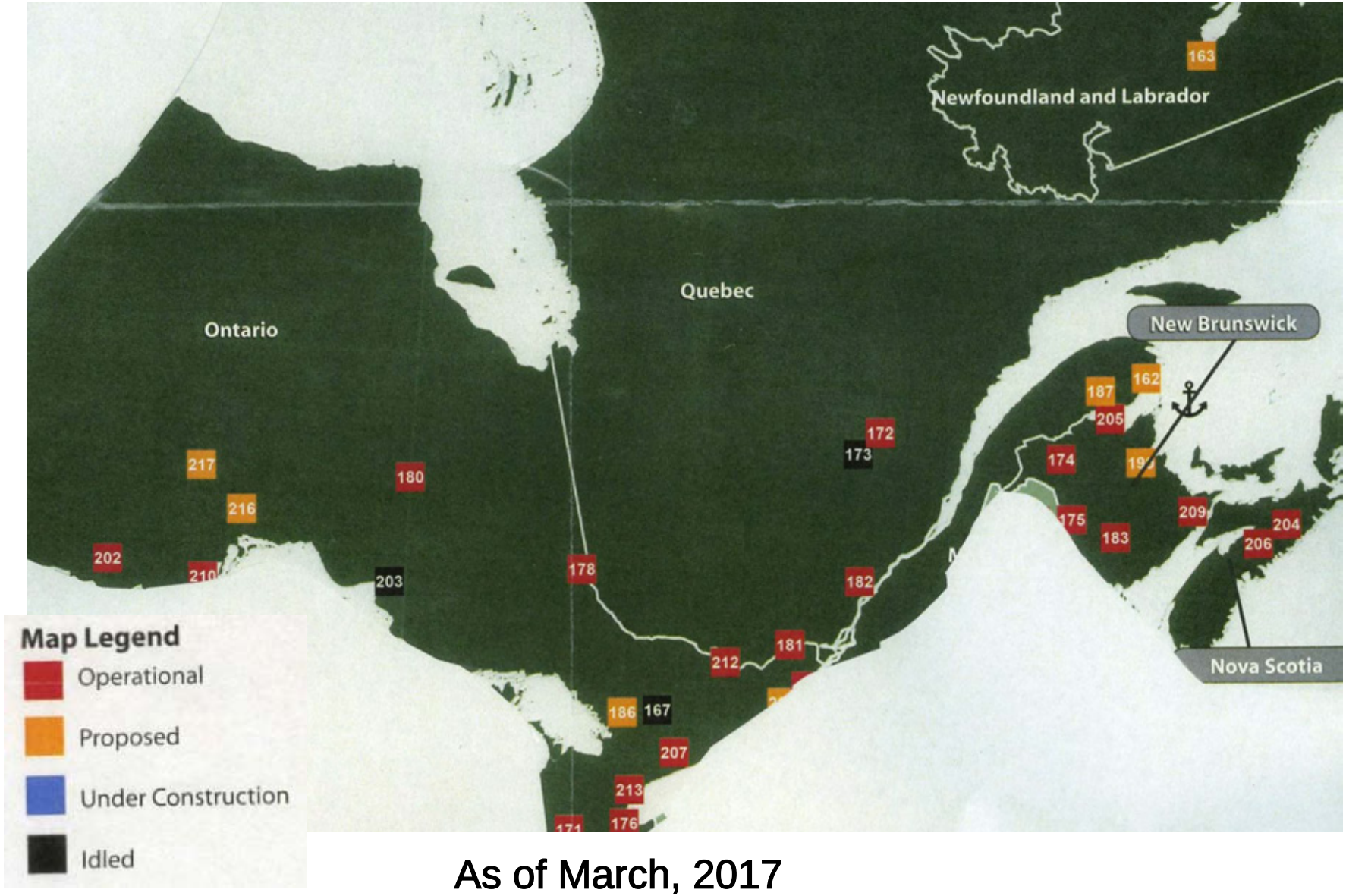
Eastern Canada



As of March, 2017

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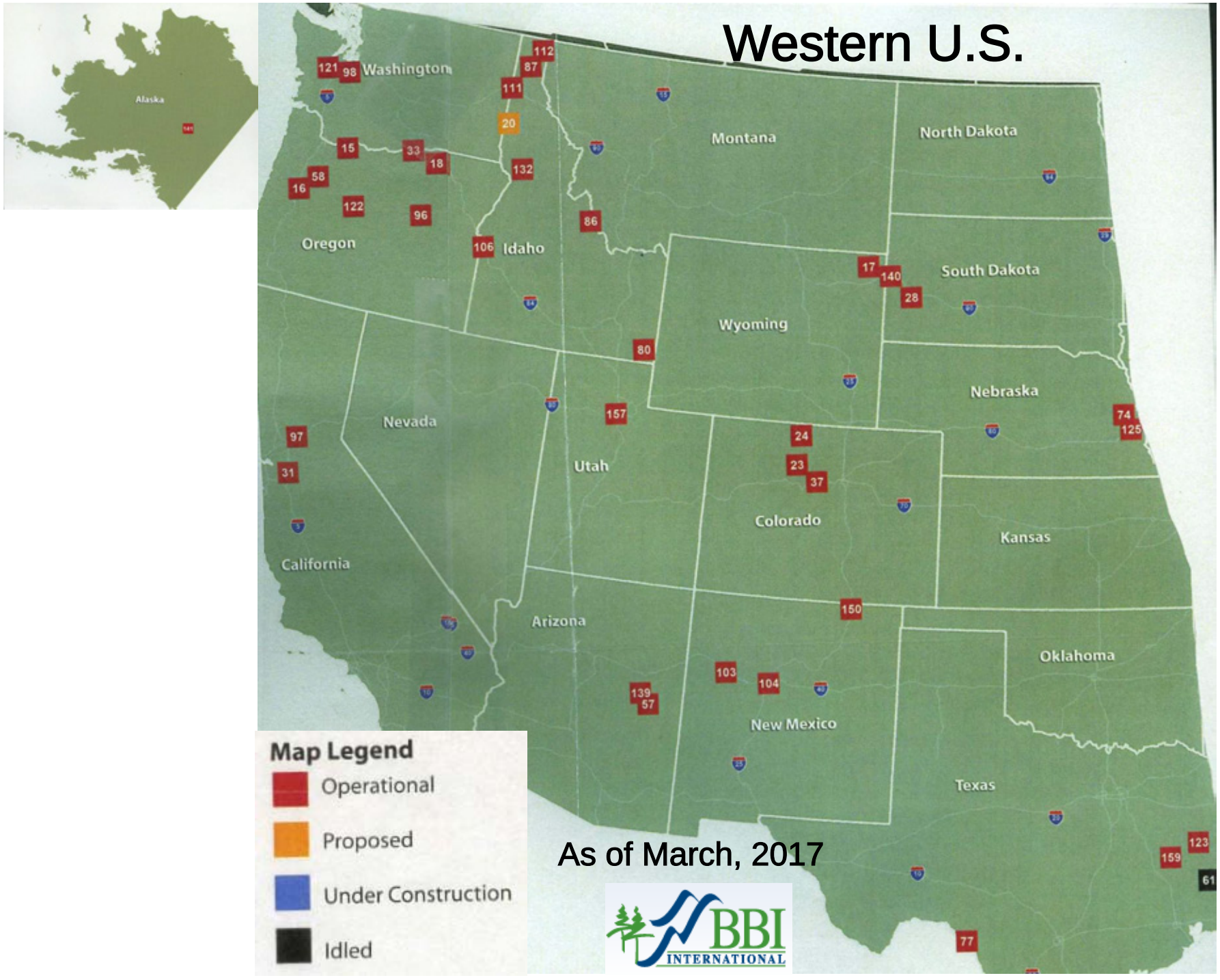
Western U.S.
Alaska
Washington
Oregon
California
Nevada
Idaho
Montana
Wyoming
Utah
Arizona
Colorado
New Mexico
North Dakota
South Dakota
Nebraska
Kansas
Oklahoma
Texas
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77
Map Legend
Operational
Proposed
Under Construction
Idled
As of March, 2017
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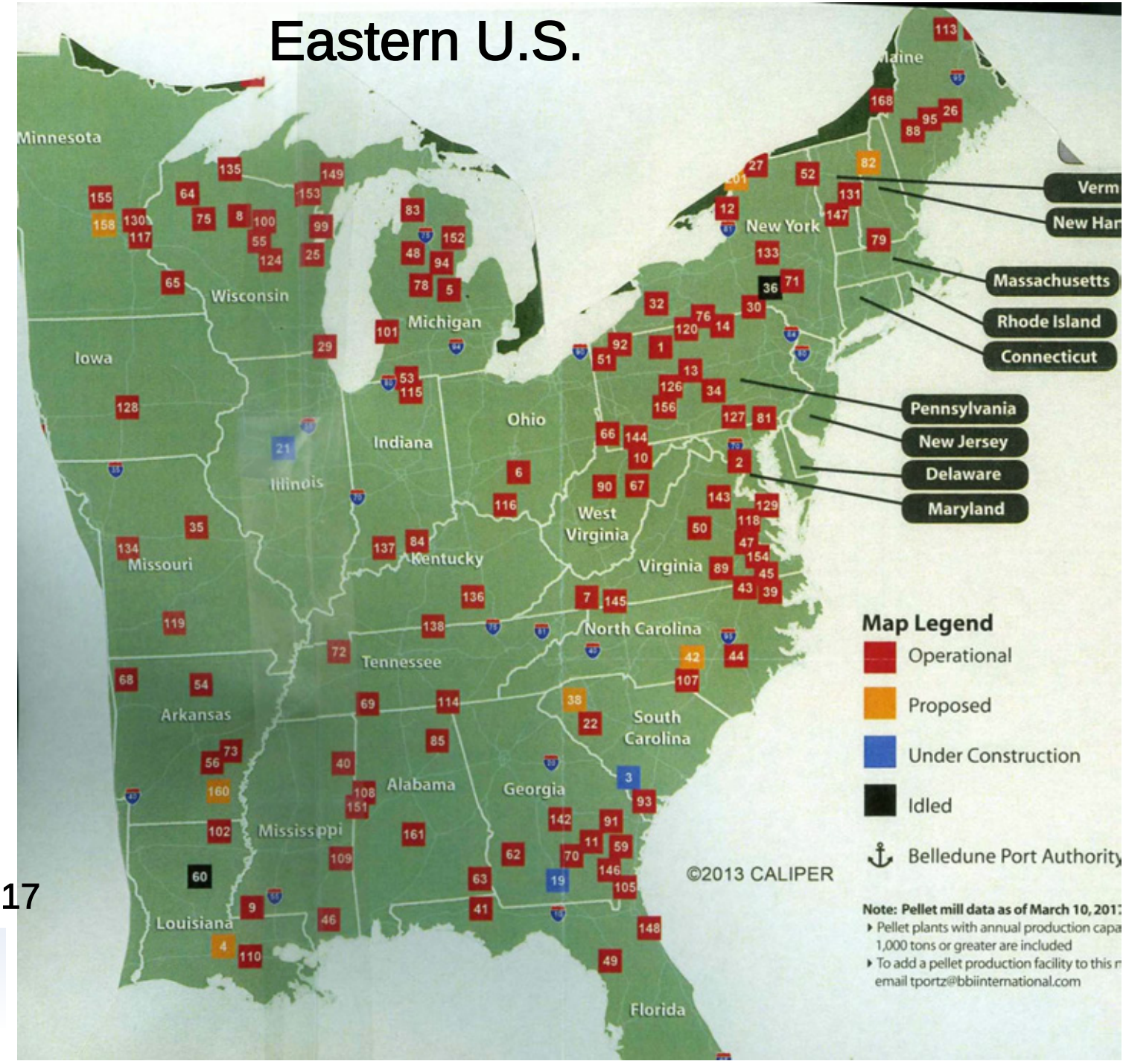
Eastern U.S.



As of March, 2017

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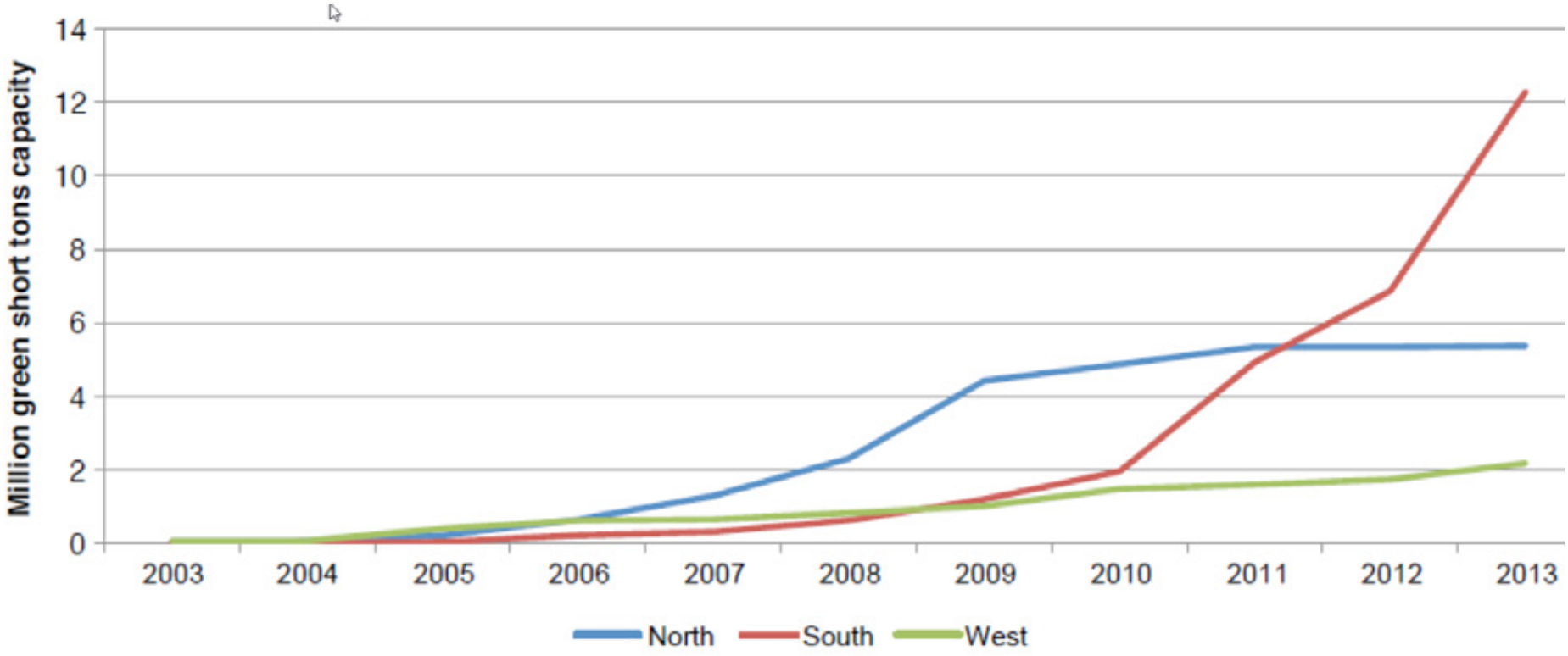
In the U.S.-The South Is Where the Action Is

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

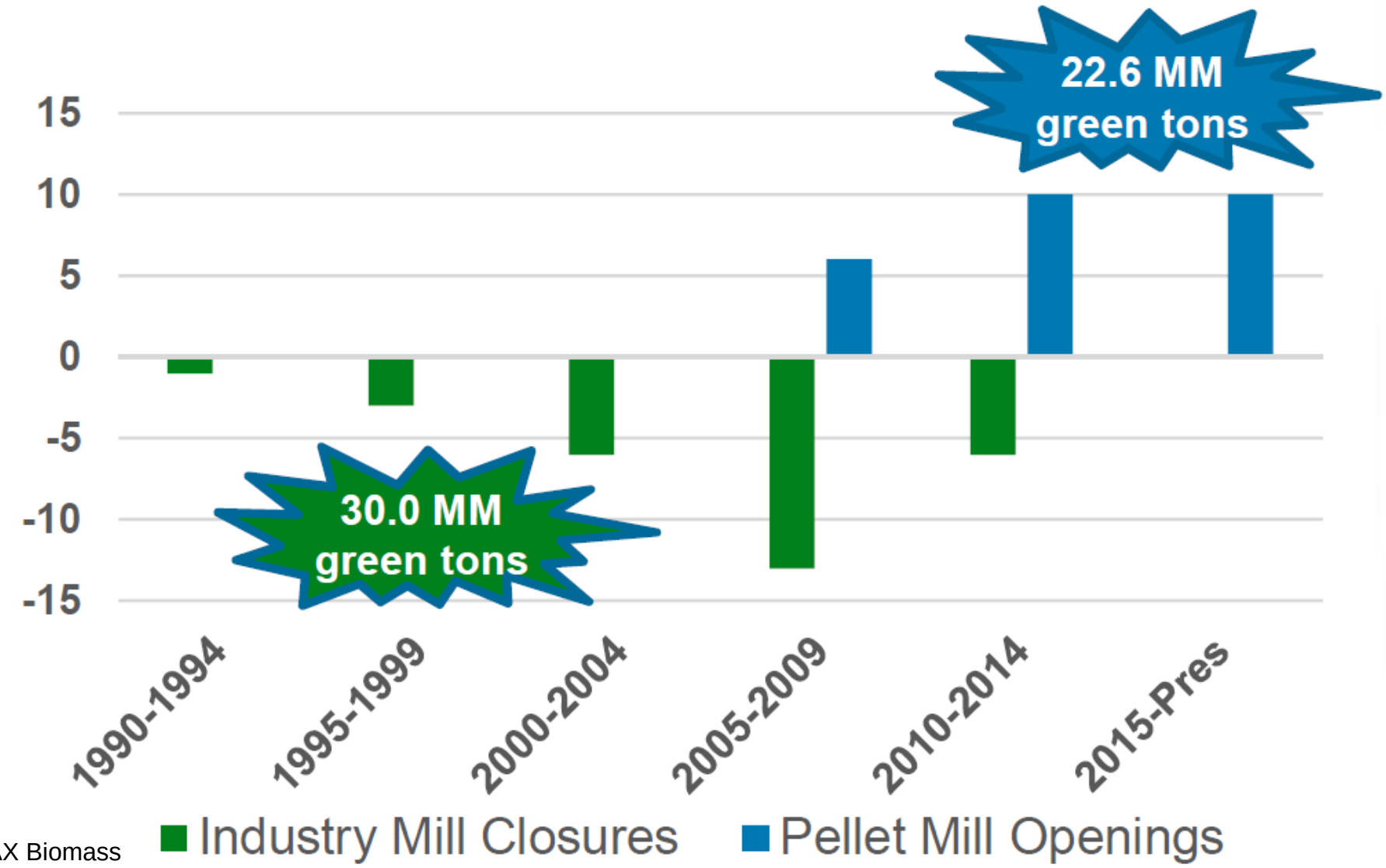
Capacities: Biomass Magazine December 9, 2015; Location: GTIS World Trade Atlas, US EIA Data

Wood pellet market development in US (2008-2016)

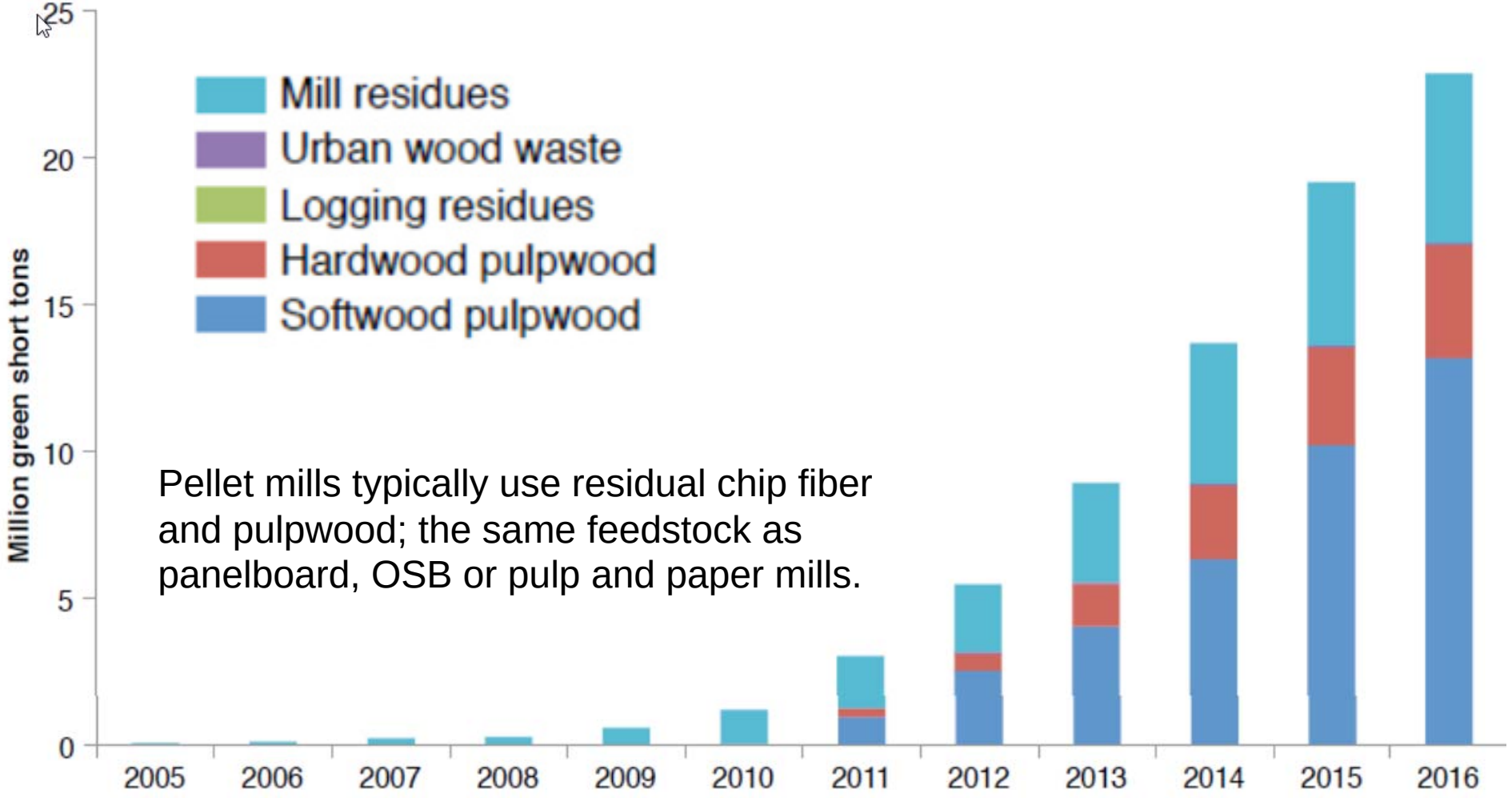


Pellet Mills Replace Lost Demand

US South Mill Closures and Openings (1990-2016)



Feedstock Selection – U.S. South



Pellet mills typically use residual chip fiber and pulpwood; the same feedstock as panelboard, OSB or pulp and paper mills.

Final Observations

Wood as a biomass input for energy, ***particularly pellets***, is on an upward trajectory….

The long-term view is also bright ***if mandates and policy support remains in place***.

Questions or Comments

Richard P. Vlosky, Ph.D.
Director, Louisiana Forest Products Development Center
Crosby Land & Resources Endowed Professor of
Forest Sector Business Development

Room 227, School of Renewable Natural Resources
Louisiana State University, Baton Rouge, LA 70803

Phone (office): (225) 578-4527; Fax: (225) 578-4251;
Mobile Phone: (225) 223-1931

E-mail: vlosky@lsu.edu

Web Site: www.LFPDC.lsu.edu