Biomass Energy

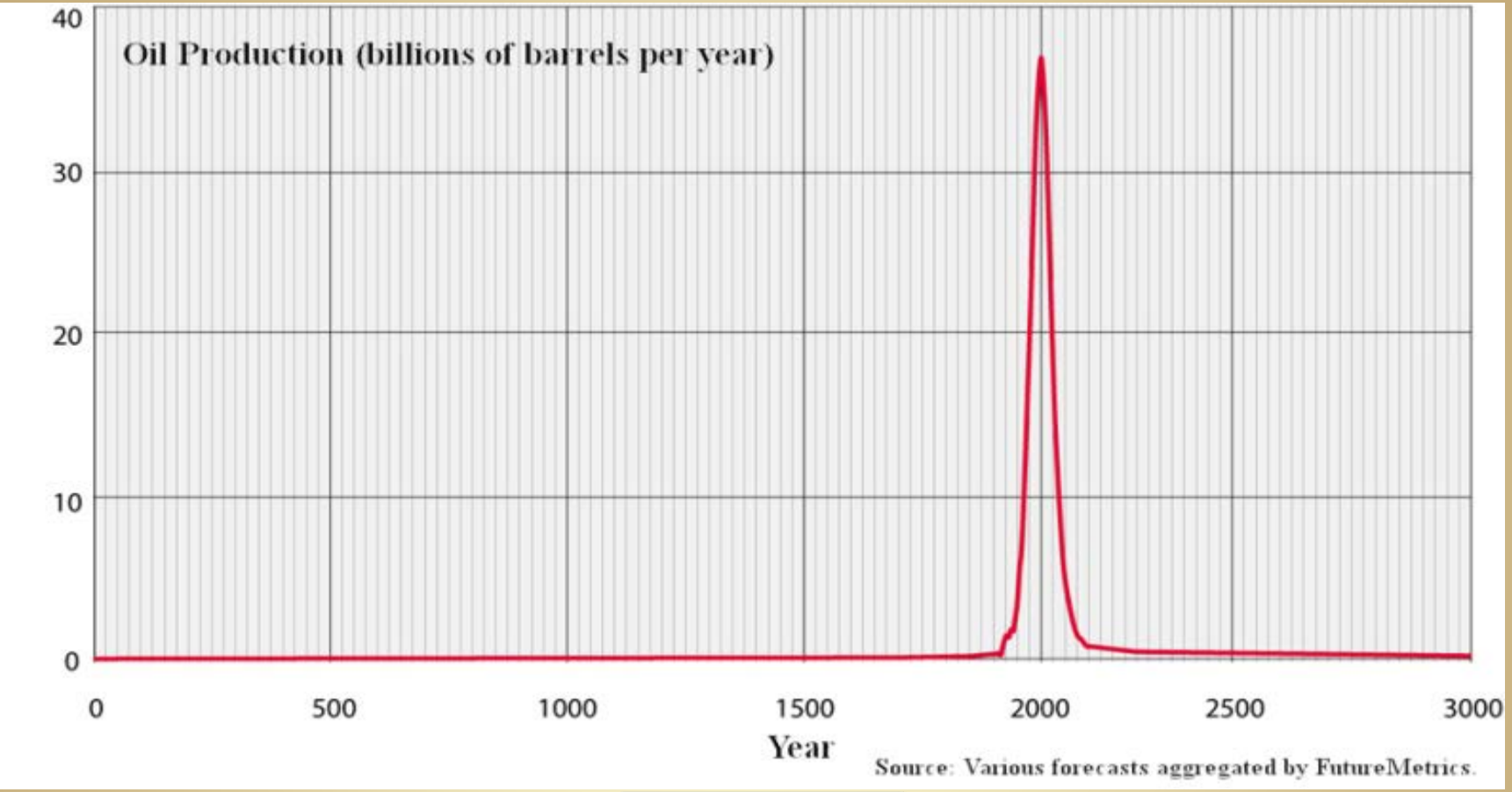
The economic and environmental benefits

Presented by William Strauss, PhD
President, FutureMetrics
Chief Economist, Biomass Thermal Energy Council

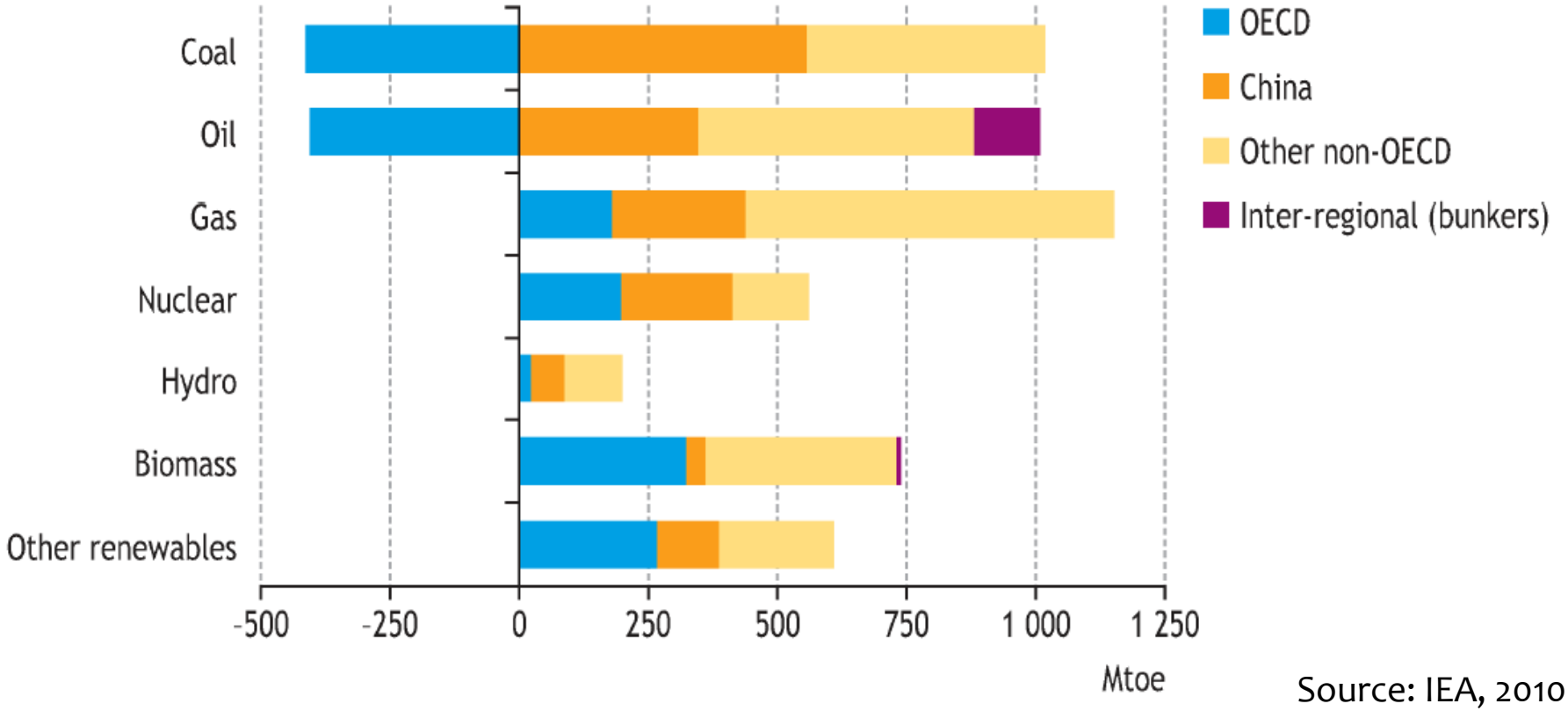
At the Florida Forestry Association Annual Conference
September 8, 2011

FLORIDA FORESTRY ASSOCIATION

Why should we care about biomass energy?

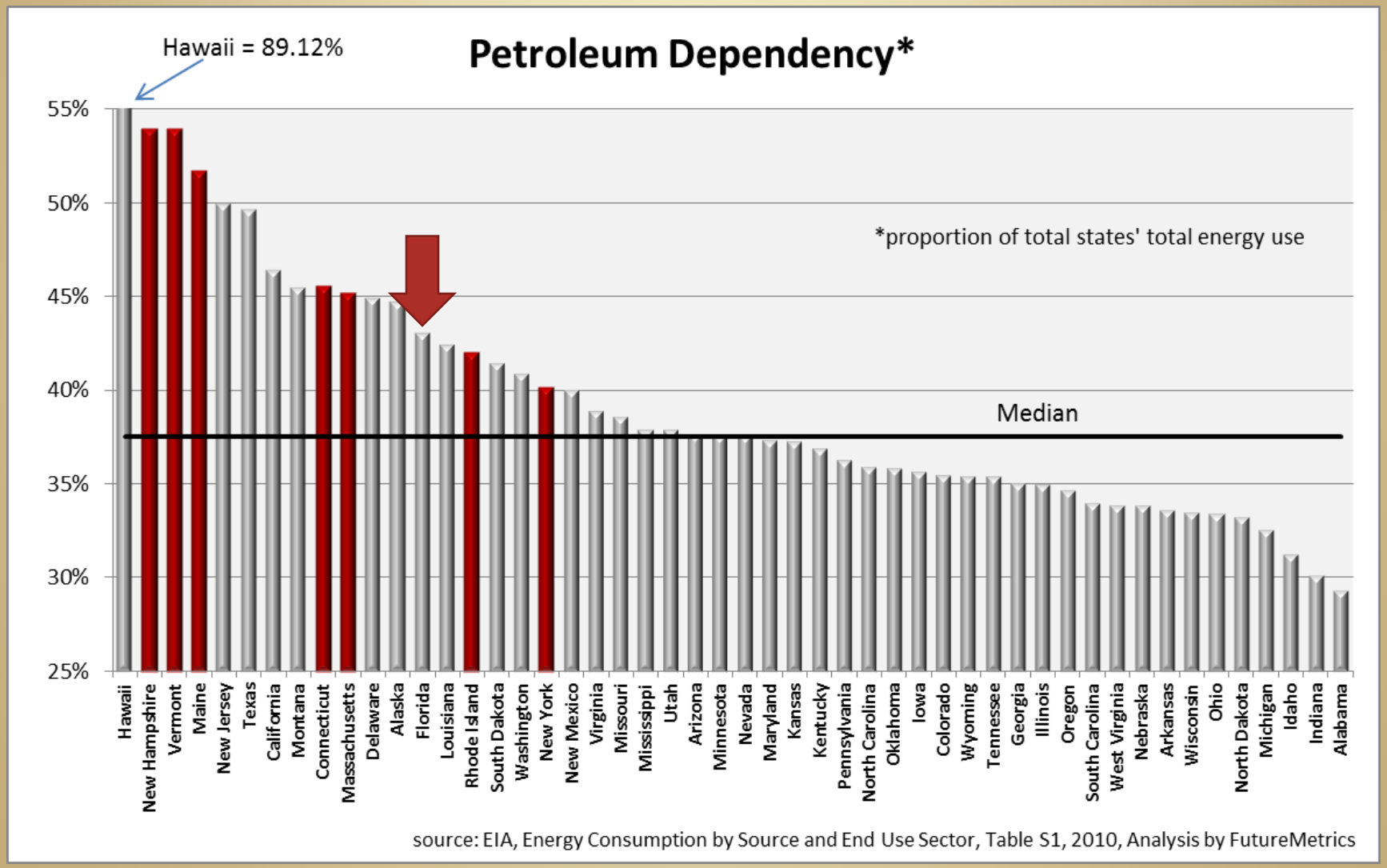


Why should we care about biomass energy?



Source: IEA, 2010

The US is very petroleum dependent. The NE states, due to a reliance on heating oil, are very dependent.



At current heating oil prices, the NE states "export" more than 16 BILLION dollars per year*

	Number of Households that Use #2 Heating Oil	Average Gallons Used per Year by those Homes	Average Total Expenditure Per Year (#2 at $3.65/gal)	**Amount that Does not Stay in the States (EXPORTED)**
Connecticut	688,000	591,680,000	$ 2,159,632,000	$ 1,684,513,000
Maine	434,000	373,240,000	$ 1,362,326,000	$ 1,062,614,000
Massachusetts	955,000	821,300,000	$ 2,997,745,000	$ 2,338,241,000
New Hampshire	291,000	250,260,000	$ 913,449,000	$ 712,490,000
New York	2,609,000	2,243,740,000	$ 8,189,651,000	$ 6,387,928,000
Pennsylvania	1,415,000	1,216,900,000	$ 4,441,685,000	$ 3,464,514,000
Rhode Island	170,000	146,200,000	$ 533,630,000	$ 416,231,000
Vermont	148,000	127,280,000	$ 464,572,000	$ 362,366,000
Total	**6,710,000**	**5,770,600,000**	**$ 21,062,690,000**	**$ 16,428,897,000**

Source: US Energy Information Administration, US Census, 2010, analysis by FutureMetrics

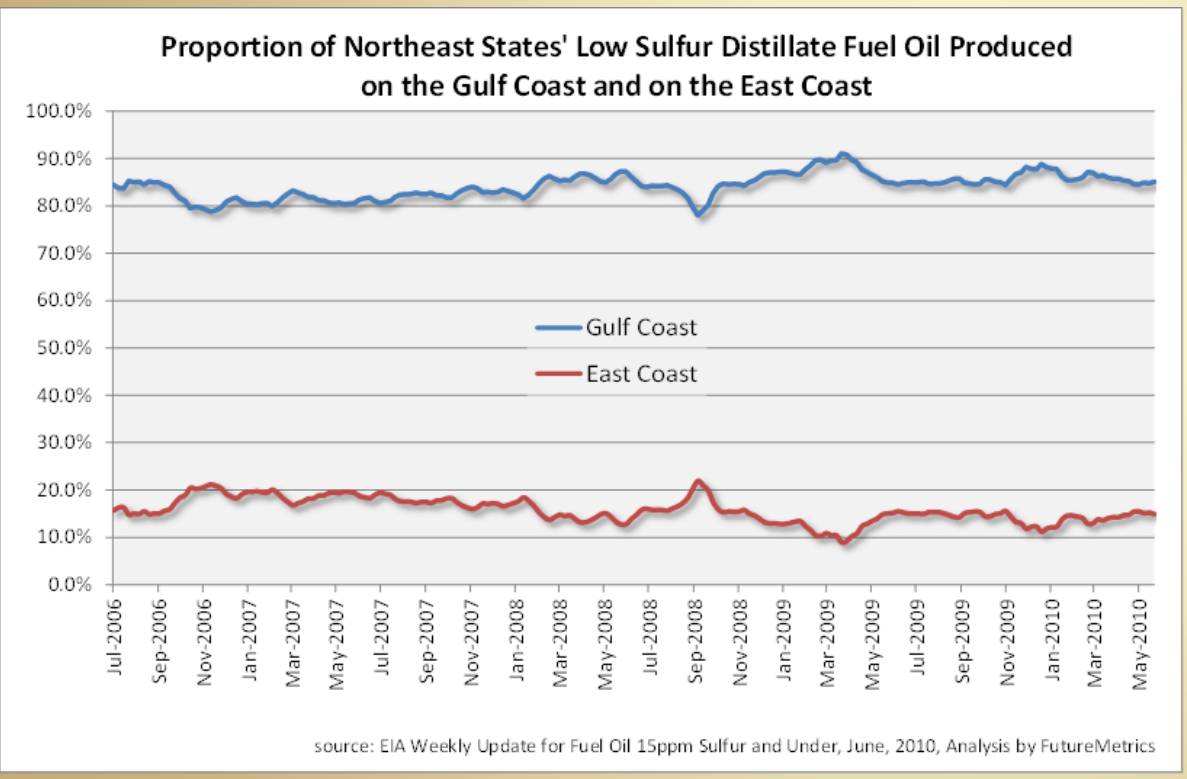
*The US EIA data shows that 78% of every dollar spent on heating oil leaves the region and most of those dollars leave the country.

When heating oil prices rise from $3.00/gallon to $4.50/gallon, **hundreds of thousands of jobs are lost** as more and more money is drained from those states' economies and sent to other places.

#2 Distillate Fuel use in Residential, Commercial, and Industrial (not Transportation)	Average Gallons per Year	Money Exported from Regional Economy at $2.75/gal	Money Exported from Regional Economy at $4.50/gal	Annual Increased Loss of Money if Heating Oil goes to $4.50/gal	Permanent Job Destruction
Maine	414,493,000	$889,087,485	$1,454,870,430	($565,782,945)	-33,908
Vermont	130,435,000	$279,783,075	$457,826,850	($178,043,775)	-10,447
New Hampshire	242,029,000	$519,152,205	$849,521,790	($330,369,585)	-18,528
Connecticut	672,464,000	$1,442,435,280	$2,360,348,640	($917,913,360)	-44,005
Rhode Island	148,551,000	$318,641,895	$521,414,010	($202,772,115)	-10,091
Massachusetts	818,841,000	$1,756,413,945	$2,874,131,910	($1,117,717,965)	-57,102
New York	1,818,841,000	$3,901,413,945	$6,384,131,910	($2,482,717,965)	-122,789
Pennsylvania	840,580,000	$1,803,044,100	$2,950,435,800	($1,147,391,700)	-57,943
	5,086,234,000	$10,909,971,930	$17,852,681,340	($6,942,709,410)	**-354,812**

Where Does that Exported Money Go?

Most of the heating oil used in the northeast is refined in the Gulf Coast area.

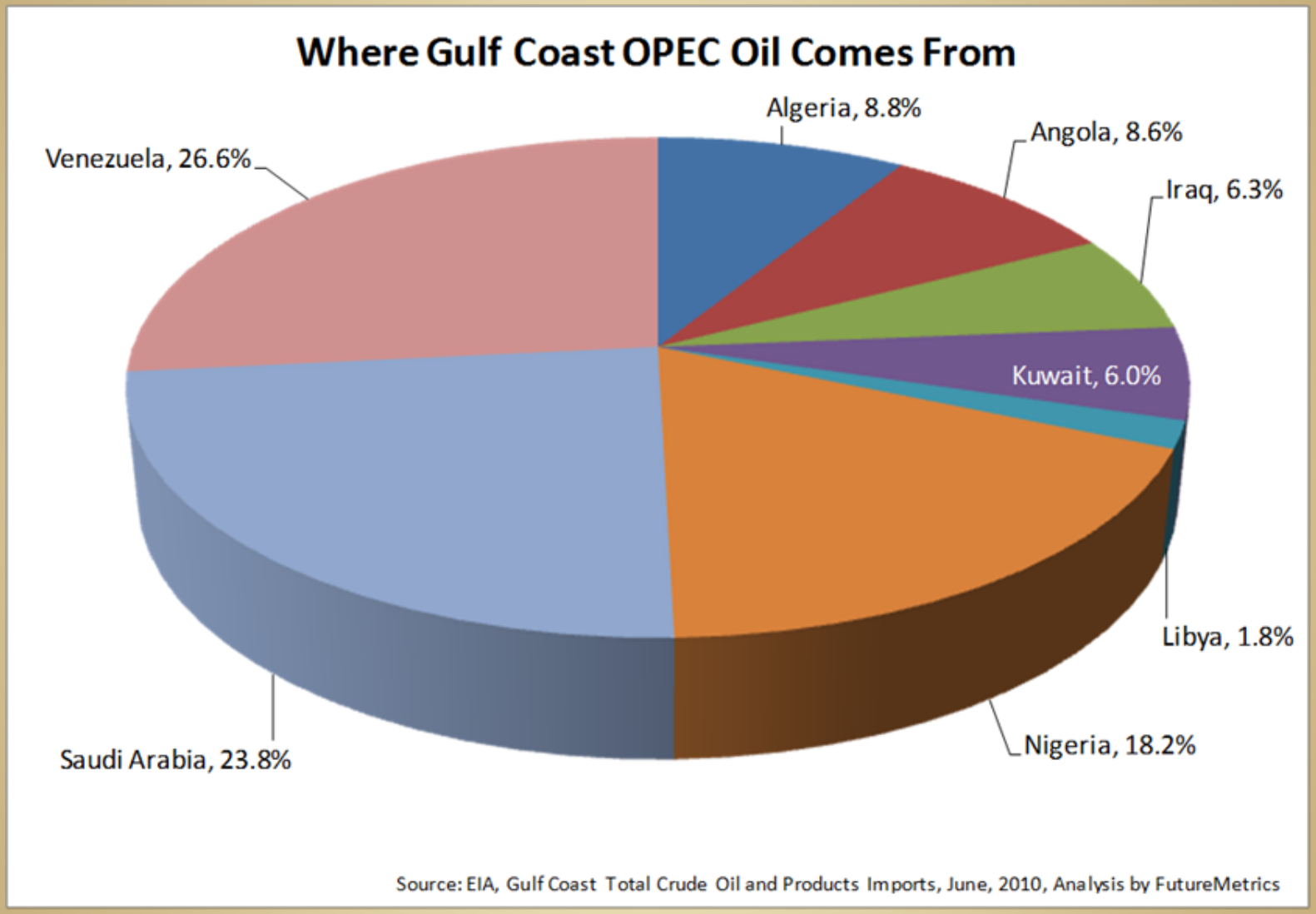


Only about 21% of the crude oil refined in the Gulf Coast area is from domestic offshore production in the Gulf of Mexico.

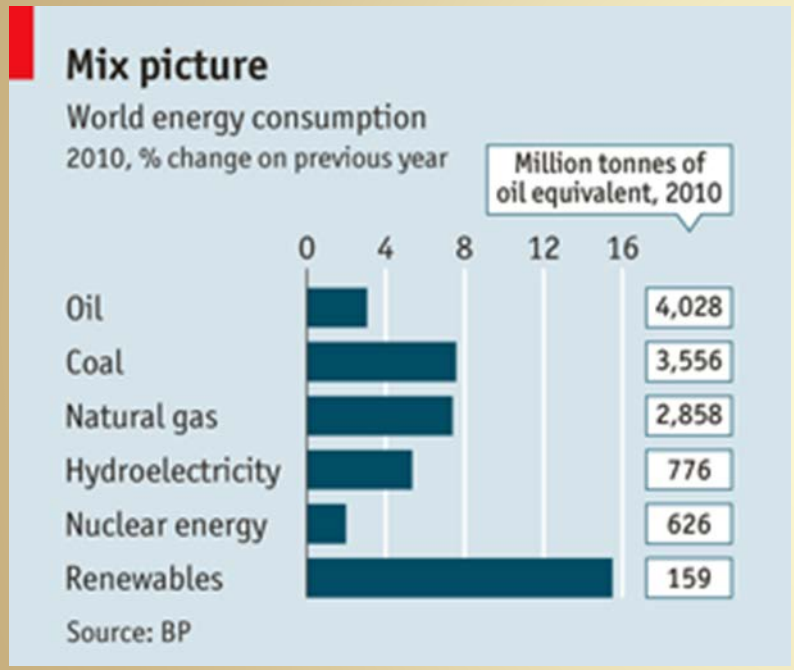
The rest is imported.

<u>About 60% of the imports are from OPEC nations.*</u>

*EIA, Special Report, Gulf of Mexico Fact Sheet, June 15, 2010

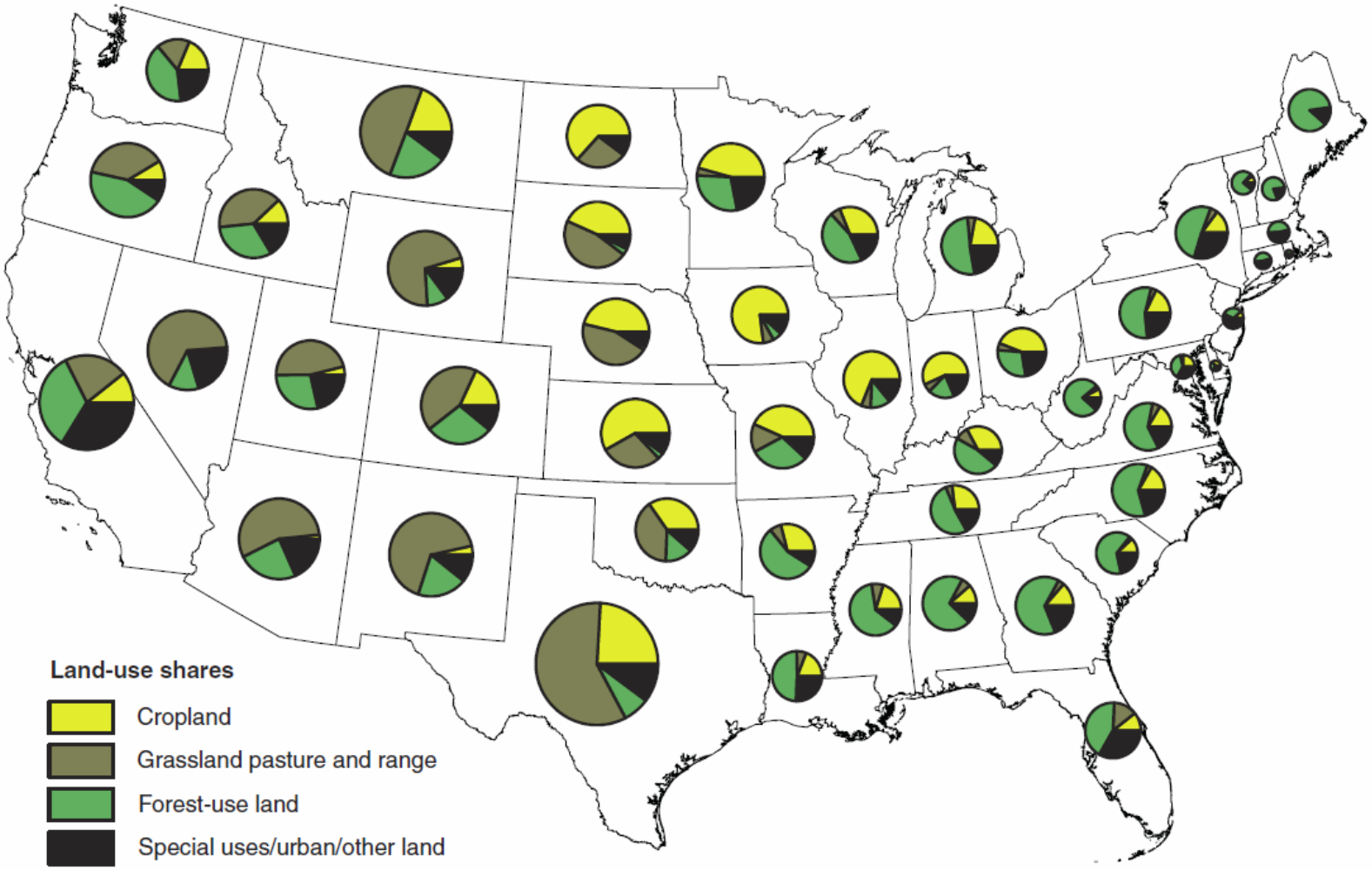

Where Gulf Coast OPEC Oil Comes From
Algeria, 8.8%
Angola, 8.6%
Iraq, 6.3%
Kuwait, 6.0%
Libya, 1.8%
Nigeria, 18.2%
Saudi Arabia, 23.8%
Venezuela, 26.6%
Source: EIA, Gulf Coast Total Crude Oil and Products Imports, June, 2010, Analysis by FutureMetrics

What is the Role of Southern Forests in Biomass Energy?



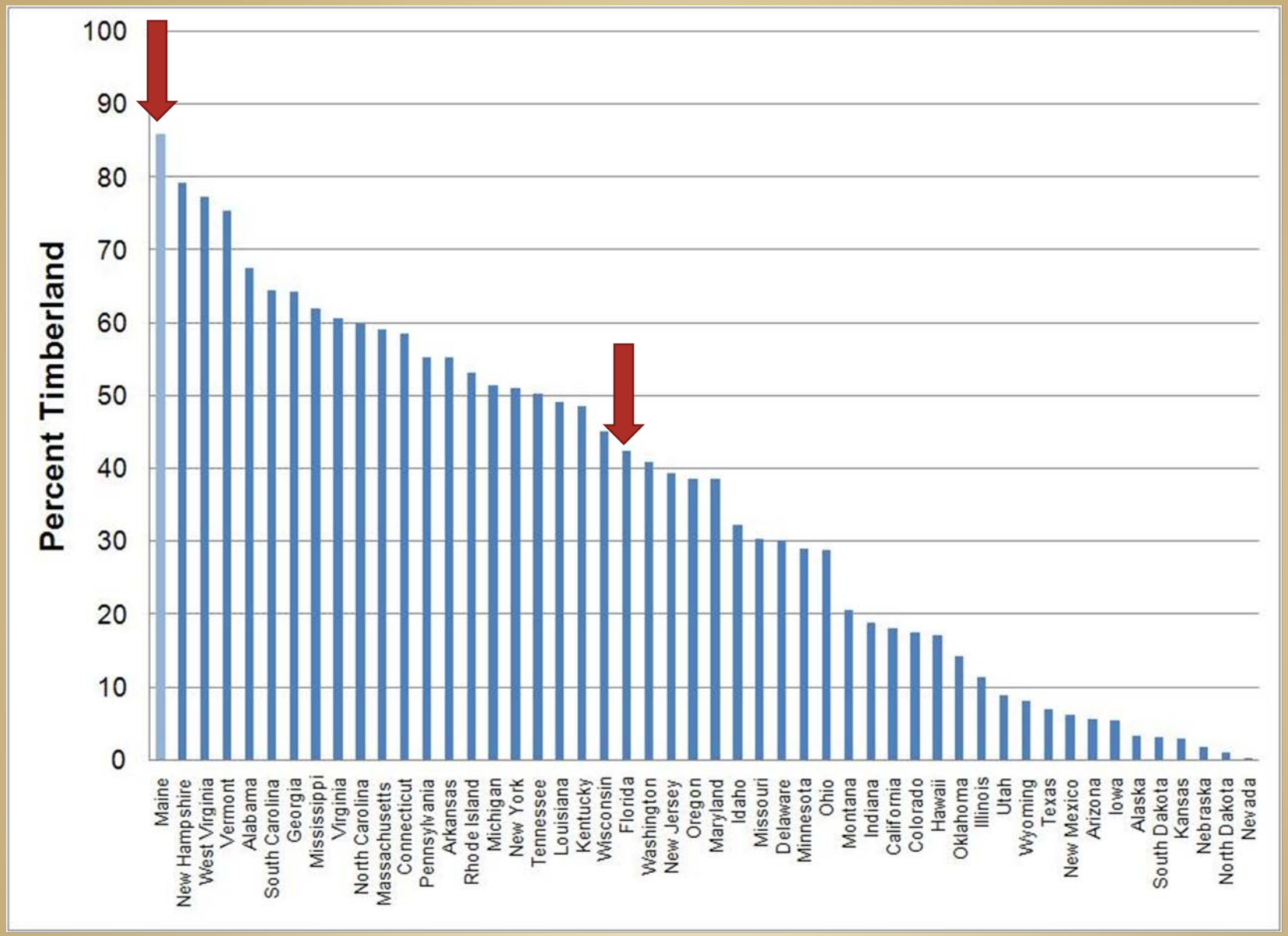
Renewables are a rapidly growing sector that is in its infancy.

And southern forests are well suited to provide the raw materials for producing power, heat, and wood pellets.



Note: The size of the pie charts is proportional to the land area in each State. Shares for Alaska are 25% in forest-use land, 75% in special uses/urban/other land, and less than 0.5% in all other uses. Shares for Hawaii are 5% in cropland, 24% in grassland pasture and range, 38% in forest use, and 33% in special uses/urban/other land.

Source: USDA/ERS Major Land Uses data series, 2005 (http://www.ers.usda.gov/data/majorlanduses/).



Source: The State of Maine's Environment 2010, a report produced by the Environmental Policy Group in the Environmental Studies Program at Colby College in Waterville, Maine

What are the economic and environmental consequences of wood-to-energy?

Economic consequences flow from the production and transportation of wood and wood fuels. Economic consequences are also created by the cost of the energy. Energy cost effects can be positive or negative.

Environmental consequences result from forestry methods, from transportation, and **from combustion**. These also can be positive or negative.

What are the economic consequences?

Direct Forest Products Jobs Created by Chip Production (per 100,000 tons per year of wood chips)	
Chipping Jobs	3
Logging Jobs	6
Trucking Jobs (Logs and Chips)	24
TOTAL	32
Indirect and Induced Jobs	34
Total Jobs per 100,000 tons per year of wood chips	66

What are the economic consequences?

BUT if the energy is costly, the benefits accrued in the forest products industry (jobs, commerce, multiplier effects) can be cancelled out by the reduction in disposable income from higher end user energy costs.

Price at the Generator

			Costs amortized over		25	years			Natural Gas at	
				at	10.00%				$7 per MMBTU	
	Construction Cost per kW	Size (MW)	Capacity Factor	Install Cost	Annual Capital Cost Amortization	Annual Output (kWh)	Fixed Capital Cost per kWh	Fixed Maintenance and other per kWh	Variable Cost per kWh	Total Cost per kWh
Hydro	$ 2,180	1000	90.0%	$ 2,180,000,000	$ 240,166,397	7,884,000,000	$ 0.0305	$ 0.0140	$ 0.0010	$ 0.0455
Natural Gas Combined Cycle	$ 1,170	200	85.0%	$ 234,000,000	$ 25,779,329	1,489,200,000	$ 0.0173	$ 0.0230	$ 0.0410	$ 0.0813
Coal	$ 2,749	500	85.0%	$ 1,374,500,000	$ 151,426,015	3,723,000,000	$ 0.0407	$ 0.0340	$ 0.0280	$ 0.1027
Landbased Wind	$ 1,485	50	23.0%	$ 74,250,000	$ 8,179,979	100,740,000	$ 0.0812	$ 0.0340	$ 0.0100	$ 0.1252
Nuclear	$ 4,930	1000	90.0%	$ 4,930,000,000	$ 543,128,596	7,884,000,000	$ 0.0689	$ 0.0470	$ 0.0400	$ 0.1559
Biomass (electricity only)	$ 3,294	200	85.0%	$ 658,800,000	$ 72,578,726	1,489,200,000	$ 0.0487	$ 0.0710	$ 0.0420	$ 0.1617
Offshore Wind	$ 2,890	50	34.0%	$ 144,500,000	$ 15,919,286	148,920,000	$ 0.1069	$ 0.0570	$ 0.0100	$ 0.1739
Solar PV	$ 5,750	100	30.0%	$ 575,000,000	$ 63,346,642	262,800,000	$ 0.2410	$ 0.0150	$ 0.0050	$ 0.2610

analysis by FutureMetrics

What is the use of wood-to-energy that provides the greatest overall economic and environmental impact?

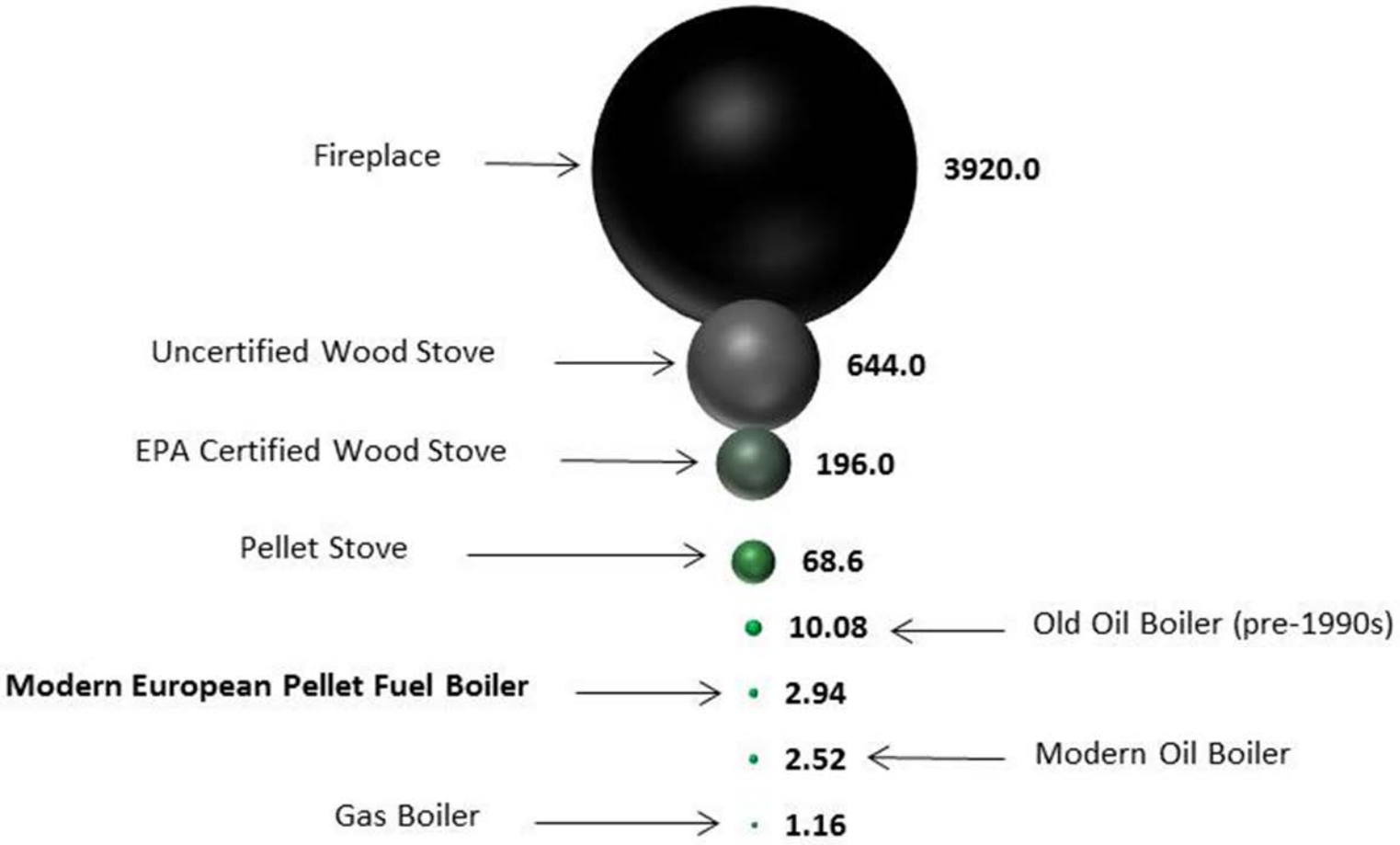
Pellet production for domestic use in the northern states to replace heating oil and propane. The economic impact is two fold – (a) creates jobs and commerce at the production end and (b) lowers heating bills and keeps the money spent on heating fuel in the US.

Modern wood pellet boilers are common in Europe and are growing in the use in the US.

Video

Total Pounds of Particulate per Year

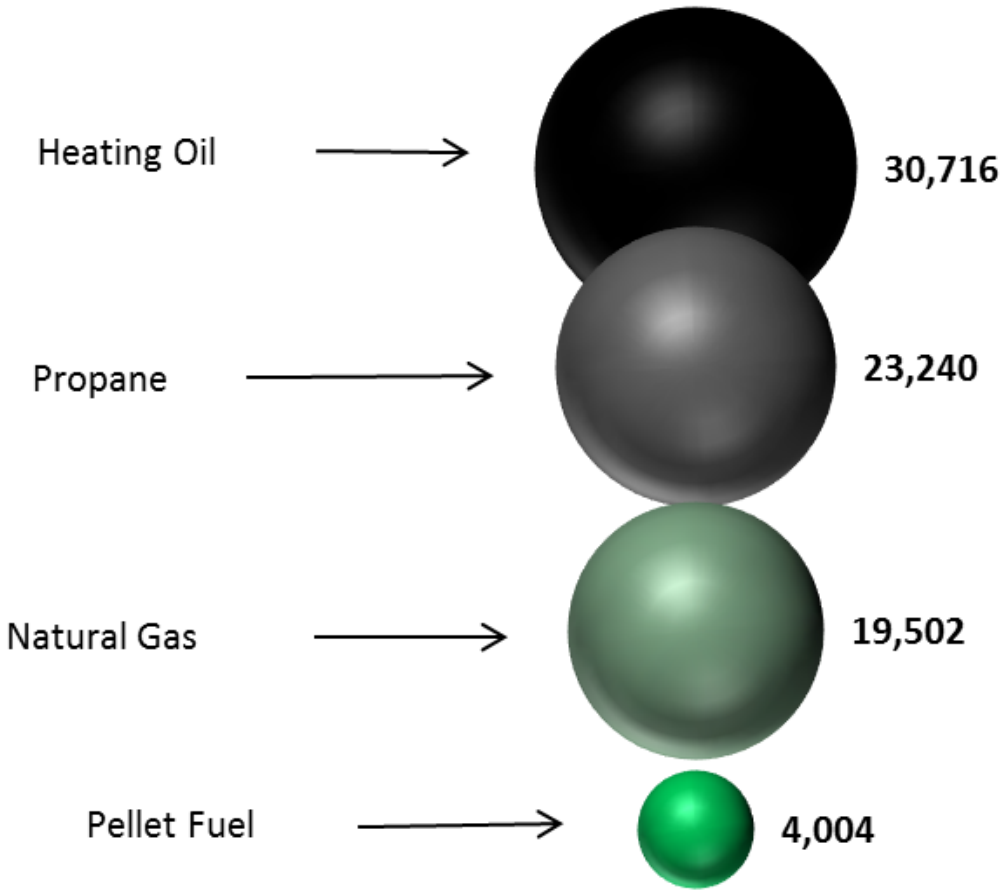
normalized to the equivalent of the BTU from 1000 gallons of heating oil per year



Source: USEPA , Maine Energy Systems, OkoFEN Eco Engineering GmbH, 2010, analysis by FutureMetrics

Total Pounds of CO_2 per Year

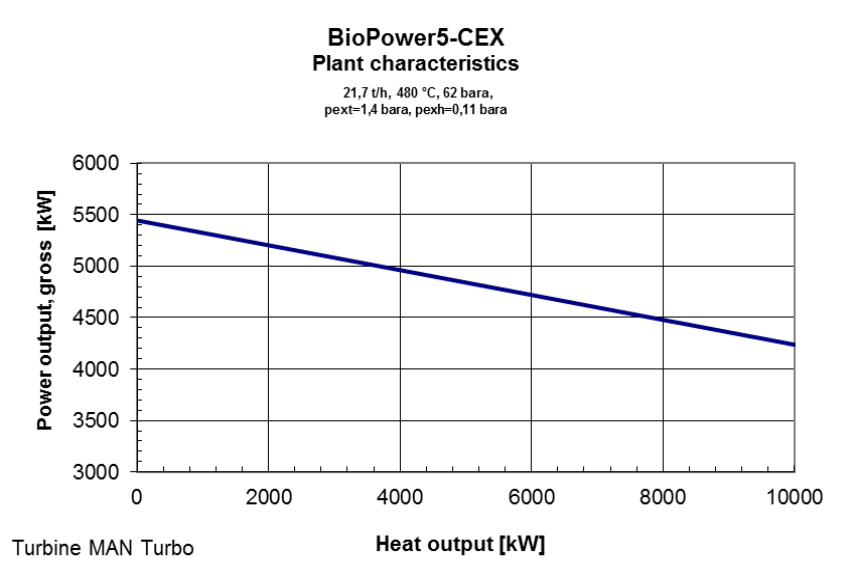
normalized to the equivalent of the BTU from 1000 gallons of heating oil per year



Life Cycle Assessment of Pellet Burning Technolgies, Thomas Willem de Haan, Univ,. of Amsterdam, June 2010.- Wood pellets are not entirely carbon neutral because some fossil fuel is required for the harvesting of trees and shipment. Extraction, refining , and transport emissions are included for each of the four fuel sources.

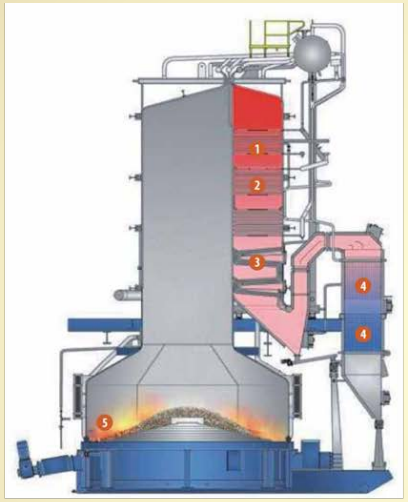
Combined Heat and Power

Which, with an optimal heat user, can reach efficiencies exceeding 80%.



Wood-fired power plants with heat and power cogeneration

Installed power:	20,5 MW
Fresh steam:	21,7 t/h
Fresh steam parameter:	485°C, 63 bar
Electricity output:	Up to 5.6 MW
Thermo output:	Up to 10 MW
Raw material need:	Approx.65.000 t/year



This is a BioPower 5 unit made by Metso and Wartsila (MW BioPower)

Comparison of CO for BP5 with propoased MACT EPA 2011

Limiting Value TA-Luft	**mg/Nm³**		**150,0**	
		Mess-Nr. 1	**Mess-Nr. 2**	**Mess-Nr. 3**
CO-Concentration real	mg/m³	7	7	7
CO-Concentration (related to 11 Vol-% O_2)	mg/m³	4,6	4,6	4,6
CO-Concentration (related to 7 Vol-% O_2)	mg/m³	**6,5**	**6,5**	**6,5**
Limiting Value EPA	**mg/Nm³**		**116,4**	
Lower deviation absolute (related to EPA)				
CO-Concentration (related to 7 Vol-% O_2)	mg/m³	109,9	109,9	109,9
Lower deviation relative (related to EPA)				
CO-Concentration (related to 7 Vol-% O_2)	%	94,42	94,42	94,42

Higher limiting value for CO is no problem for BP5

Biopower 5 – Emissions - PM

Dust Concentration BP5		Limiting Value EPA 2011
2.5 g/mmBTU	<	13.59 g/mmBTU

Higher limiting value for PM of proposed EPA 2011 limits are no problem for the BP5

Assumptions:

Annual Energy Input BP5:	**65,000 t/yr** = 162,500 MWh = 554,493 mmBTU
Annual Dust BP5:	max. measured value = 5 mg/Nm^3 x 35,000 Nm^3/h x 8,000 hr/yr = 1.4 t/yr
Dust Concentration BP5:	1.4 x10^9 /554,493 mmBTU = 2.525 g/mmBTU
Limiting Value EPA 2011:	0.03 lbs./mmBTU = 13.59 g/mmBTU (0.01 lbs = 4.53 g)

Less than one fireplace!

Pellet production for export to Europe

The southeast has good logistics for export. The market for both premium pellets for home heating system boilers and utility grade pellets for co-firing with coal in utility power boilers is expected to grow dramatically.

European policy will drive the demand:

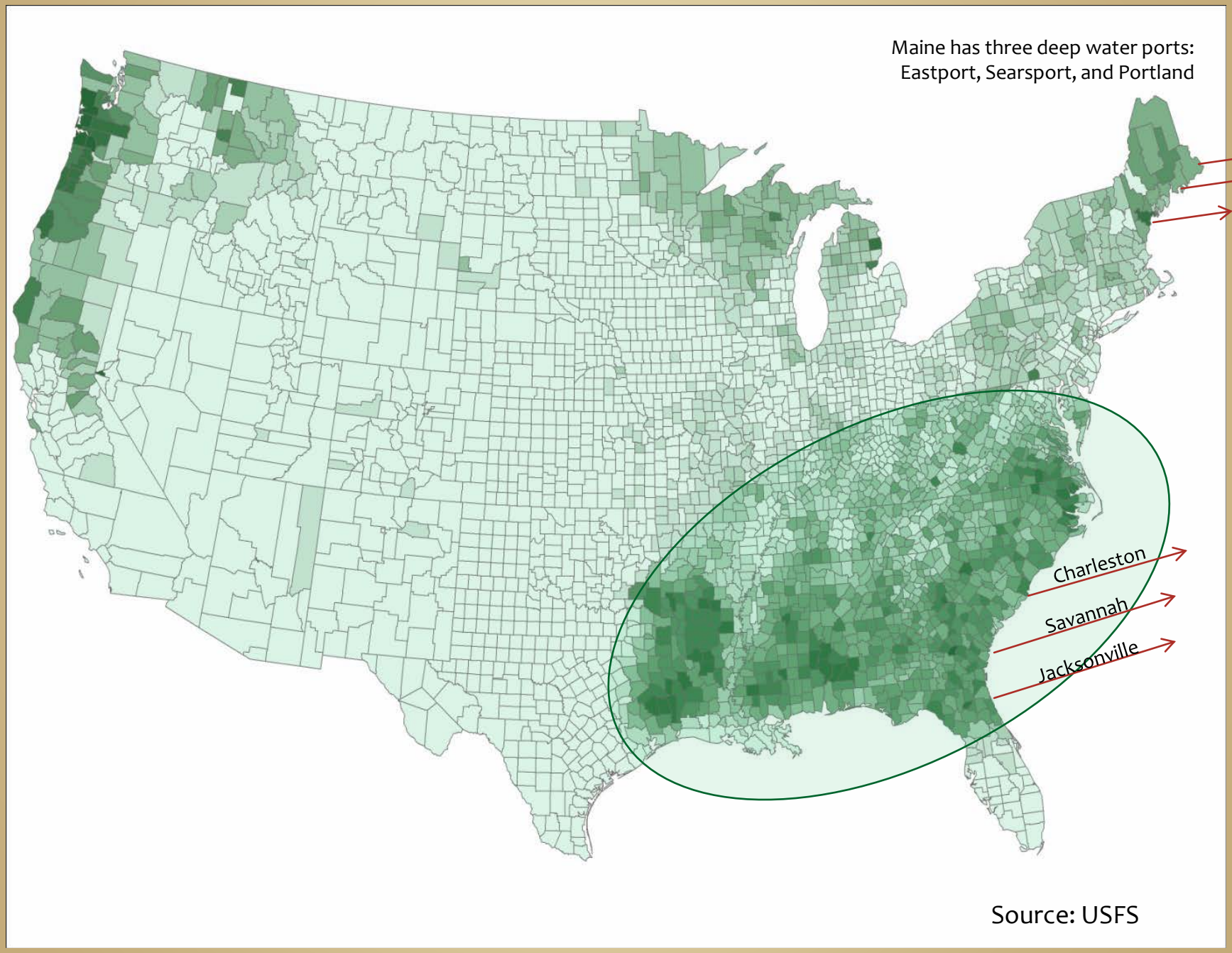
- 20/20/20 benchmarks for 2020
  - 20% reduction in greenhouse gasses
  - 20% from renewables
  - 20% efficiency gains

Greenhouse gas reduction (more on that later!) is a major benefit of biomass fuel AND biomass fuel is renewable.

The European Renewable Energy Council says that 61% of renewable energy will be from biomass.

Europe will barely create 50% of the needed supply.

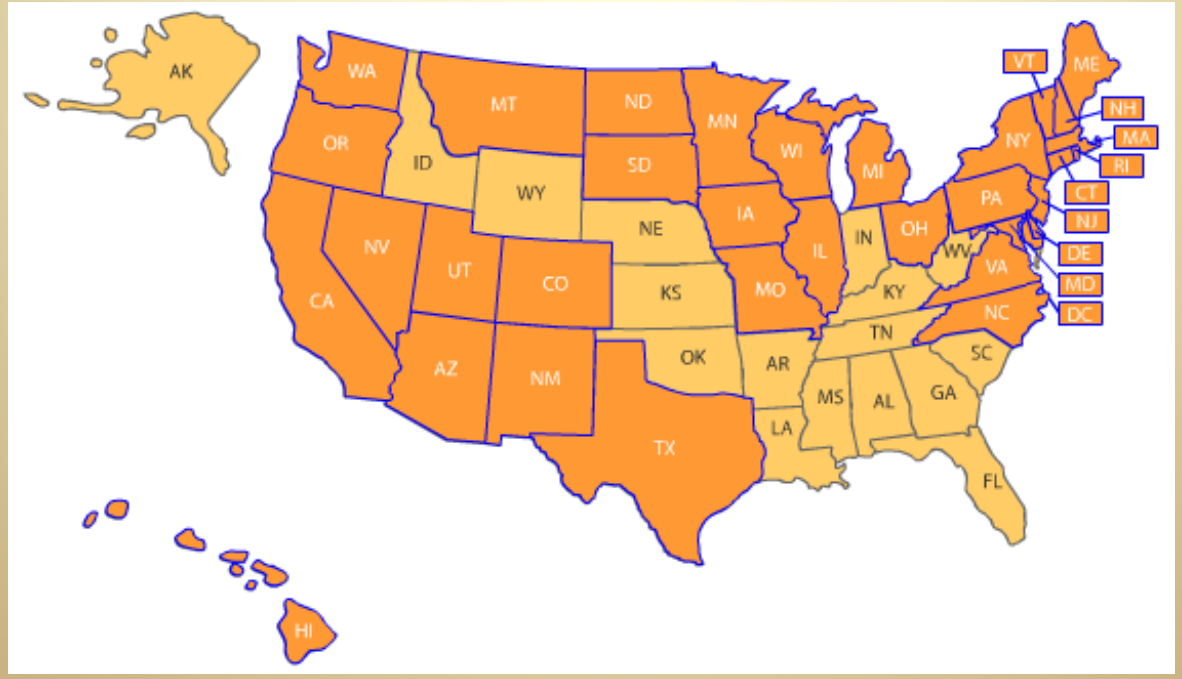
Roundwood Production per Acre



What about Domestic Power Plant Co-firing?

Also driven by policy. As long as coal is abundant and CO_2 emissions are not penalized in the US, exports of utility wood pellets will be the major wood-to-energy driver for the southeast.

Renewable Portfolio Standards (RPS) are hit and miss with the states. Currently there are 24 states with RPS policies. Five other states have nonbinding goals for adoption of renewable energy.



Southeast has no RPS policy

Source: US DOE

So the BIG Question: Is Wood-to-Energy Carbon Neutral?

As many of you know, most of the world says YES as long as the forests are sustainably managed.*

But a recent study commissioned by the Massachusetts Department of Energy Resources (DOER)** has not only confused policy makers but has also given opponents of wood-to-energy ammunition.

But the emperor has no clothes…

*In the simplest of terms (ignoring all the other ecological sustainability criteria) here we mean that the net stock of the forest systems resource is never depleted. That is, the growth to harvest ratio is equal to or greater than one.

**"Biomass Sustainability and Carbon Policy Study," prepared by the Manomet Center for Conservation Sciences, June, 2010.

From www.NoBiomassBurning.org

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Air Pollution Water Pollution Dirtier Than Coal Public Health Forests
Climate Change Ash Civil Rights Contact

NEW REPORT

Biomass Electricity:
Clean Energy Subsidies for a Dirty Industry

The case for ending taxpayer and rate-payer subsidies that harm public health, environment, climate, and forest

Download Report: Biomass Electricity Report.pdf

Audio of Report Presentation June 28, 2011 Press Conference Audio.mp3
Speakers:
Meg Sheehan, attorney, Biomass Accountability Project;
William Sammons, M.D., pediatrician with expertise on health and fiscal impacts;
Mary Booth, PhD, founder, Partnership for Policy Integrity, air emissions, forest and climate impacts
Senator Marc Pacheco, Massachusetts Legislator, author of Global Warming Solutions Act, current Chair, Environment Committee
James Maloy, Florida, citizen activist, defeated Adage/Duke/Areva biomass project
Shane Avery, M.D., Indiana, medical doctor assisting biomass opponents
Lee Ann Warner, citizen activist, Stop Toxic Incineration in Springfield, MA
Margaret Dodd, Mayor, Traverse City, MI, defeated biomass projects in MI

Ten Frequently Asked Questions About Biomass Combustion 10 Frequently Asked Questions About Biomass Combustion Power.pdf

Press Release Press Release June 28 P.pdf

The so-called Manomet Study has provided these groups a state sponsored source of support.

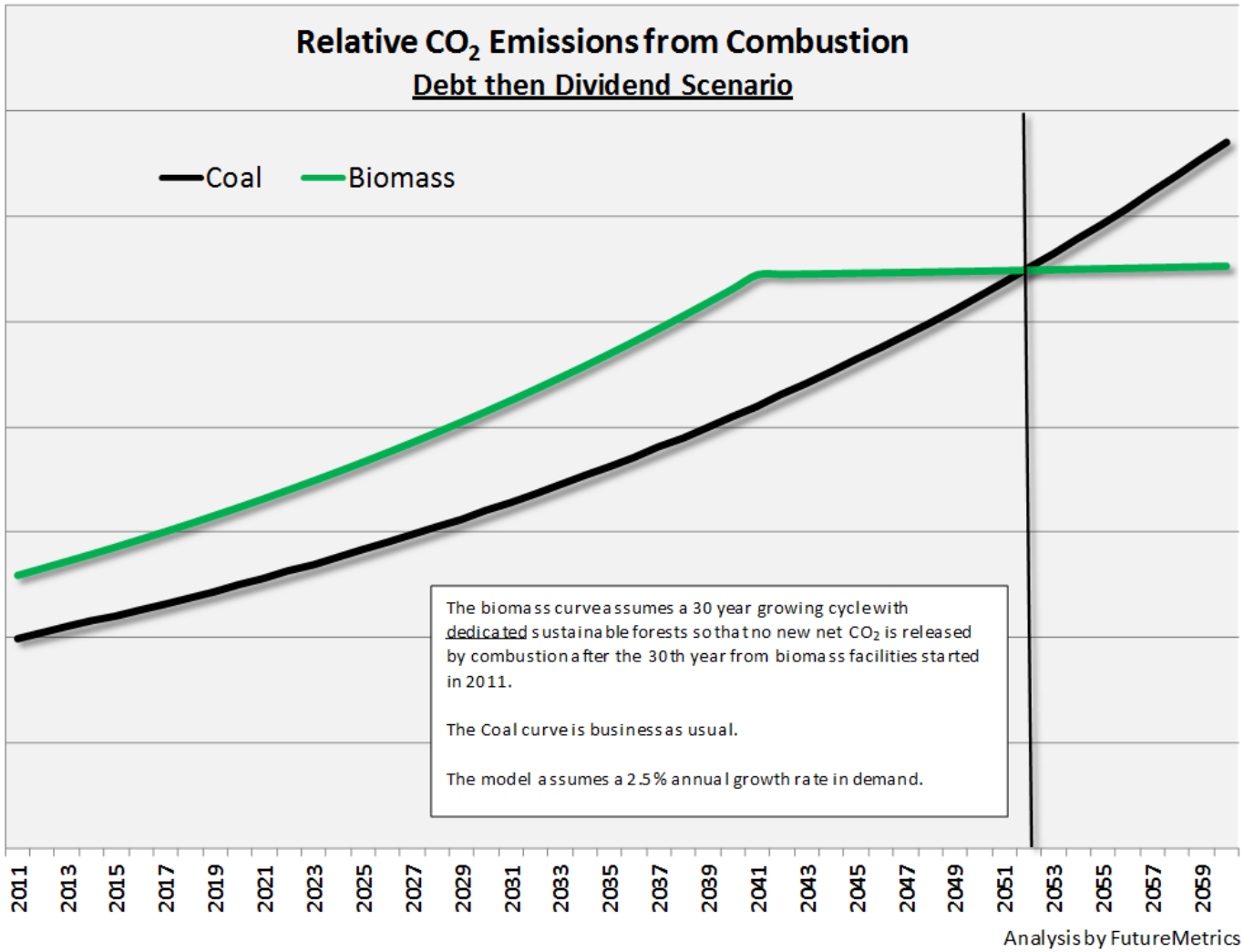
But does the Manomet Study hold water?

My company, FutureMetrics, has published a research paper that essentially say that the study is highly flawed. The Manomet Center published a rebuttal to our paper and FutureMetrics has replied to that as well.

What follows is the essence of the discussion.

All of the papers are available from www.FutureMetrics.com

The Manomet Study essentially says that the carbon debt created from burning biomass will take decades to unwind.

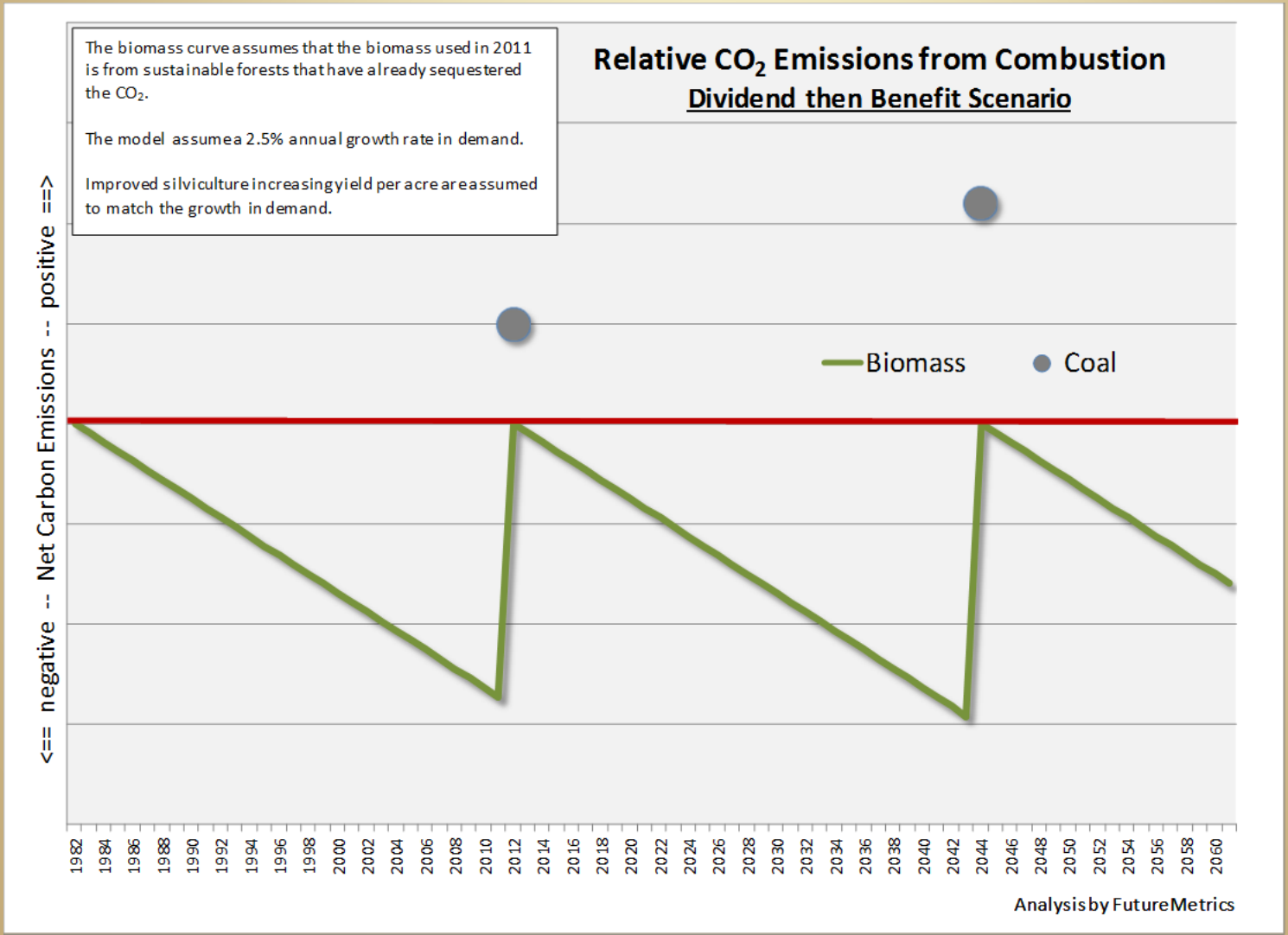


The preceding chart illustrates the foundation of the Manomet logic.

Taken to the logical extreme, the Manomet study's logic is essentially beginning with a full grown tree, then they are watching that tree get harvested and used for energy and having its stored carbon released as CO_2 (the debt).

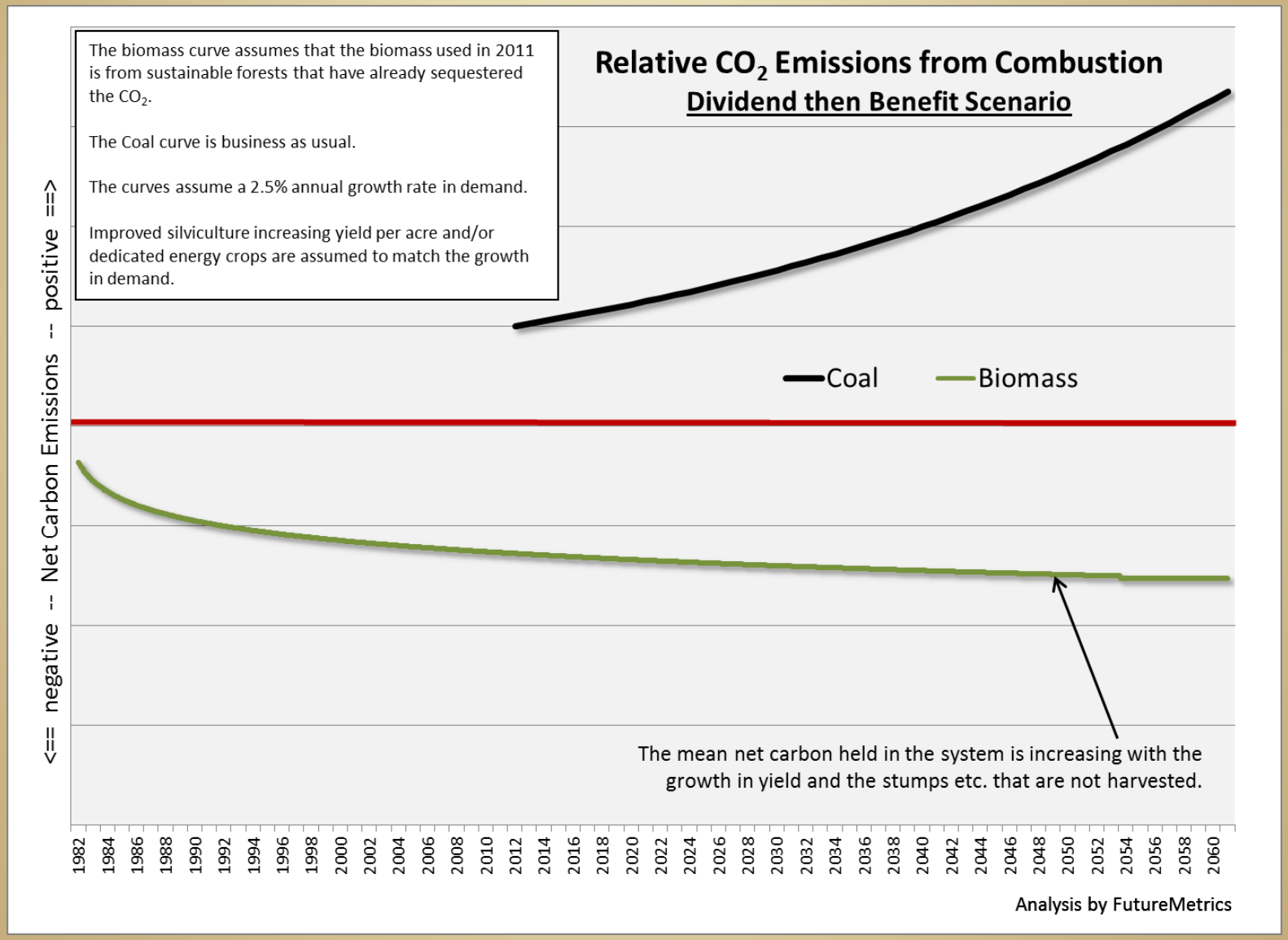
Then they continue to watch the empty spot where there tree was for 30 to 50 years while a new tree grows in its place. Only after that regrowth is the carbon debt repaid (the dividend).

The Manomet Study has many flaws but perhaps the most egregious is their failure to take into account the fact that forest systems have been capturing carbon for decades prior to harvest and combustion.



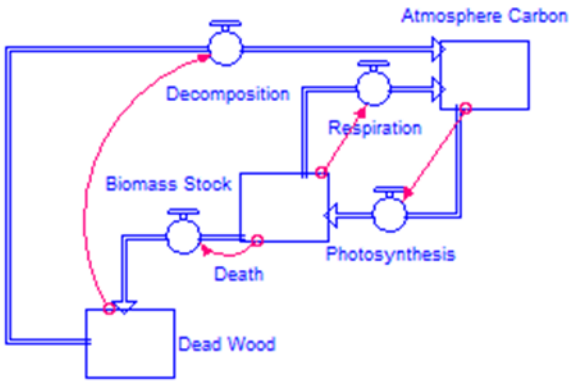
At the stand level.

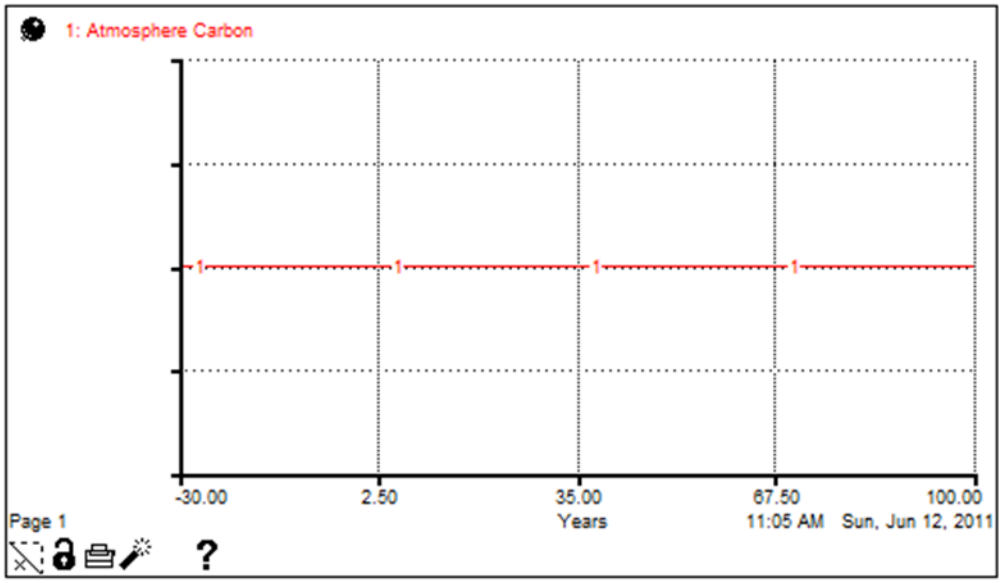
At the system level, the net carbon sequestered is increasing.



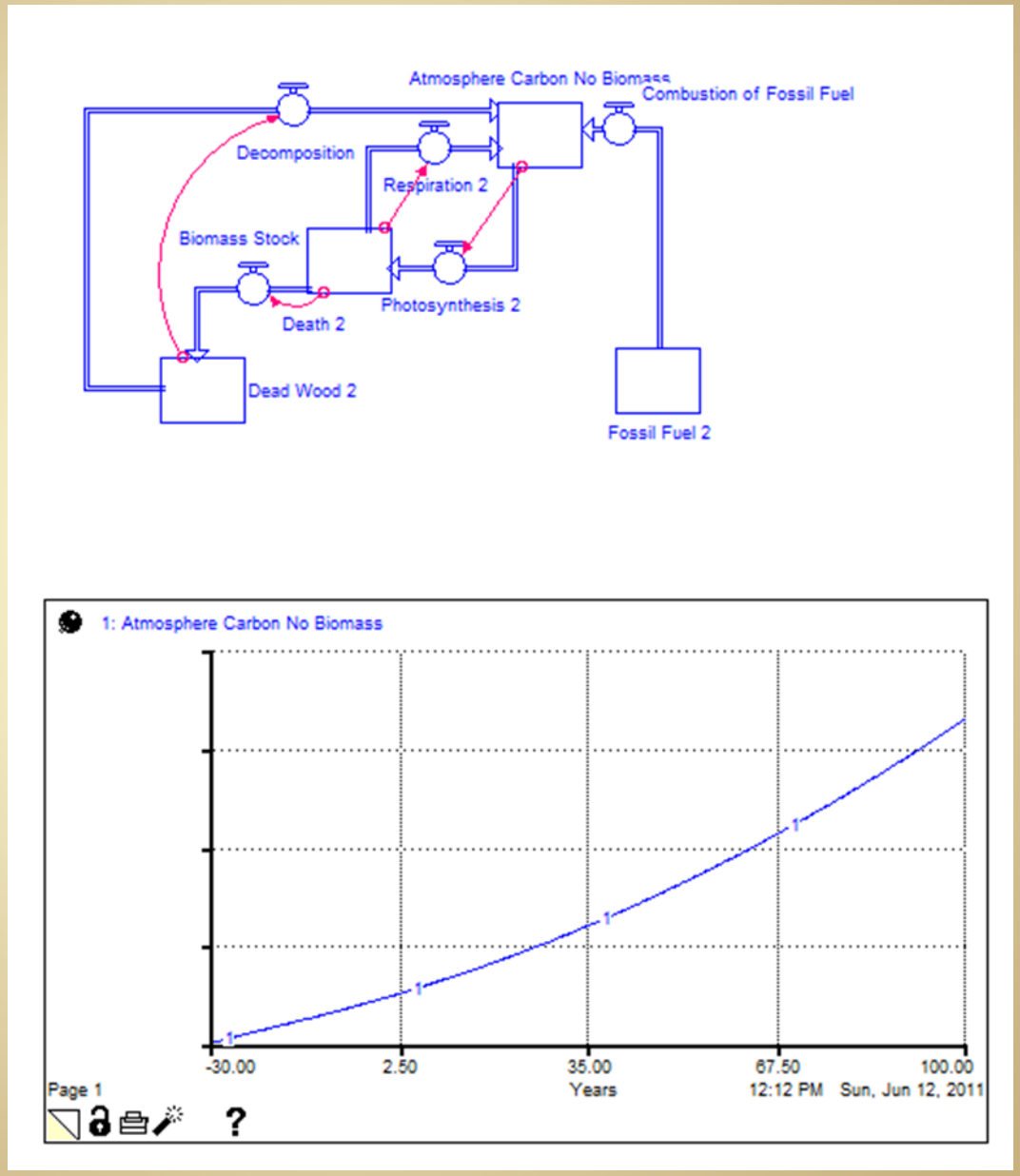
This is better illustrated using a simple simulation

We begin with a look at the carbon cycle for wood with <u>no combustion of fossil fuels or wood fuels</u>.



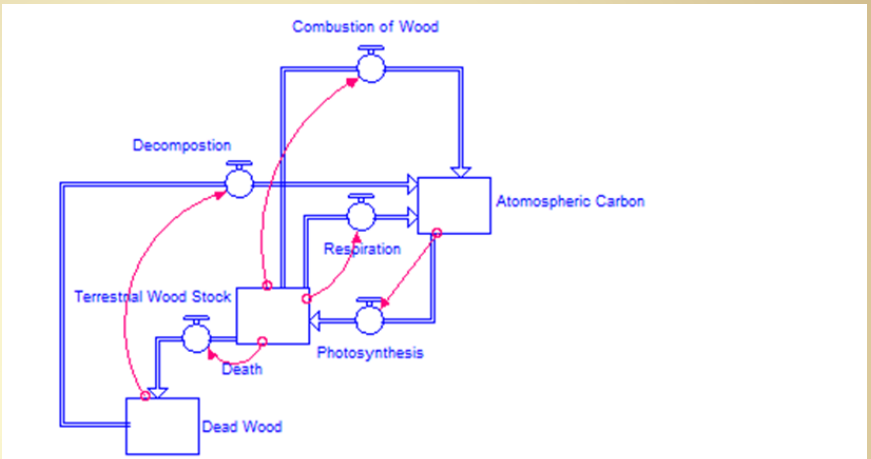


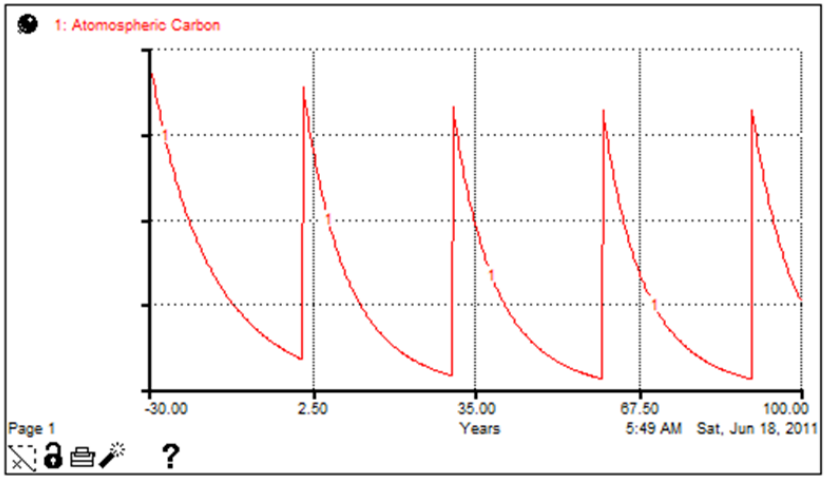
This shows the carbon effects of fossil fuel combustion



Now we remove fossil fuel and look at the carbon effects of using a <u>single stand</u> of trees for energy.

Of course in a forest system, trees are at many stages of growth and in aggregate the net stock remains more or less constant (assuming sustainable forestry) or grows (assuming better silviculture).



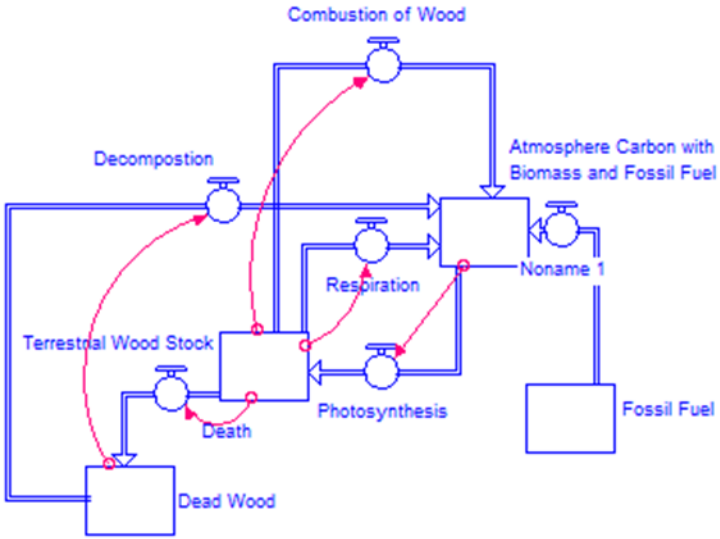


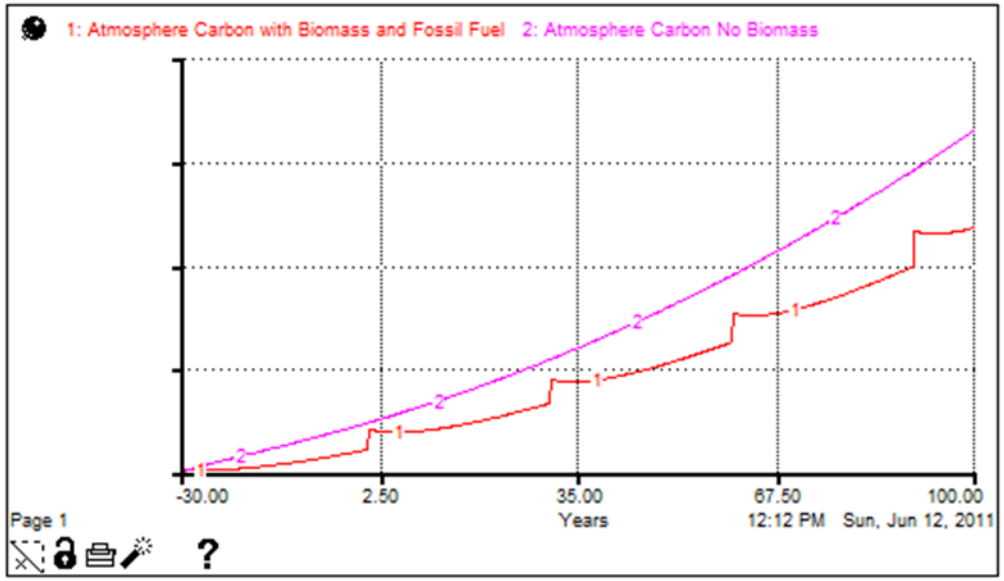
Finally we add fossil fuel back in at about the proportion it will have to grow to meet energy demand even with a some conversion to wood energy.

This very stylized model has us harvest in 30 year cycles (with no harvest in between). This it totally detached from the reality of how forests are managed but shows the net carbon effect of <u>two cases</u>:

- fossil fuel only and
- fossil fuel with some biomass to offset some of the growth in fossil fuel demand.

Both cases show overall growth in CO_2 because the fossil fuel growth is required in both cases.


Combustion of Wood
Decompostion
Atmosphere Carbon with
Biomass and Fossil Fuel
Noname 1
Respiration
Terrestrial Wood Stock
Photosynthesis
Fossil Fuel
Death
Dead Wood


1: Atmosphere Carbon with Biomass and Fossil Fuel
2: Atmosphere Carbon No Biomass
-30.00
2.50
35.00
67.50
100.00
Years
Page 1
12:12 PM Sun, Jun 12, 2011

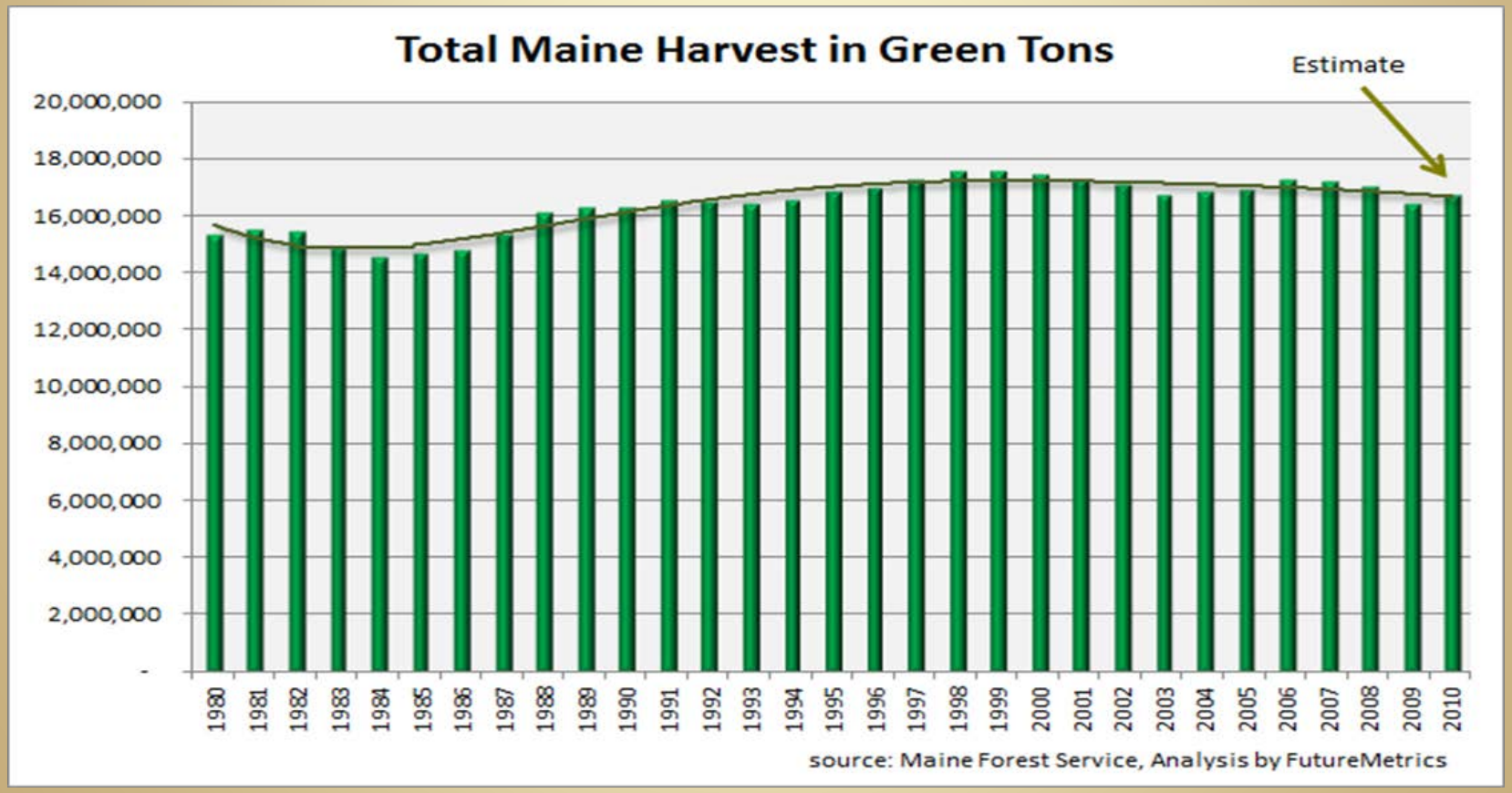
The carbon "Bottom Line" shows that the there is no merit to anti-biomass for energy based green house gas concerns.

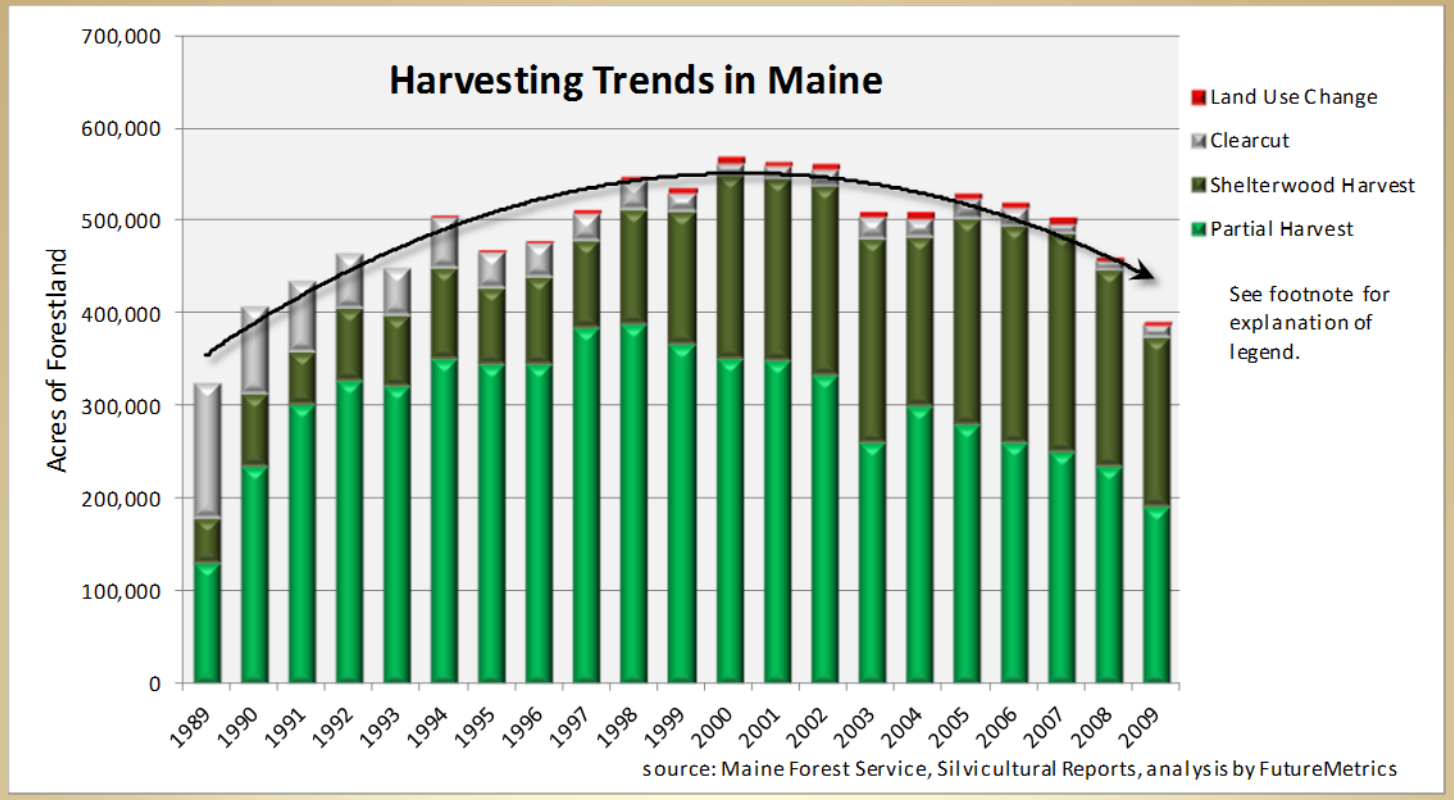
Quite the opposite!

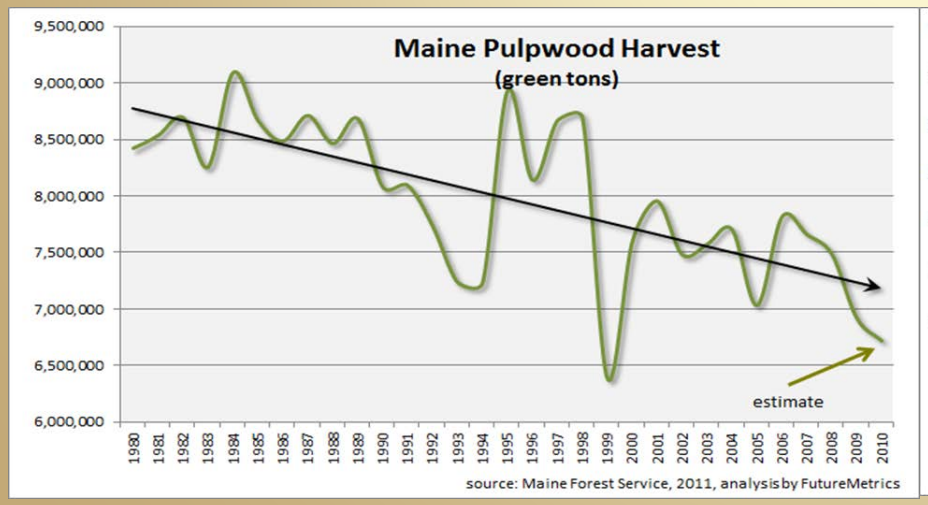
	CO_2 (lbs) Created Per Million BTU						
	Firewood (average of all species)	Wood Pellets	Green Wood Chips	Heating Oil	Natural Gas	LPG	Coal
Thinning, Harvesting, Loading	4.2	4.2	4.2				
Extraction				30.1	7.6	8.1	47.8
Pipelining (750 miles) and Shipping				5.3	6.1	5.2	4.2
Refining and Distillation				19.9	5.9	11.9	
Chipping		0.4	0.4				
Feedstock transport (150 miles)		2.0					
Drying (using wood chips as energy source)		24.5					
Plant operations		18.2					
Product transport (200 miles)	7.2	2.3	7.2	1.9	1.3	2.8	4.7
Retail Transport (20 miles)	1.6	1.5	1.6	1.4	0.8	2.1	
Combustion	288.0	232.0	263.6	160.8	117.6	135.9	191.0
Total	**301.0**	**285.1**	**277.0**	**219.4**	**139.3**	**166.0**	**247.7**
Total Carbon Sequestered (assuming a 35 year growth cycle - entire tree including roots and stumps) - in CO_2 equivalent	341.8	341.8	341.8	0.0	0.0	0.0	0.0
Proportion of Total Tree used in Feedstock	84%	75%	77%				
Carbon (CO_2 equivalent) in the Feedstock	288.0	256.5	263.6				
Net CO_2 Emissions	**13.0**	**28.6**	**13.4**	**219.4**	**139.3**	**166.0**	**247.7**
Net Carbon Permanently Sequestered (includes unharvested and uncombusted materials) - in CO_2 equivalent	**40.8**	**56.7**	**64.8**	**-219.4**	**-139.3**	**-166.0**	**-247.7**

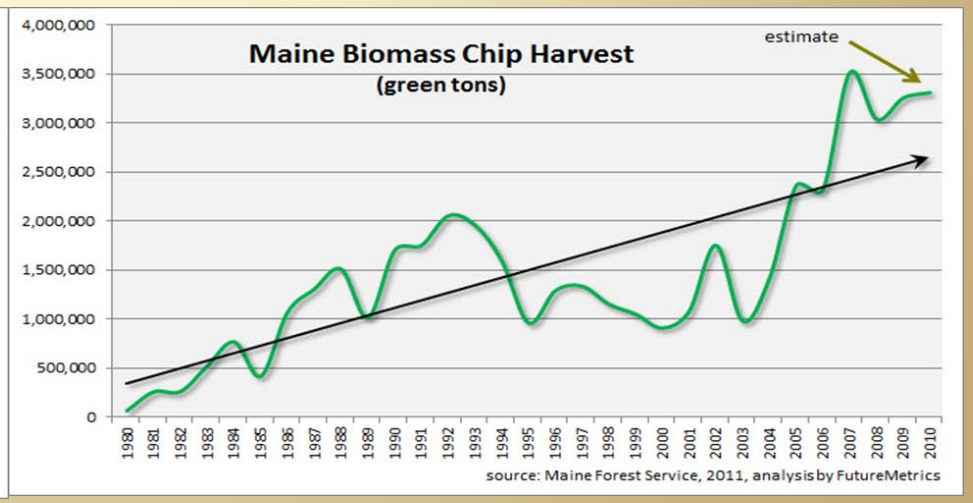
And what about sustainability?

I cannot speak for this region but in Maine sustainable forestry is a way of life for most landowners.




Harvesting Trends in Maine
Acres of Forestland
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Land Use Change
Clearcut
Shelterwood Harvest
Partial Harvest
See footnote for explanation of legend.
source: Maine Forest Service, Silvicultural Reports, analysis by FutureMetrics


Maine Pulpwood Harvest
(green tons)
9,500,000
9,000,000
8,500,000
8,000,000
7,500,000
7,000,000
6,500,000
6,000,000
estimate
source: Maine Forest Service, 2011, analysis by FutureMetrics


Maine Biomass Chip Harvest
(green tons)
estimate
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
source: Maine Forest Service, 2011, analysis by FutureMetrics

Thought Experiment!

If I have $1,000,000 saved up and earn 5% per year, at the end of a year I will have $1,050,000.

If I spend $50,000 over the next year, following the Manomet view of the world, I would simply say that I have spent and lost $50,000.

Following a more commonsense view of the world, I would say I have a benefit that was earned by 30 years of management and growth, that I have lost nothing, and that in fact I have sustainably managed my nest egg.

Conclusion

Biomass fuels should be at the top of policymakers' list of solutions to our dependence on foreign.

Wind and solar get a lot of attention and a lot of help from the government.

Europe has been a world leader in converting to renewable energy for a number of reasons.

Biomass dominates there and should here as well!

Total Renewable Energy Production in Europe in 1000's of tons of oil equivalent (TOE)												
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solar energy	0.4%	0.4%	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.8%	0.9%	1.2%	1.6%
Biomass	**60.7%**	**60.5%**	**60.1%**	**59.2%**	**62.3%**	**64.1%**	**63.8%**	**65.4%**	**66.0%**	**66.8%**	**66.6%**	**66.8%**
Geothermal Energy	4.5%	4.7%	4.8%	4.5%	4.8%	5.0%	4.8%	4.6%	4.5%	4.3%	4.0%	3.9%
Hydro power	31.3%	30.9%	30.8%	31.5%	27.2%	24.8%	24.5%	22.4%	21.4%	19.8%	19.6%	18.7%
Wind power	1.0%	1.3%	1.9%	2.3%	3.1%	3.6%	4.5%	5.2%	5.7%	6.7%	7.2%	7.6%

source: Eurostat Energy Statistics, 2011

Conclusion

Using renewable biomass for energy is
A ***triple-E solution***.

That is, it makes good sense
Economically, **E**nvironmentally, and **E**cologically.

It should be a key part of our strategic portfolio for making the US more **E**nergy independent (another "E").

Education of policymakers, emphasizing jobs creation, is key (another "E").

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Thank you

William Strauss

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