BioEnergy in the Northeast:

Economic growth, energy independence, and environmental stewardship for Maine and its neighbors

Presented at the Focus the Nation: Energy Innovation Conference
By Dr. William Strauss, FutureMetrics

March, 2012

FutureMetrics – Globally Respected Consultants in BioEnergy

The following slides are organized as follows:

First:

What is the sustainable amount of biomass that can be used for fuel?

Second:

How many homes and businesses will that allow to convert to pellet fueled boilers?

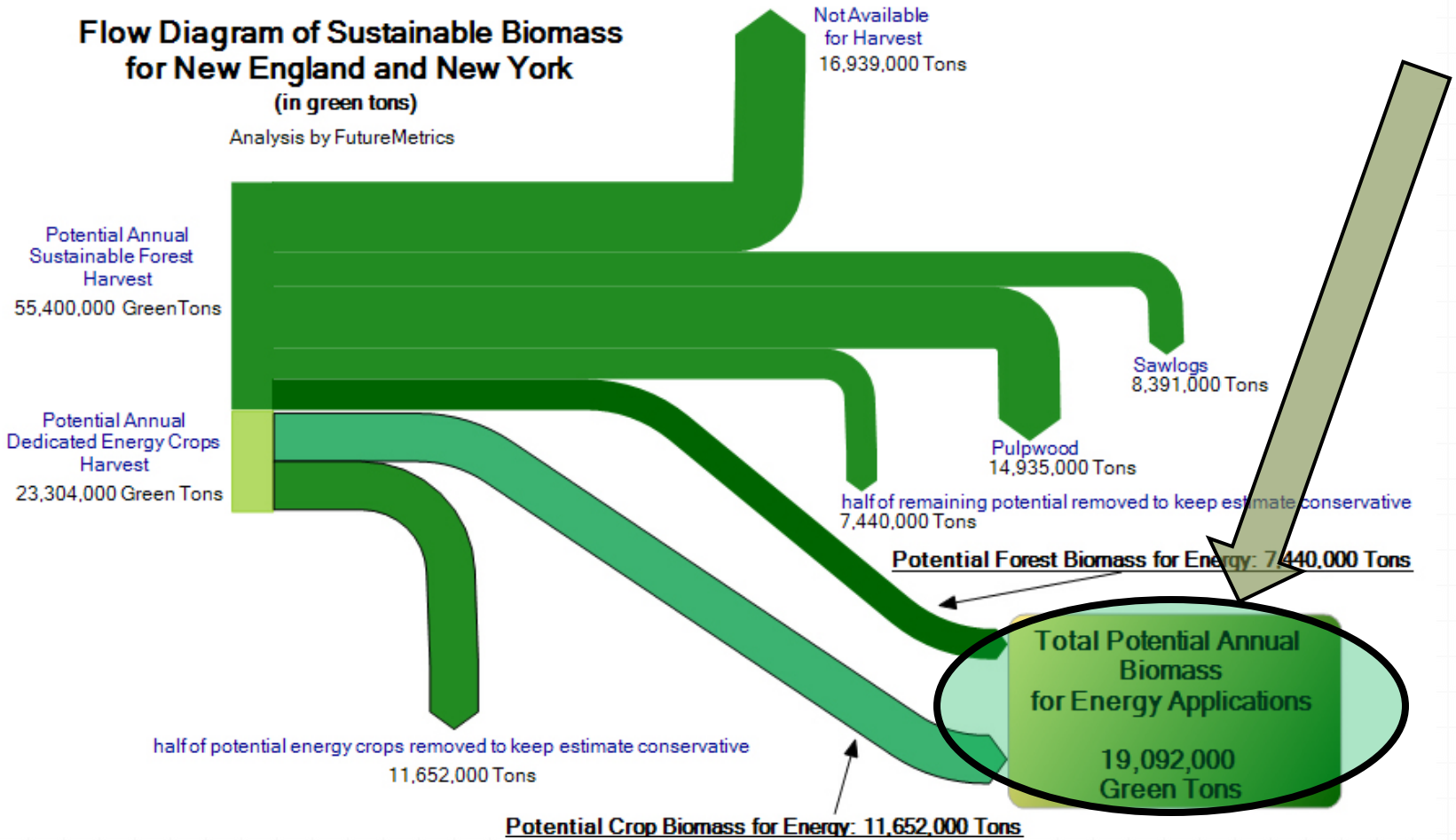
Third:

What are the potential profits and cash flows?

Last:

Lots of material on the economic and environmental impacts of bioenergy in the Northeast.

This analysis assumes that pulp and paper mills and sawmills will remain at current capacity.



Note: Does not include Pennsylvania

Source: From the 25 x 25 Study, http://www.biomassthermal.org/resource/pdfs/heatne_vision_full.pdf

The analysis on the preceding slide is VERY conservative. It cuts the expected volume for green wood and dedicated energy crops IN HALF to allow for the growth of other uses (export, biomass CHP, etc.)

	Forest Biomass Production per Year for BioEnergy	Potential Crop Biomass Production per Year	Total Biomass Production per Year (green tons)
Connecticut	100,000	354,000	454,000
Maine	3,190,000	450,000	3,640,000
Massachusetts	110,000	498,000	608,000
New Hampshire	400,000	294,000	694,000
New York	3,330,000	8,766,000	12,096,000
Pennsylvania	2,800,000	3,894,000	6,694,000
Rhode Island	10,000	156,000	166,000
Vermont	300,000	1,134,000	1,434,000
TOTAL	10,240,000	15,546,000	25,786,000
			analysis by FutureMetrics

25.8 million tons of green wood can make enough pellets for about 1.6 million homes and businesses.

Note that this analysis does NOT consider any Canadian wood.

The wood supply along the northern border is substantial. Some wood pellets are already imported into the US from several Canadian pellet mills.

The opportunity to expand available biomass with Canadian imports is <u>not</u> considered in this analysis.

If we assume that each state provides biomass for its own needs, the table below shows the conversion rates.

Maine is highest proportionally with 32.33% of its homes and businesses converting.

New York is highest in absolute numbers with 756,000 homes and businesses converting.

	Occupied Households	Number of Businesses	Total Number of Households and Businesses	Total Biomass Production per Year (green tons)	Total Number Converting in each State if there is NO Interstate Transport of Pellets (based on 8 tons per user per year average)	
Connecticut	1,323,000	394,651	1,717,651	454,000	1.65%	28,400
Maine	542,000	161,679	703,679	3,640,000	32.33%	227,500
Massachusetts	2,449,000	730,537	3,179,537	608,000	1.20%	38,000
New Hampshire	501,000	149,448	650,448	694,000	6.67%	43,400
New York	7,907,420	2,358,783	10,266,203	12,096,000	7.36%	756,000
Pennsylvania	4,877,735	1,455,028	6,332,763	6,694,000	6.61%	418,400
Rhode Island	405,000	120,812	525,812	166,000	1.97%	10,400
Vermont	251,000	74,873	325,873	1,434,000	27.50%	89,600
	18,256,155	5,445,811	23,701,966	25,786,000		1,611,700

analysis by FutureMetrics

Given these levels of penetration and assuming $20/ton profit for pellet manufacturing and $20/ton profit for pellet fuel delivery, the annual profit for pellet flow is more than **$64 million.**

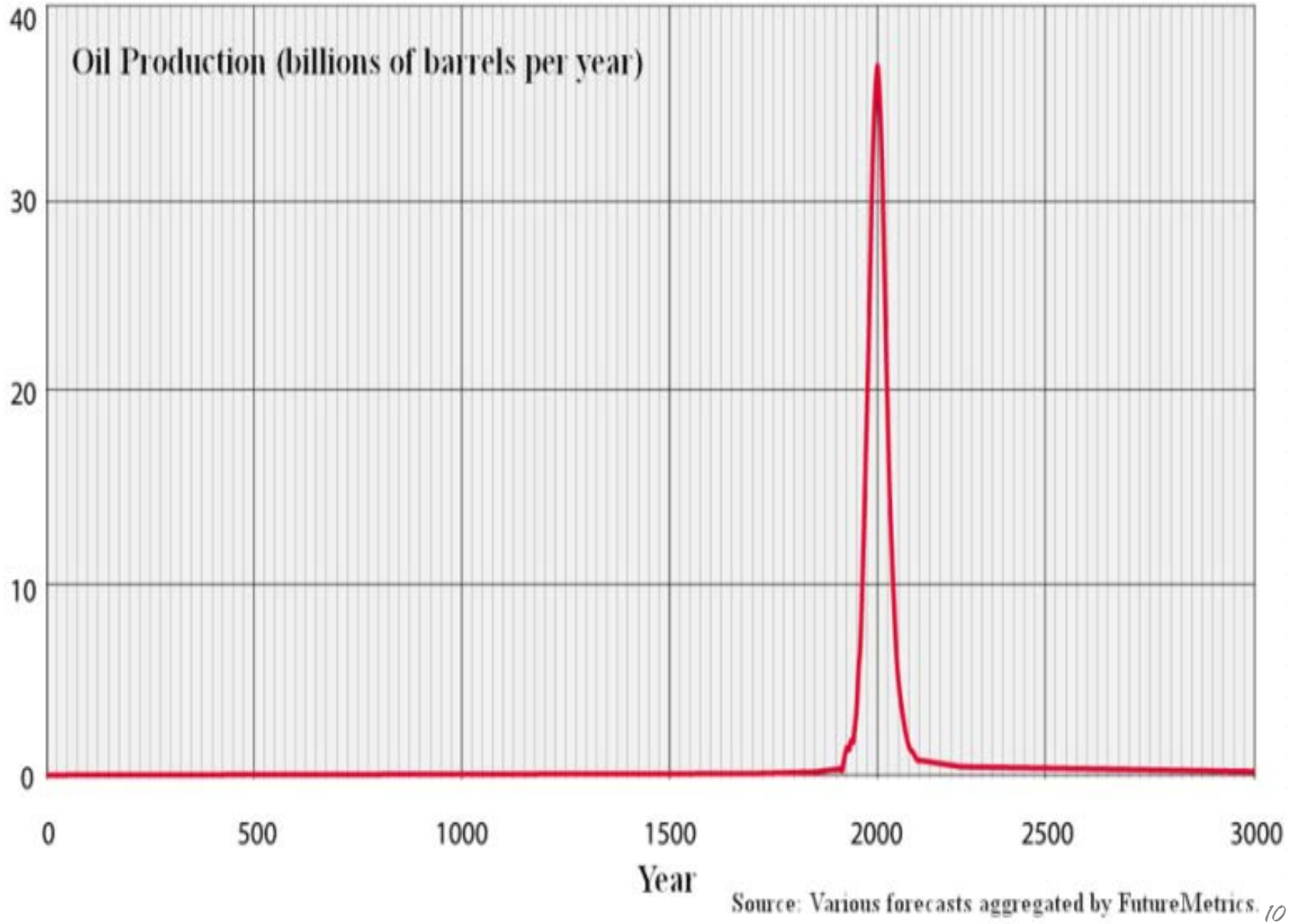
Installing 1.6 million pellet boilers with an assumed margin of $3500 per unit yields a total gross margin on boiler sales of more than **$5.6 billion**.

	Annual Profits from Pellet Sales	Total Gross Margin from Boiler Sales
Connecticut	$1,136,000	$99,400,000
Maine	$9,100,000	$796,250,000
Massachusetts	$1,520,000	$133,000,000
New Hampshire	$1,736,000	$151,900,000
New York	$30,240,000	$2,646,000,000
Pennsylvania	$16,736,000	$1,464,400,000
Rhode Island	$416,000	$36,400,000
Vermont	$3,584,000	$313,600,000
	$64,468,000	$5,640,950,000

analysis by FutureMetrics

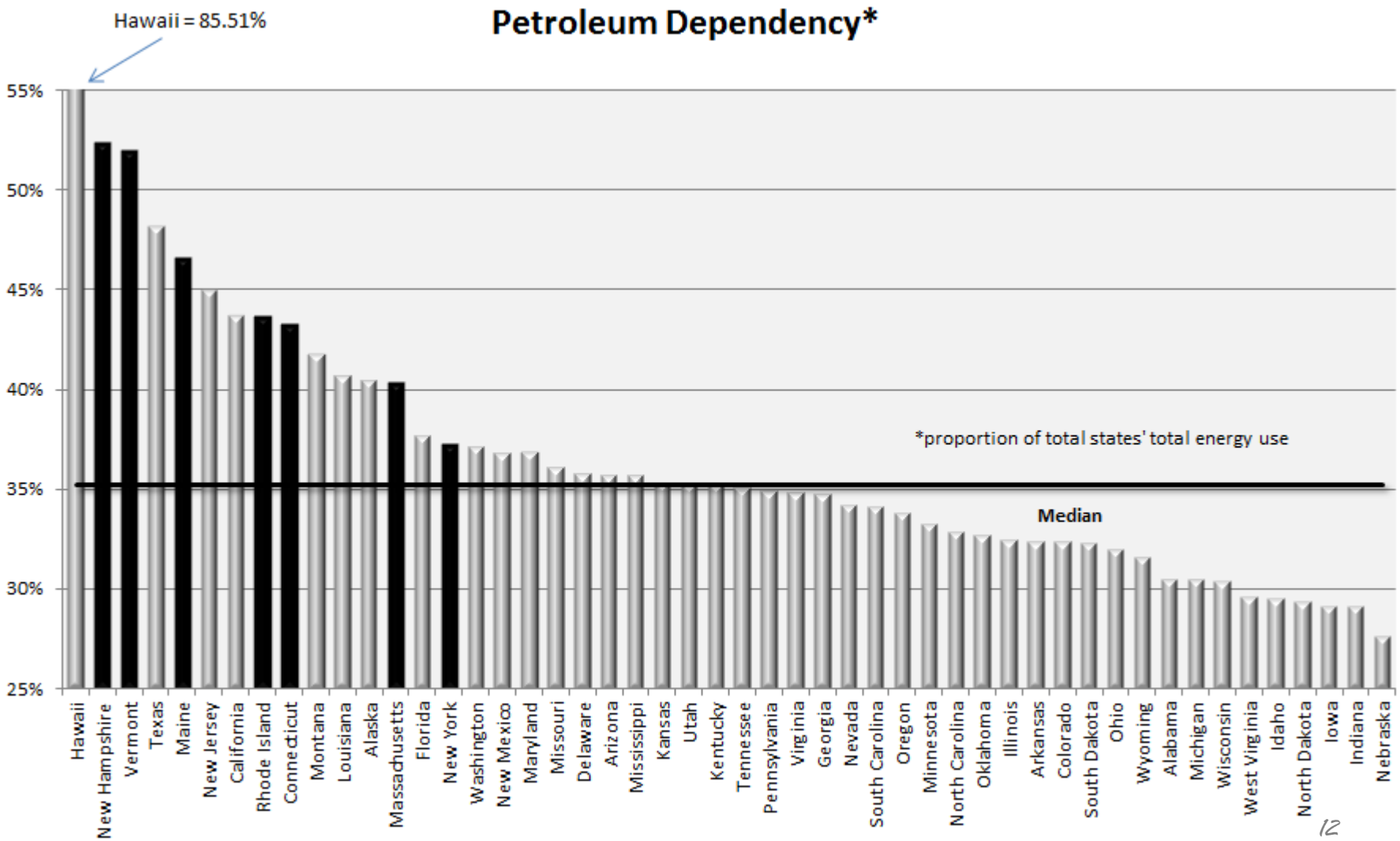
But why should we care about conversion to this form of renewable energy?

Economic Consequences and Energy Independence

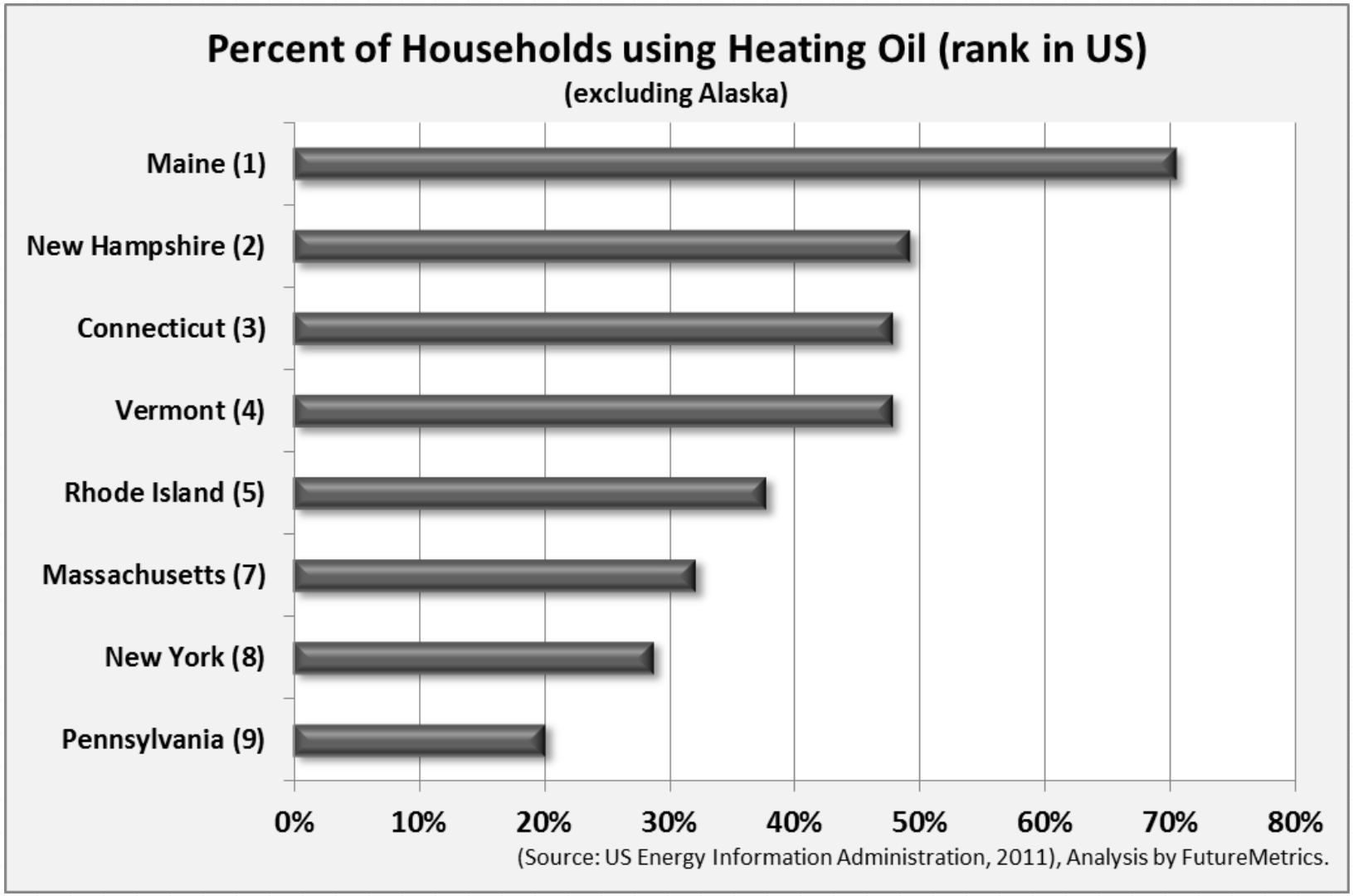

Oil Production (billions of barrels per year)
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
Year
Source: Various forecasts aggregated by FutureMetrics.

United States' "Energy Policy"

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



source: EIA, Energy Consumption by Source and End Use Sector, Table S1, 2009, Analysis by FutureMetrics


Percent of Households using Heating Oil (rank in US)
(excluding Alaska)
Maine (1)
New Hampshire (2)
Connecticut (3)
Vermont (4)
Rhode Island (5)
Massachusetts (7)
New York (8)
Pennsylvania (9)
0%
10%
20%
30%
40%
50%
60%
70%
80%
(Source: US Energy Information Administration, 2011), Analysis by FutureMetrics.

At current heating oil prices, the NE states "export" more than **20 BILLION** dollars per year*

	Number of Households that use Heating Oil	Average Gallons Used per Year by all Users	Average Total Expenditure Per Year (#2 at $3.65/gal)	**Amount that Does not Stay in the State (EXPORTED)**
Connecticut	873,000	720,225,000	$ 2,628,821,250	$ 2,050,481,000
Maine	418,000	376,200,000	$ 1,373,130,000	$ 1,071,041,000
Massachusetts	1,110,000	915,750,000	$ 3,342,487,500	$ 2,607,140,000
New Hampshire	409,000	368,100,000	$ 1,343,565,000	$ 1,047,981,000
New York	3,275,000	2,947,500,000	$ 10,758,375,000	8,391,533,000
Pennsylvania	1,837,000	1,377,750,000	$ 5,028,787,500	3,922,454,000
Rhode Island	208,000	166,400,000	$ 607,360,000	473,741,000
Vermont	201,000	180,900,000	$ 660,285,000	$ 515,022,000
Total	**8,331,000**	**7,052,825,000**	**$ 25,742,811,250**	**$ 20,079,393,000**

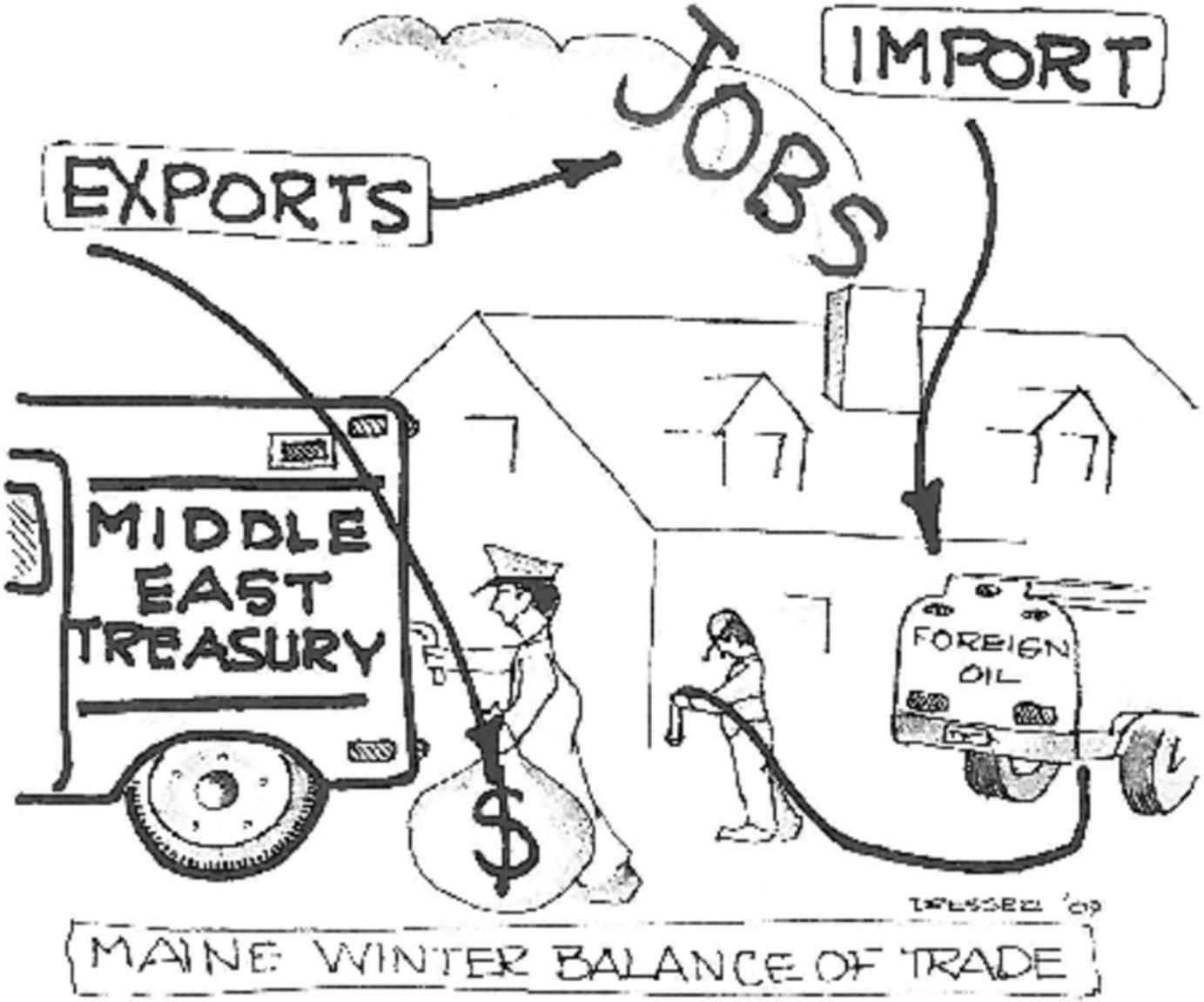
Source: US Energy Information Administration, 2010, US Census, analysis by FutureMetrics

*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.

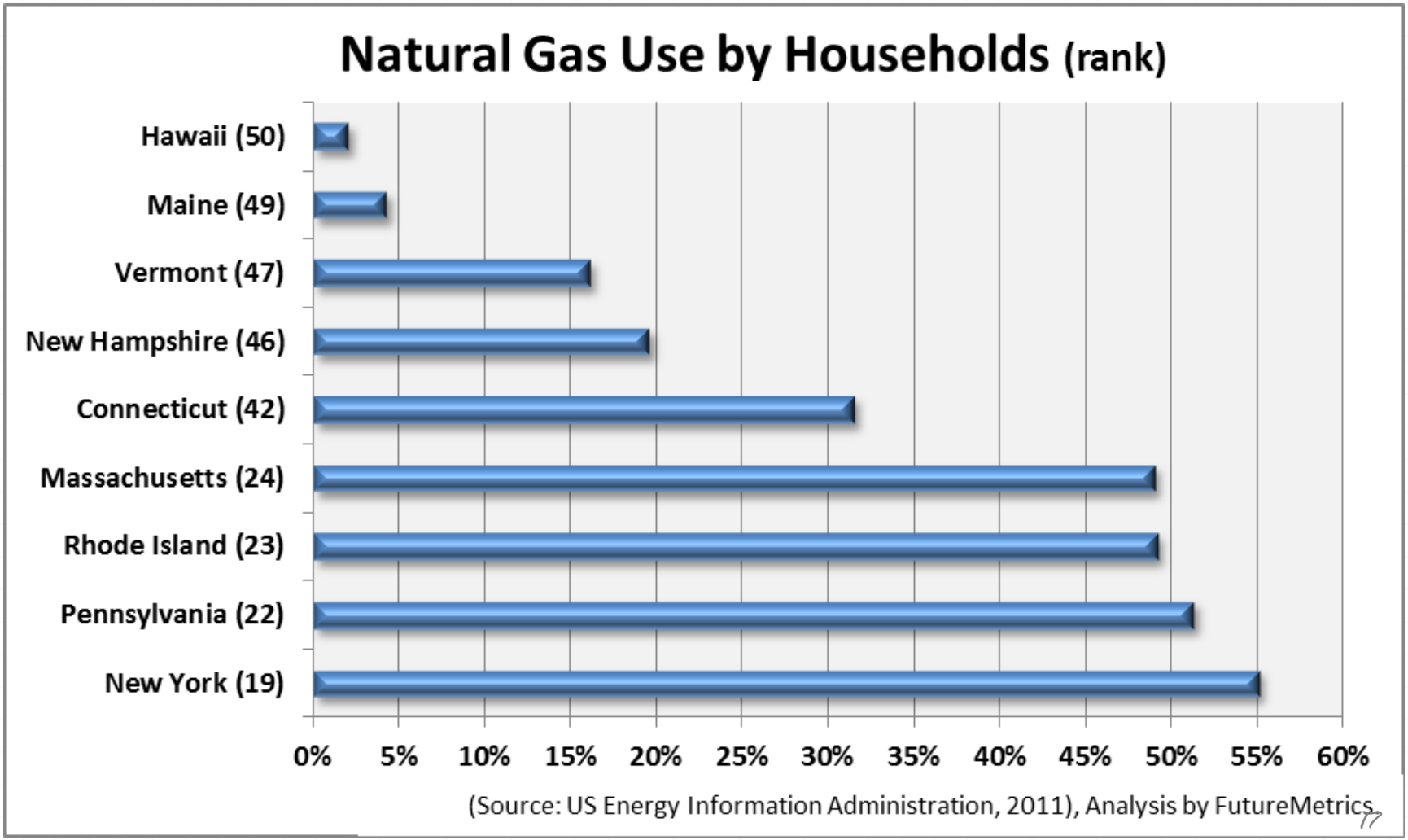
At current heating oil prices, **about ONE MILLION jobs are destroyed** as money is drained from those states' economies and sent to other places.

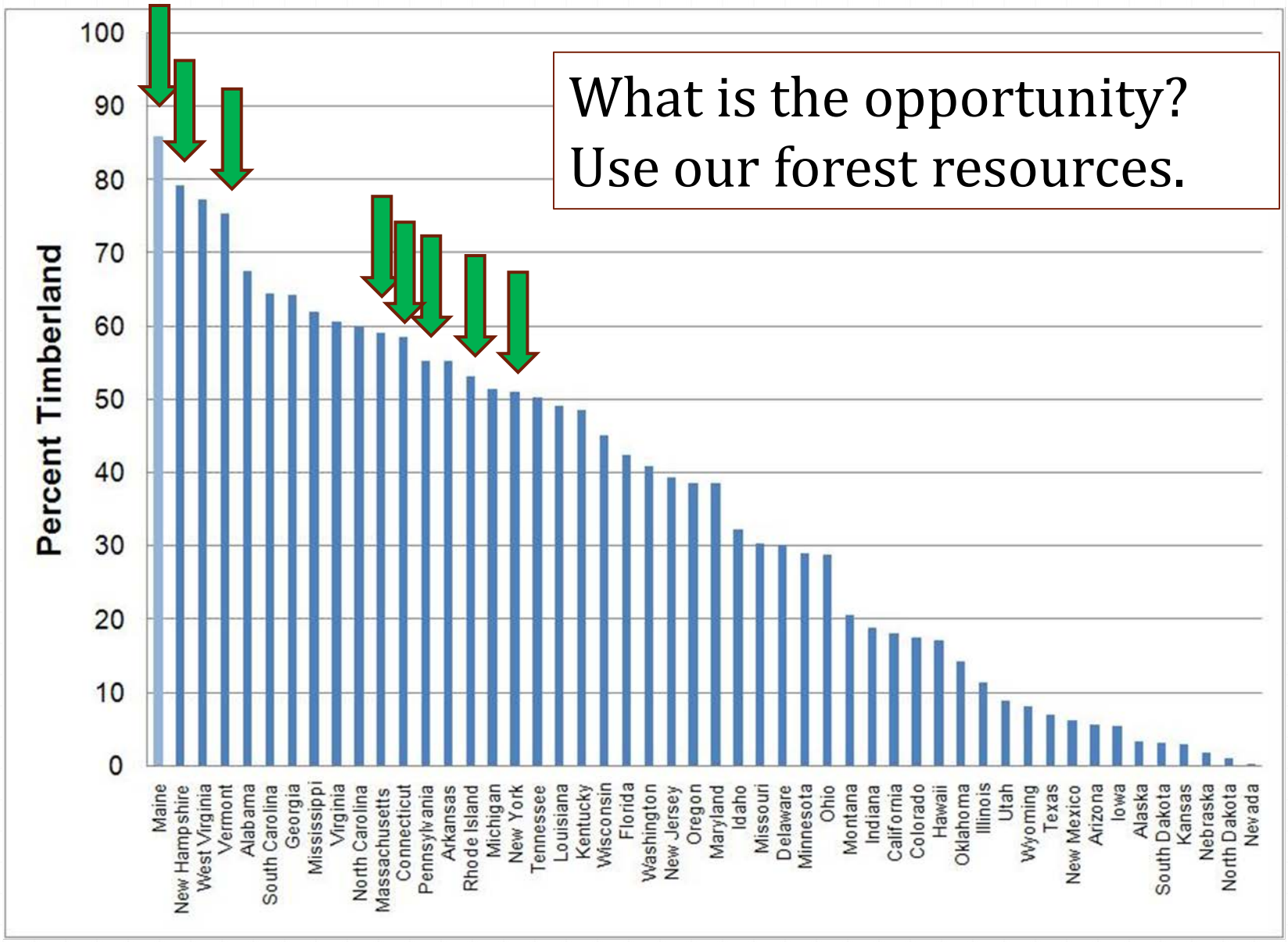
#2 Distillate Fuel use in Residential, Commercial, and Industrial (not Transportation)	Average Gallons per Year	Money Exported from Regional Economy at $3.65/gal	**Permanent Job Destruction**
Connecticut	720,225,000	($2,050,480,575)	-98,300
Maine	376,200,000	($1,071,041,400)	-64,189
Massachusetts	915,750,000	($2,607,140,250)	-133,194
New Hampshire	368,100,000	($1,047,980,700)	-58,773
New York	2,947,500,000	($8,391,532,500)	-415,023
Pennsylvania	1,377,750,000	($3,922,454,250)	-198,084
Rhode Island	166,400,000	($473,740,800)	-23,575
Vermont	180,900,000	($515,022,300)	-30,219
	7,052,825,000	**($20,079,392,775)**	**-1,021,357**

analysis by FutureMetrics


IMPORT
JOBS
EXPORTS
MIDDLE EAST TREASURY
FOREIGN OIL
MAINE WINTER BALANCE OF TRADE

Natural gas is unavailable in much of the rural New England states; and even in states with high availability (like NY) 45% of homes still do not have access.





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 if some of that dependence on heating oil were converted to biomass?

Job Destruction would become Job Creation.

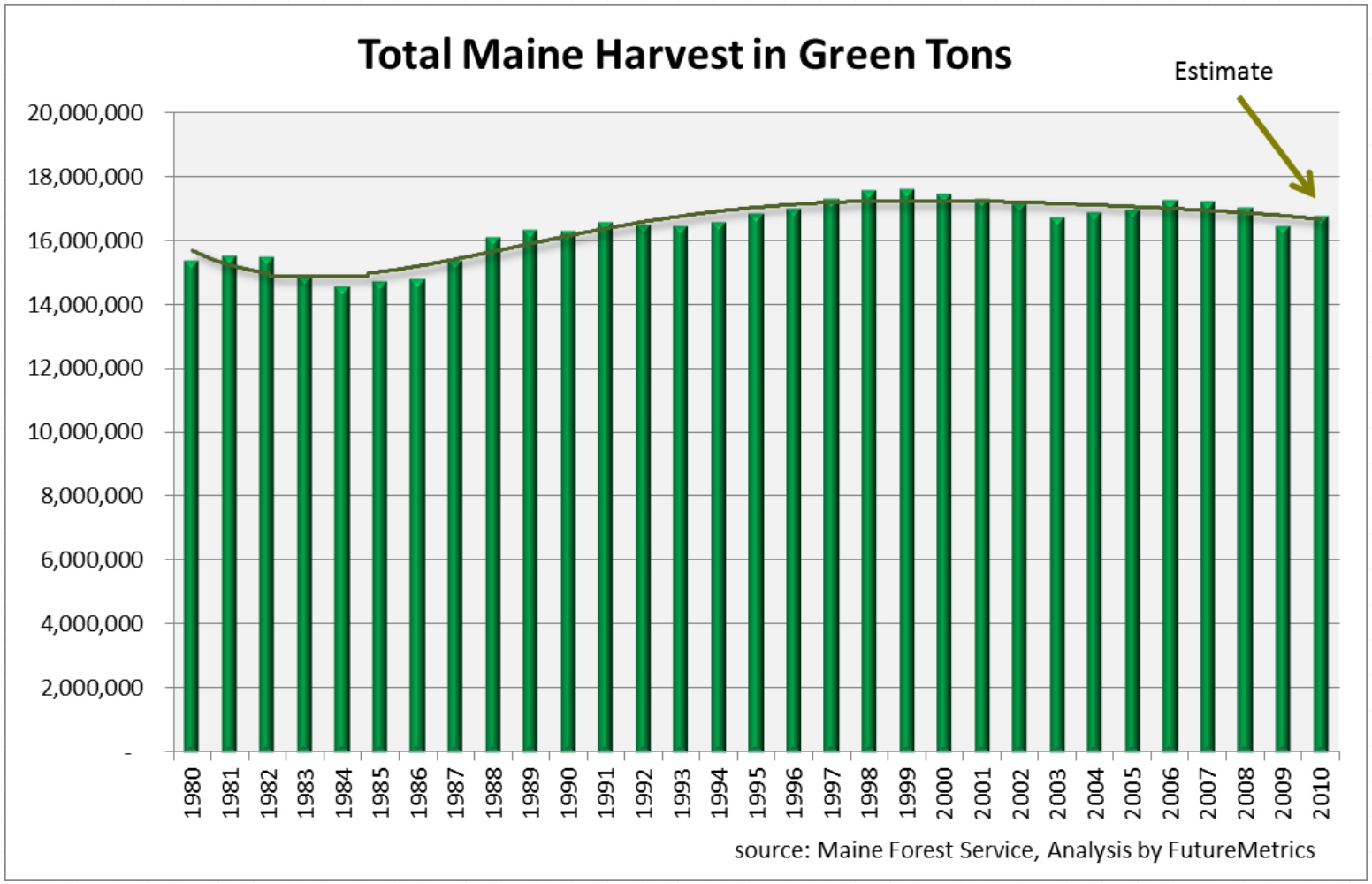
This is due to three effects (they all have direct and multiplier effects):

- Money spent on fuel stays in the regional economy,
- Lower cost fuel releases money for investment and consumption,
- The supply chain for regionally produced fuels will create jobs.

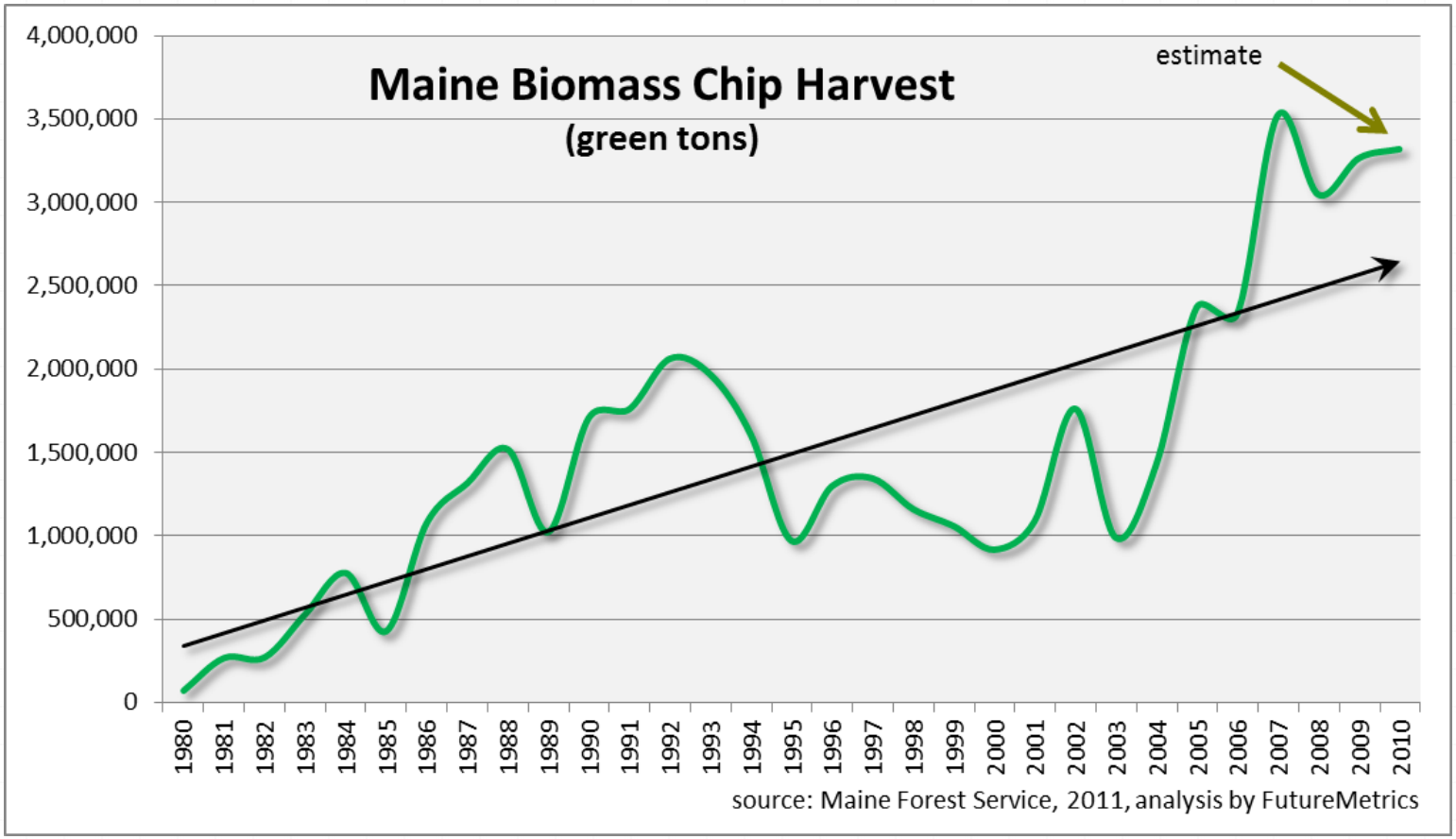
How much of the Northeast can be converted depends on the **SUSTAINABLE** quantity of biomass.

- What is the SUSTAINABLE annual harvest from timberland?
- How much idle cropland and pastureland could be used for energy crops?
- What uses other than biomass thermal applications of the sustainable harvest have a higher value added for the forest products industry?

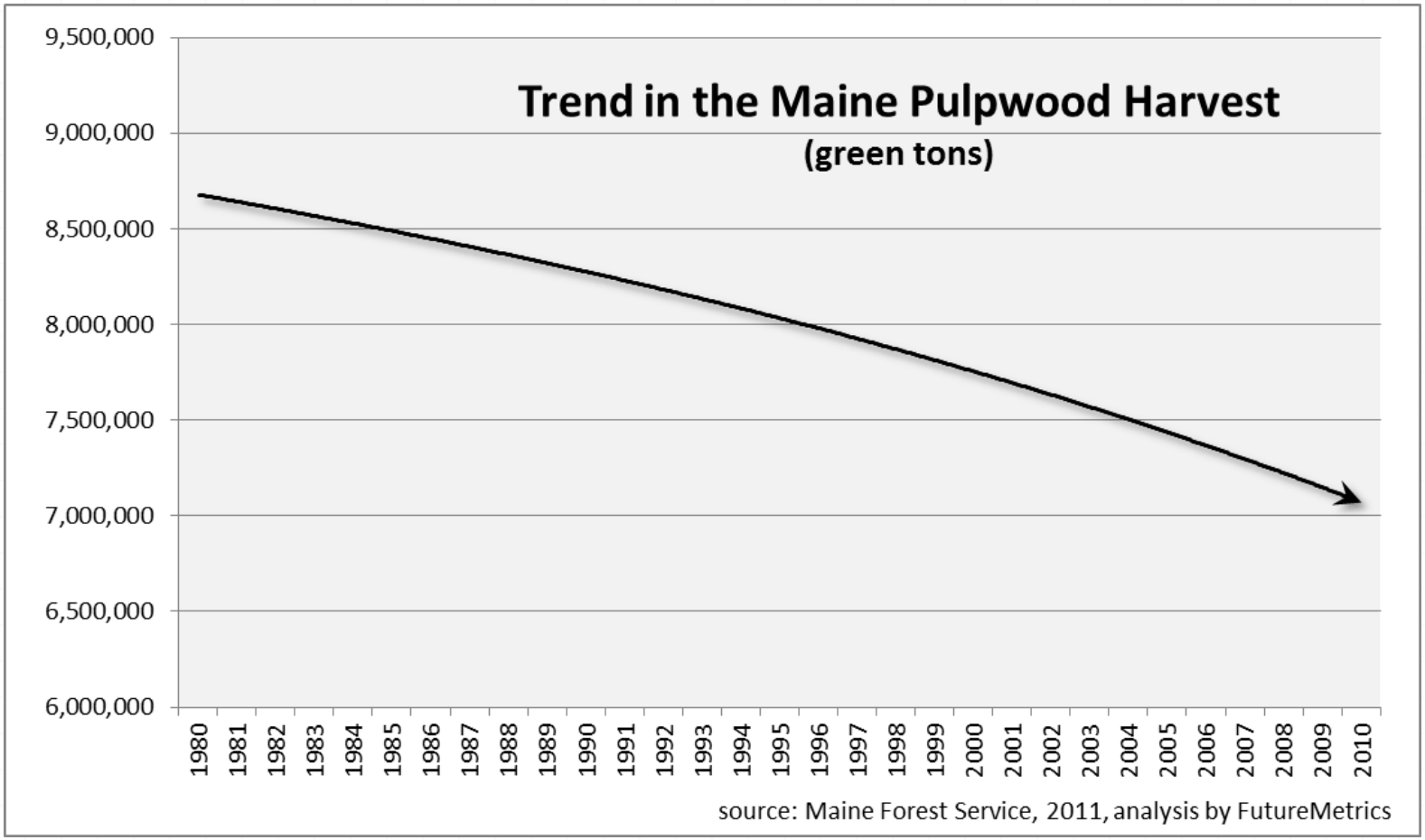
Biomass harvest for heating MUST be sustainable. The total Maine harvest is sustainable at about 18 million tons per year.



The biomass for fuel harvest already is nearly 3.5 million tons per year in Maine



Maine Pulpwood Demand is Declining



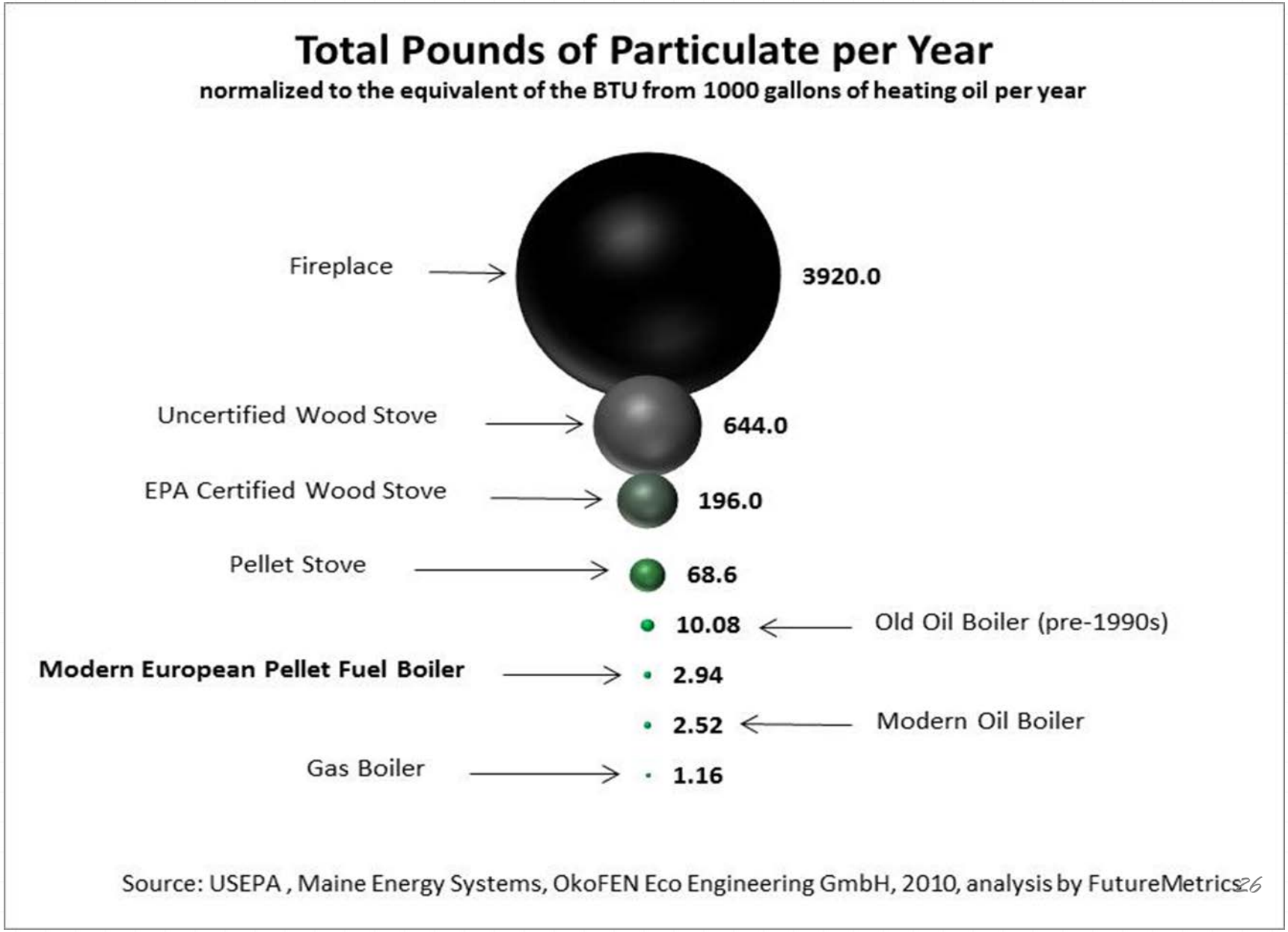
Wood pellet production for domestic use in the northern states to replace heating oil.

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

They are fully automatic, clean, and reliable.

Wood pellet fuel is common in Europe where more than a million homes have home heating systems automatically fueled with wood pellets.

Modern Wood Pellet Boilers are CLEAN and completely automatic



To put this into perspective, let's compare using <u>one cord</u> of wood in a <u>fireplace</u> and one cord of wood's worth of energy from wood pellets in a <u>modern pellet boiler</u>.

375 pounds

Particulate emissions (SMOKE!)

0.28 pound

What is the Future for Renewable Energy?

Europe is more than a decade ahead.

Note the role of biomass in the European renewable energy portfolio.

Solar and wind are less than 10% while biomass makes up 67% in the most recent year's data.

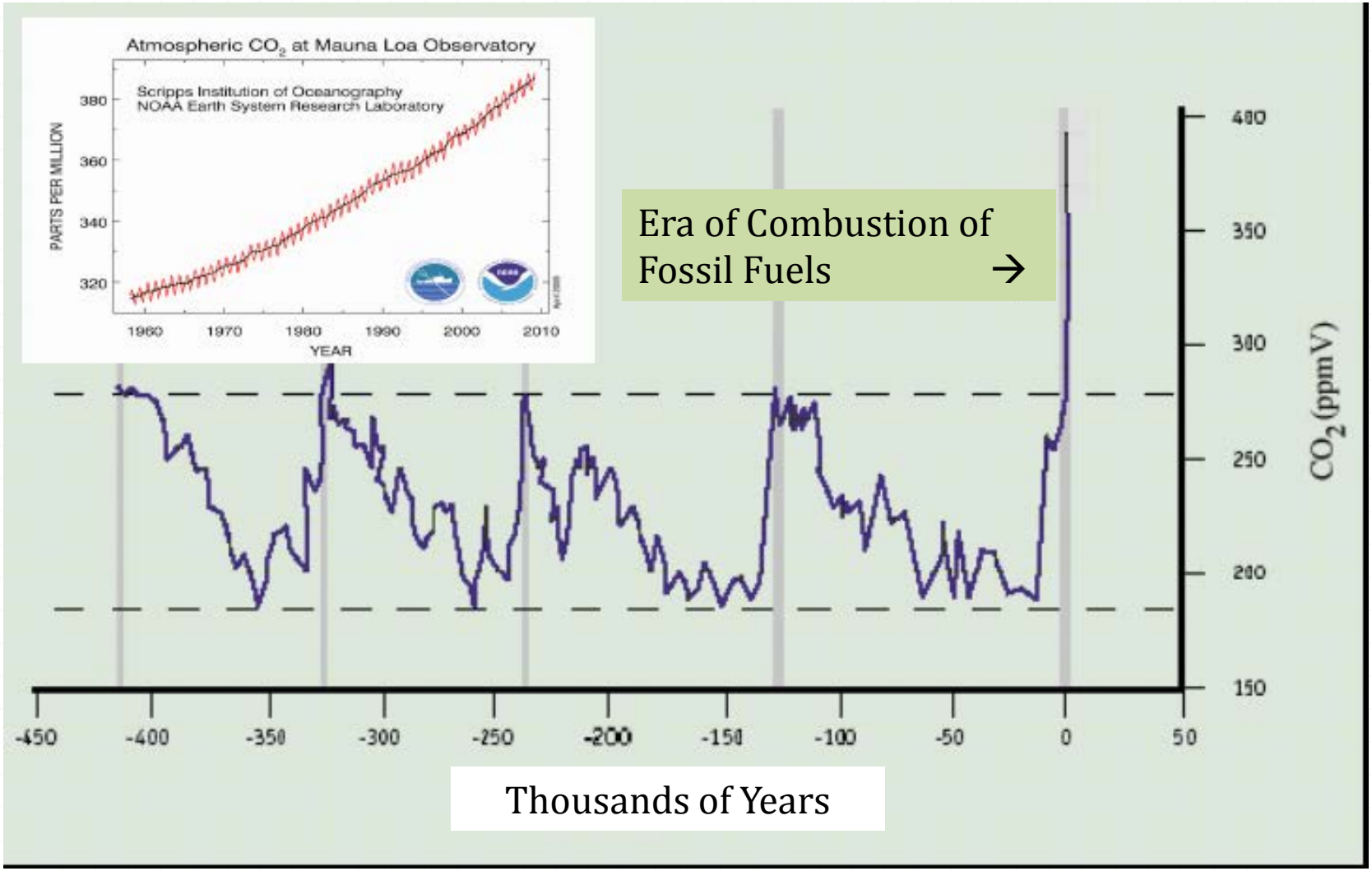
Total Renewable Energy Production in Europe in 1000's of tons of oil equivalent (TOE)												
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solar energy	0.4%	0.4%	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.8%	0.9%	1.2%	1.6%
Biomass	**60.7%**	**60.5%**	**60.1%**	**59.2%**	**62.3%**	**64.1%**	**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

Environmental Advantages

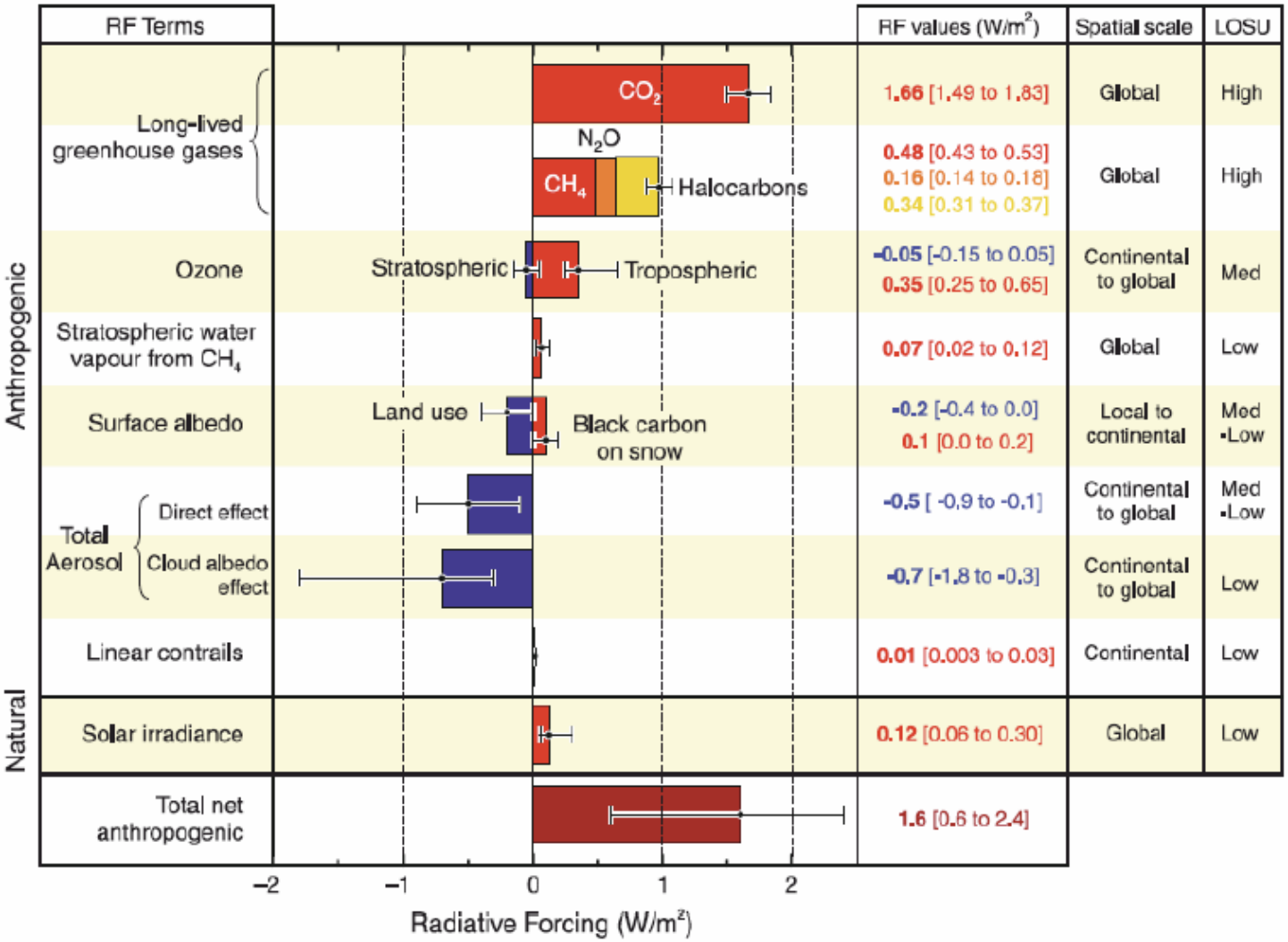
Using biofuel like wood pellets made from sustainably managed forests are carbon neutral in combustion.

Why should we care about CO_2?



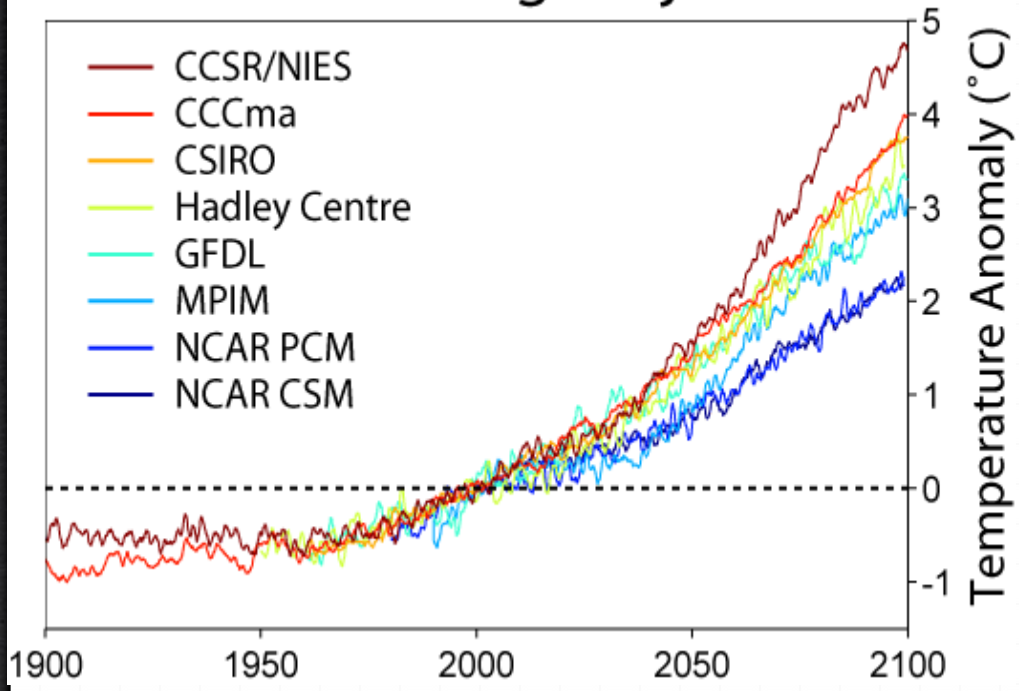
Source: NOAA

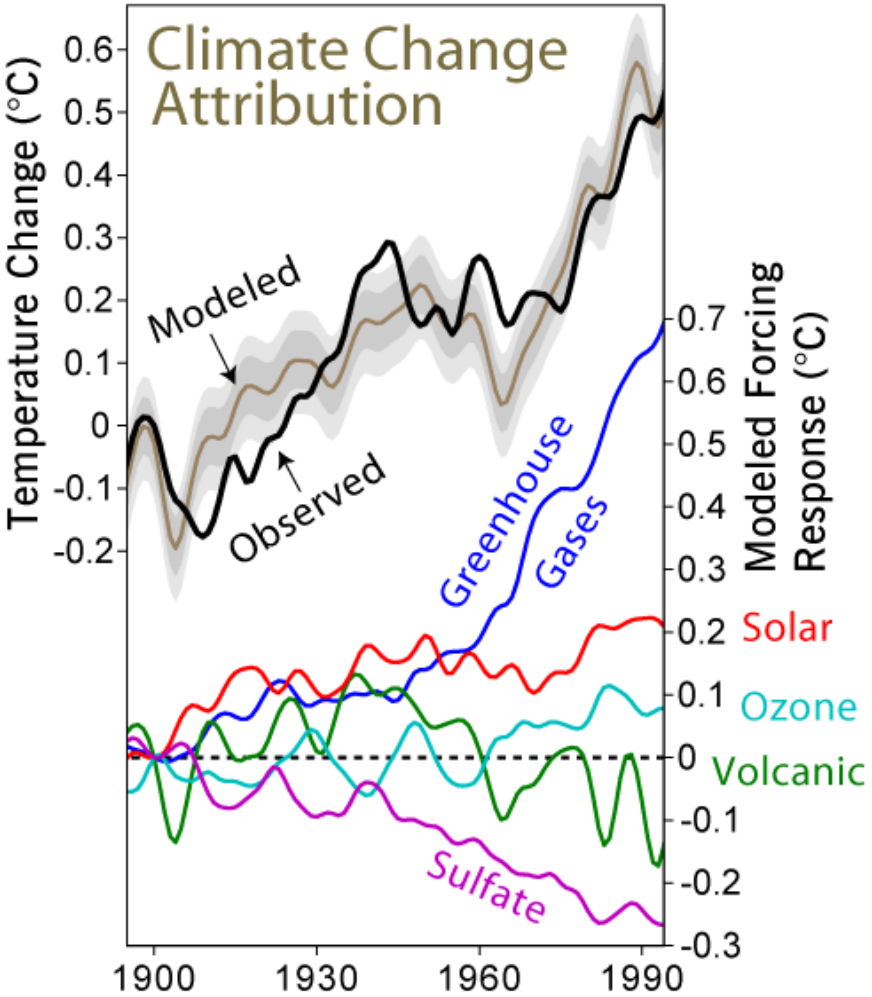
Radiative forcing components



Source: Intergovernmental Panel on Climate Change, 2009

Global Warming Projections





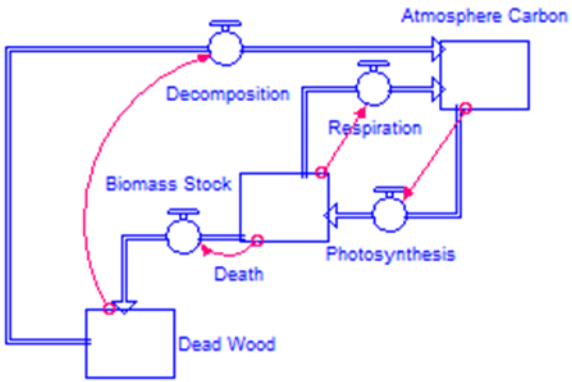
CCSR/NIES: Center for Climate System Research [1] & National Institute for Environmental Studies, [2], CCSR/NIES AGCM + CCSR OGCM Models 1890-2100
CCCma: Canadian Center for Climate Modelling and Analysis [3], CGCm2 Model 1900-2100
CSIRO: Commonwealth Scientific and Industrial Research Organisation [4], CSIRO-Mk2 model 1961-2100
Hadley Centre: Hadley Centre for Climate Prediction and Research [5], HADCM3 model 1950-2099
GFDL: Geophysical Fluid Dynamics Laboratory [6], R30 Model 1961-2100
MPI-M: Max Planck Institute für Meteorologie [7], ECHAM4/OPYC coupled model 1990-2100
NCAR PCM: National Center for Atmospheric Research [8], PCM model 1980-2099
NCAR CSM: National Center for Atmospheric Research [9], CSM Model 2000-2099

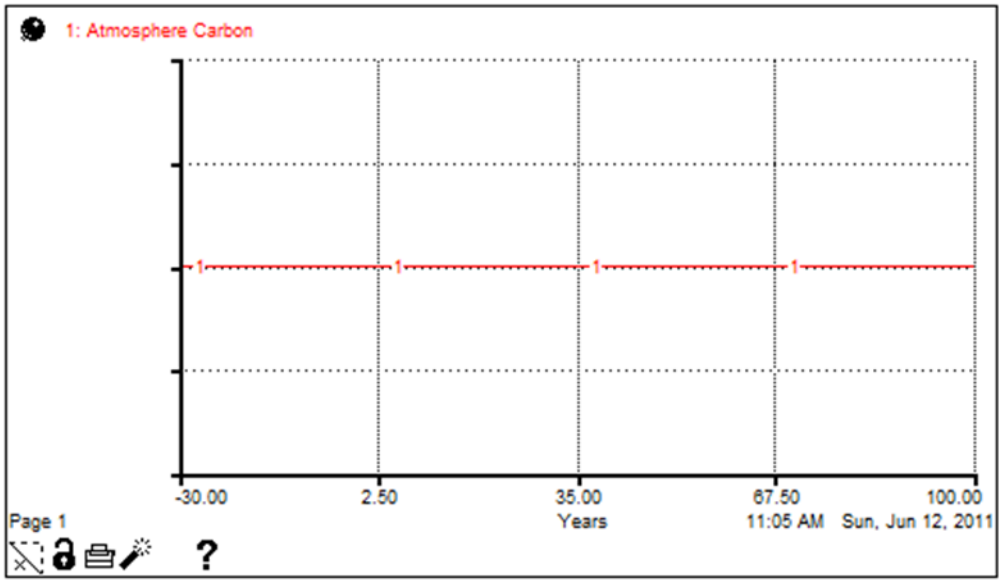
"… an extensive dataset of 1,372 climate researchers and their publication and citation data show that 97% to 98% of the climate researchers most actively publishing in the field support the tenets of anthropogenic climate change…"

From "Expert credibility in climate change", published in the Proceedings of the National Academy of Sciences of the United States of America, June 21, 2010.

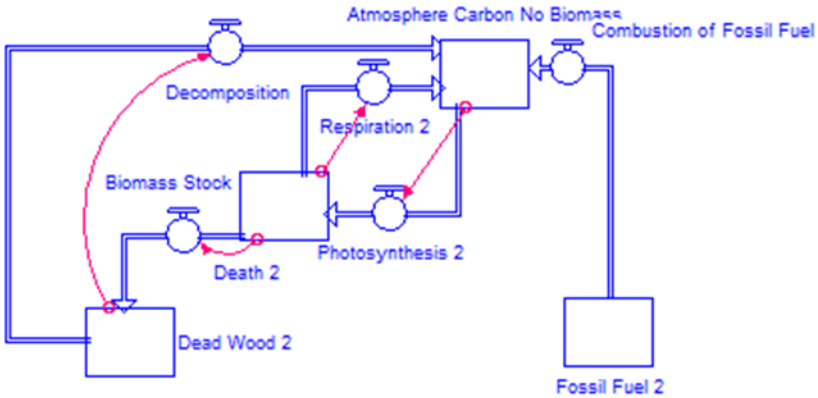
I can illustrate the carbon neutrality using a simple simulation

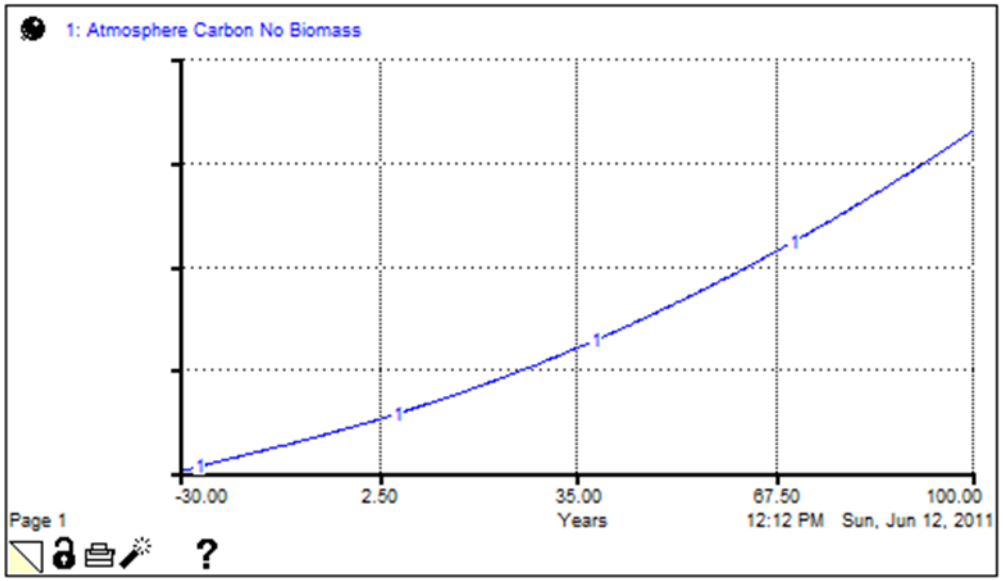
We begin with a look at the carbon cycle for wood with <u>no combustion of fossil fuels or wood fuels</u>. (note that his model ignores the ocean carbon sink)





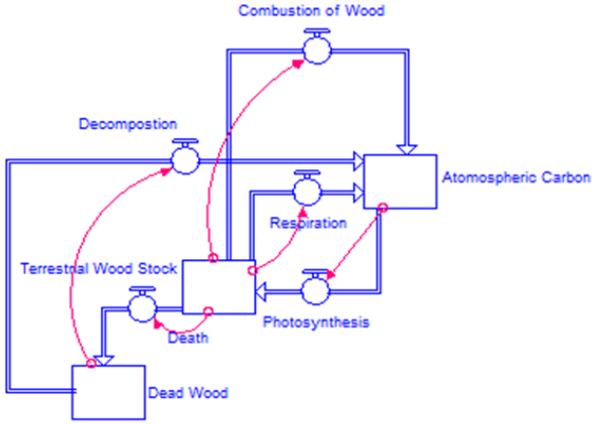
This shows the carbon effects of fossil fuel combustion



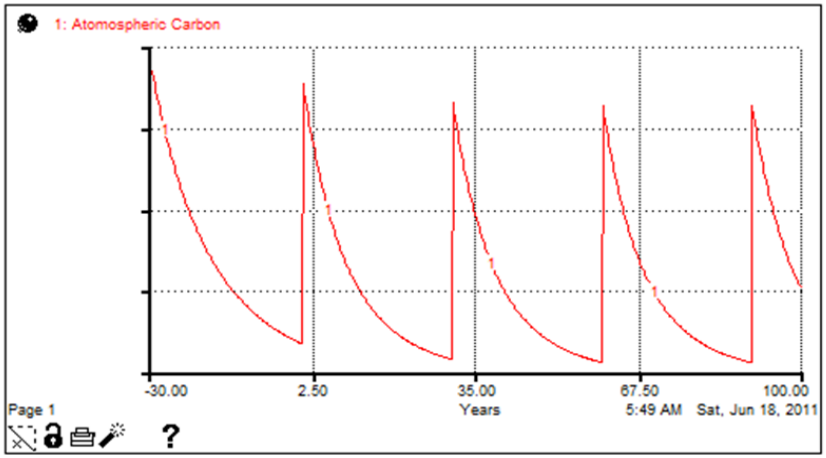


Now we remove fossil fuel and look at the carbon effects of using a <u>single stand</u> of trees for energy.

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) and/or grows (assuming better silviculture).



Note that the stand removes carbon BEFORE it gives up most of it in combustion.



It is Really this Simple:

Suppose we have a biomass fueled central heating plant for which 3650 tons per year are needed. That is 10 tons per day every day of the year.

A northeastern forest can sustainably produce about one ton of new growth per acre per year.

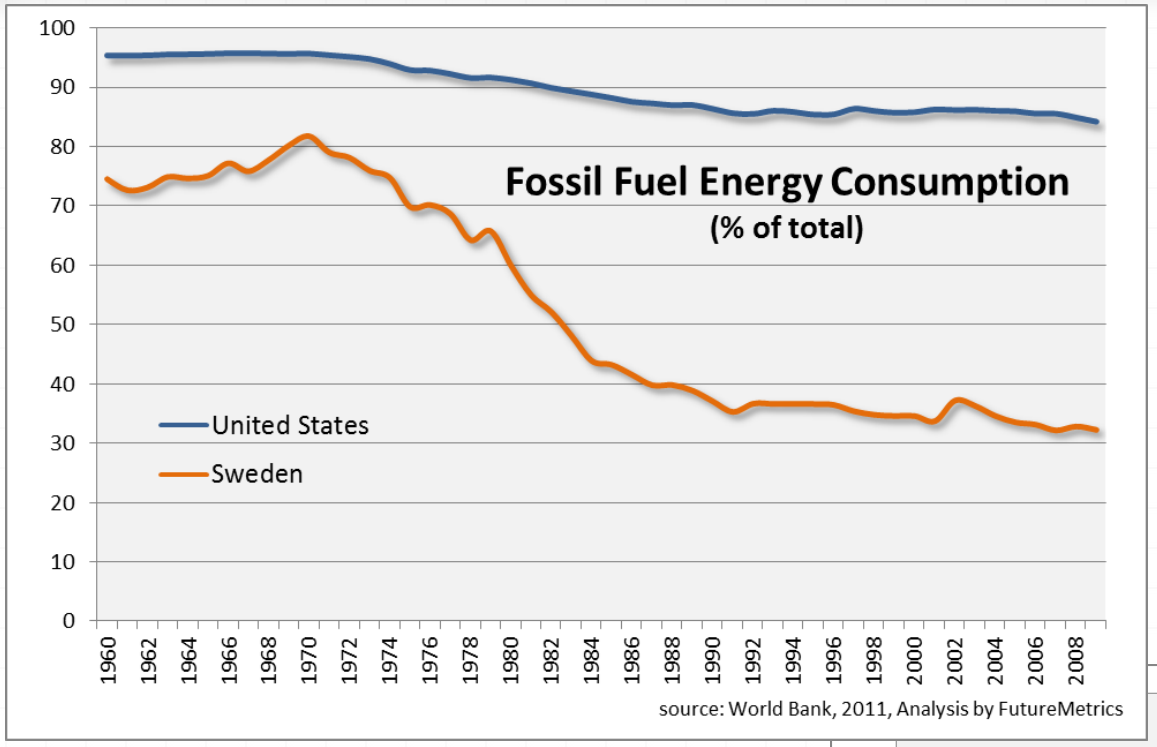
That means that the 3650 tons per year of biomass needed to fuel our CHP plant will need 3650 acres of forestland if we require that the forest does not shrink over time.

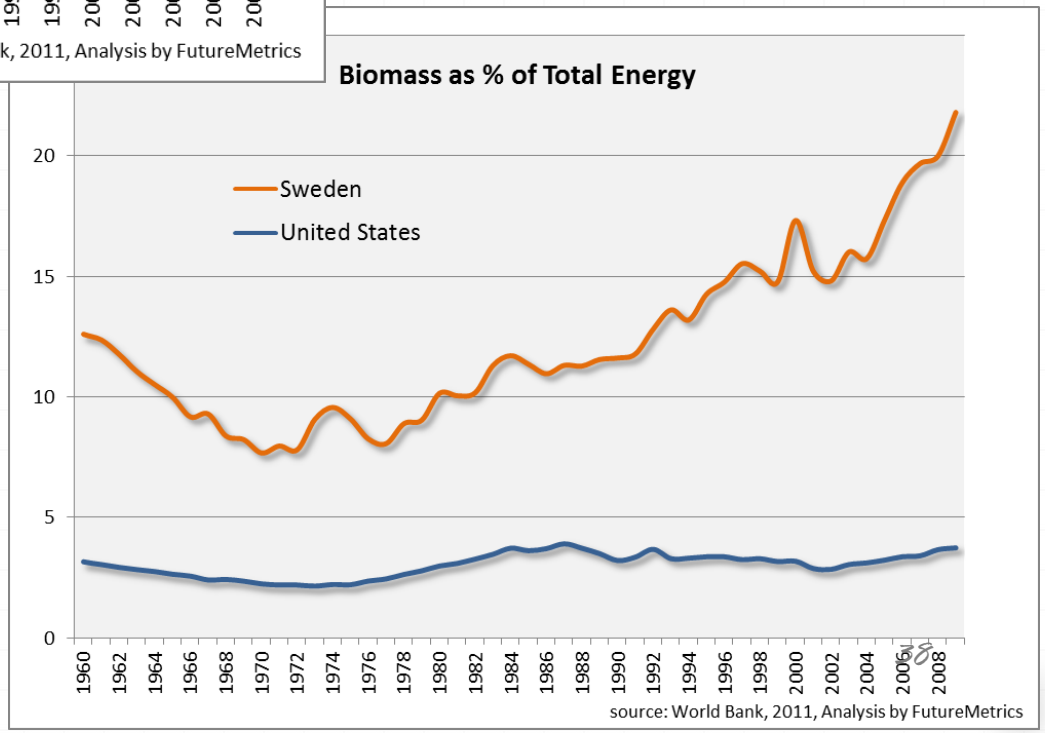
For our CHP plant, 10 tons per day are harvested and delivered off of our 3650 acre FSC or SFI certified forest.

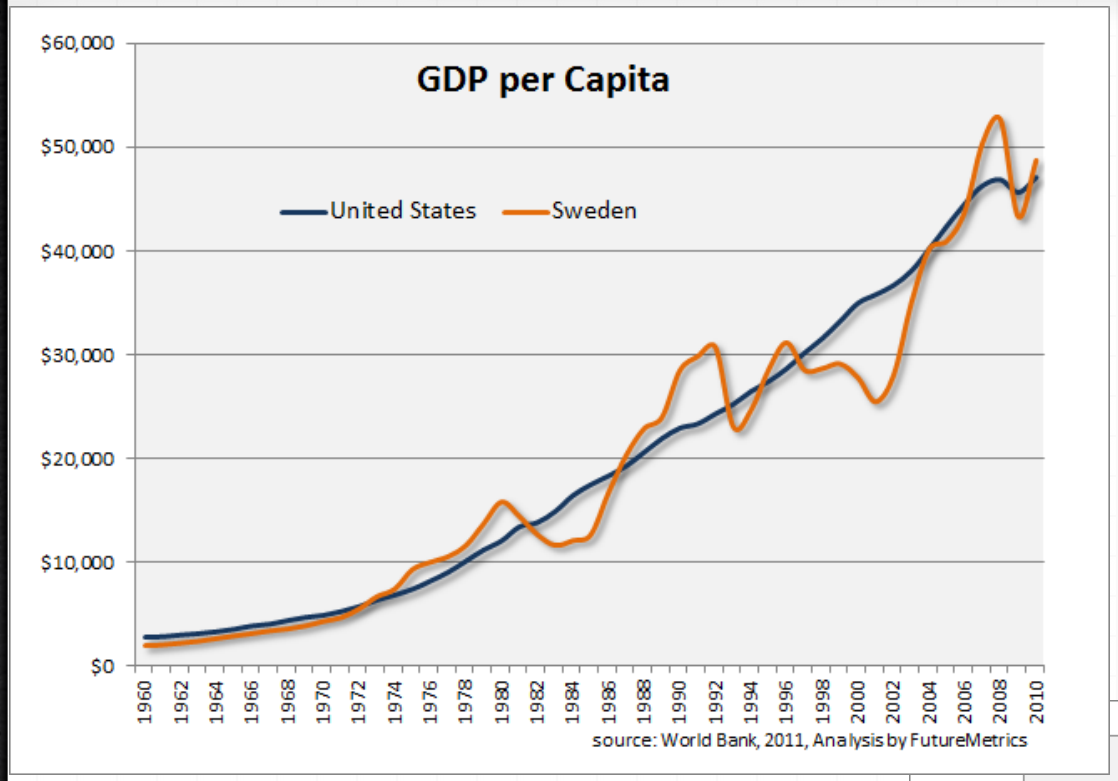
But during that same day on our 3650 acre plot, 10 new tons of wood grow and sequester the amount of carbon that was just released.

Combustion of wood from a <u>sustainably managed forest</u> is carbon neutral.

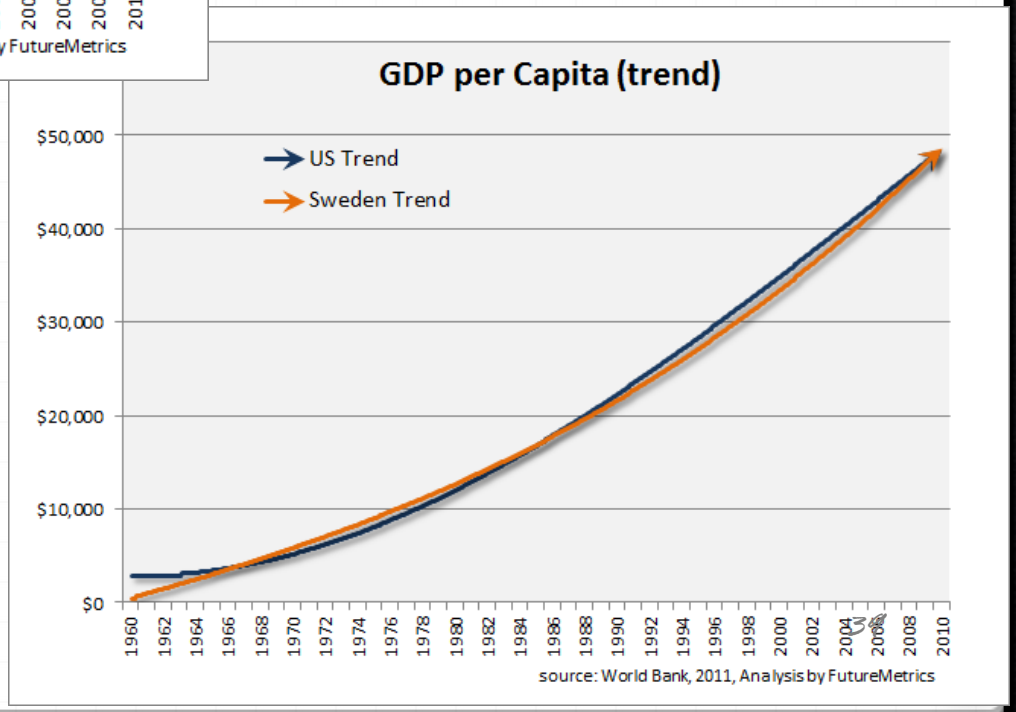
A case study – Sweden



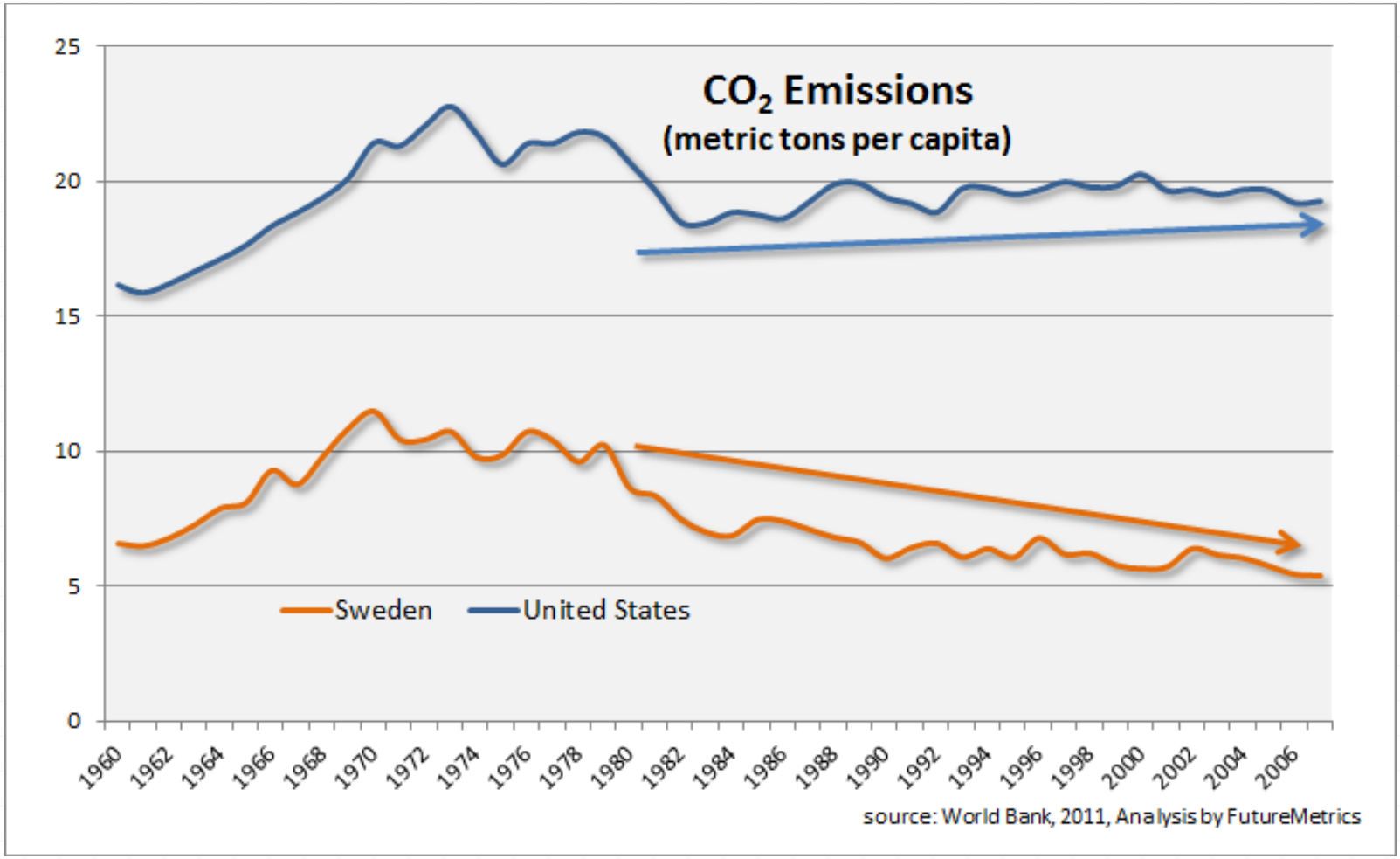




The smoothed trend in GDP per capita is virtually identical.

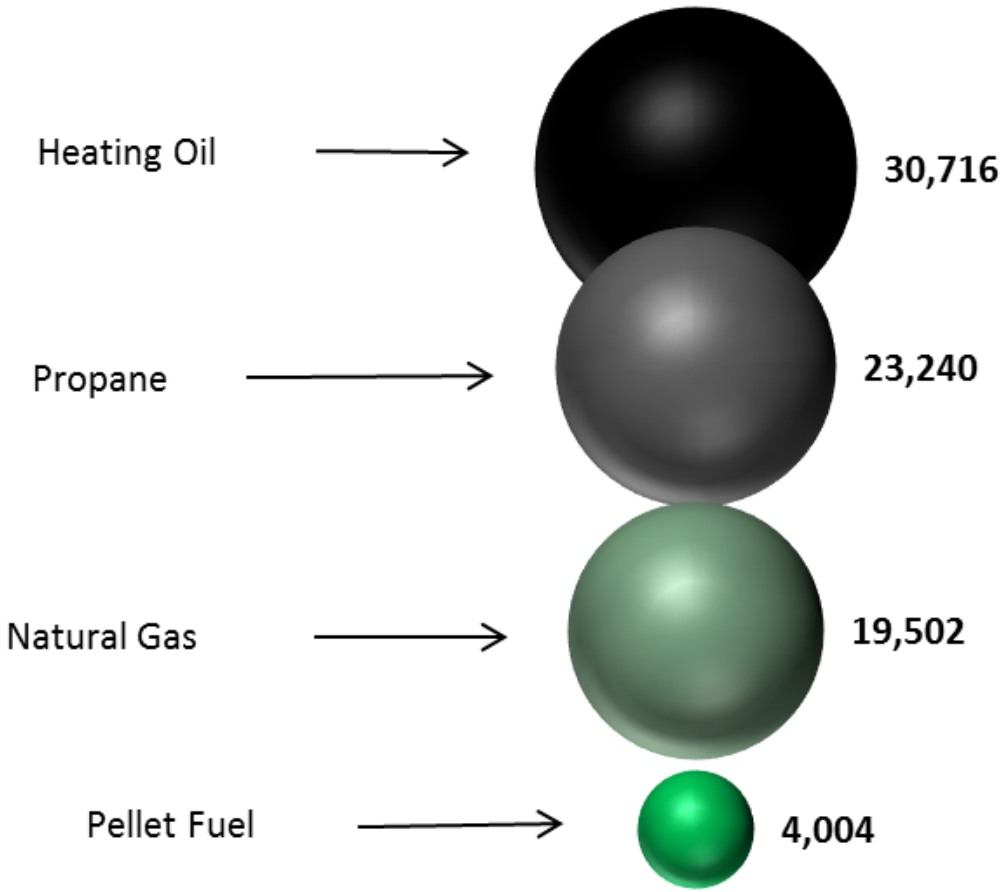


And as an added benefit….



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.

The foundations for an energy independent low carbon future for heating our homes and businesses is in place:

- Fuel refineries exist (some call them pellet factories) and more can be built;
- European style pellet boilers and bulk fuel delivery are here now (see www.MaineEnergySystems.com);
- The forest products sector has a long history in the NE and can, as pulp and paper declines, supply the raw materials for fuel from our own region;
- There are hundreds of thousands of acres of fallow agricultural land that can grow fast rotation fuel crops.

The penalty for failure is dire!

When oil prices rise and push heating oil from the current $3.65/gallon to $4.50/gallon, massive numbers of jobs will be lost <u>if the northeast does not end its heating oil addiction</u>.

#2 Distillate Fuel use in Residential, Commercial, and Industrial (not Transportation)	Average Gallons per Year	Money Exported from Regional Economy at $3.65/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
Connecticut	720,225,000	$2,050,480,575	$2,527,989,750	($477,509,175)	-22,892
Maine	376,200,000	$1,071,041,400	$1,320,462,000	($249,420,600)	-14,948
Massachusetts	915,750,000	$2,607,140,250	$3,214,282,500	($607,142,250)	-31,018
New Hampshire	368,100,000	$1,047,980,700	$1,292,031,000	($244,050,300)	-13,687
New York	2,947,500,000	$8,391,532,500	$10,345,725,000	($1,954,192,500)	-96,649
Pennsylvania	1,377,750,000	$3,922,454,250	$4,835,902,500	($913,448,250)	-46,129
Rhode Island	166,400,000	$473,740,800	$584,064,000	($110,323,200)	-5,490
Vermont	180,900,000	$515,022,300	$634,959,000	($119,936,700)	-7,037
	7,052,825,000	$20,079,392,775	$24,755,415,750	($4,676,022,975)	**-237,850**

analysis by FutureMetrics

Table 6: **Climate Change Performance Index for OECD Member Countries**

Rank	Country	Score	Rank	Country	Score	Rank	Country	Score
5	Sweden	69.88	18	Slovak Republic	60.48	38	Japan	53.09
6	Norway	67.01	20	Ireland	59.78	40	Austria	52.86
7	Germany	66.98	24	Iceland	58.73	41	Italy	52.70
8	United Kingdom	65.92	27	Czech Republic	57.48	43	Greece	52.43
9	France	64.64	30	Netherlands	56.43	50	Turkey	49.02
11	Mexico	63.95	31	Finland	55.11	51	Luxembourg	48.25
13	Switzerland	63.63	33	Denmark	54.64	54	USA	46.49
14	Portugal	63.38	34	Korea, Rep.	54.54	55	Poland	46.33
16	Hungary	61.79	35	Spain	54.41	57	Canada	43.86
17	Belgium	61.49	37	New Zealand	53.73	58	Australia	42.86

Rank	Tendency	Country	Score**	Partial Score (Trend, Level, Policy)
1*		-	-	
2*		-	-	
3*		-	-	
4	→	Brazil	70.5	
5	→	Sweden	69.9	
6	↗	Norway	67.0	
54	↘	USA	46.5	
55	↘	Poland	46.3	
56	↘	China	44.9	
57	↗	Canada	43.9	
58	↘	Australia	42.9	
59	↘	Kazakhstan	42.5	
60	→	Saudi Arabia	25.8	

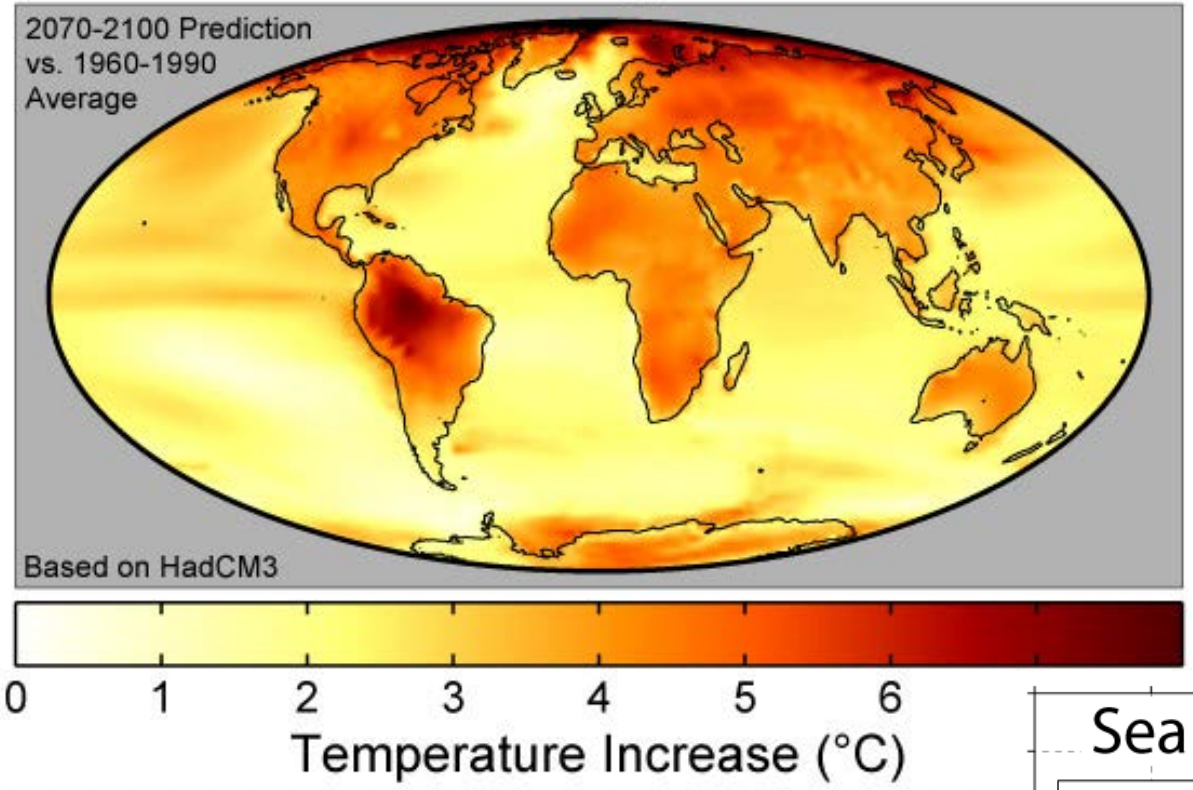
Index Categories

- Emissions Trend (50% weighting)
- Emissions Level (30% weighting)
- Climate Policy (20% weighting)

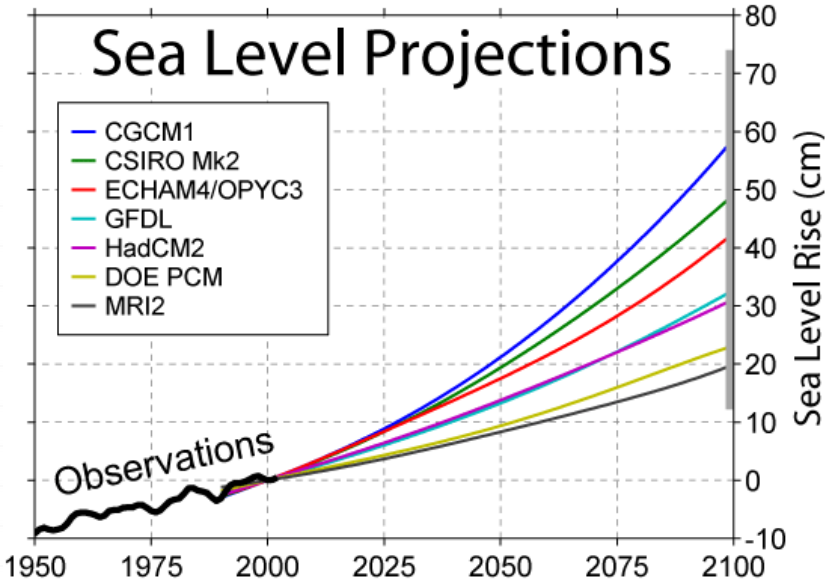
Rating

- Very good
- Good
- Moderate
- Poor
- Very poor

Global Warming Predictions



The predicted warming over the 21st century due to <u>business as usual</u> greenhouse gas emissions scenario (IS92a) as reported by the HadCM3 climate model. The average warming in this model is 3.0 °C.



Thank you!

William Strauss, PhD

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