

MEMORANDUM

To:	Caroline Garber, Chief, Environmental Studies Section, WI DNR Kris Krause, Co-Chair, GWTF Technical Advisory Committee George Edgar, Co-Chair, GWTF Technical Advisory Committee
From:	Glen Wood, ICF International (ICF), and Jeff Amlin, Systematic Solutions Inc. (SSI)
Date:	April 25, 2008
Re:	<u>Policy Scenarios 1 & 2</u>

The following memorandum compares the ENERGY 2020 model outputs for Policy Scenarios 1 and 2 with the Reference Case. Scenario 1 which consists of all policies approved for modeling by the Task Force except for the Cap & Trade policy will be discussed first. The memo then goes on to discuss areas in which model results differ for Policy Case 2.

The “Reference Case” used for comparison purposes is the Reference Case based on the high energy price scenario, adjusted to include the impacts of the Energy Independence and Security Act. The comparisons shown below are based on the Reference Case and respective Policy Cases, including the impacts of feedback with the REMI model.

1. Introduction

The data is presented for a set of milestone years established after discussion with the TAG. ENERGY 2020 provides data for all years in the modelled period should that be required.

ENERGY 2020 outputs typically display the data for about 70 economic sectors and other categories. The data presented below has been consolidated by sector based on the following sectors as agreed to with the TAG:

- Residential
- Commercial
- Pulp and Paper
- Other Energy Intensive Industries (*these include Smelting and Refining, Iron and Steel, Chemicals, Cement, Petroleum Refining, & mining*)
- Other Industry (including construction)
- Passenger Transportation
- Freight Transportation (including off-road)
- Agricultural
- Forestry
- Waste and Wastewater
- Power Sector

Modeling results are presented for Wisconsin, the Region around the state and for the rest of the US. The States Included in the “Region” for modeling purposes include:

- Illinois
- Indiana
- Iowa
- Michigan
- Minnesota
- Missouri
- Ohio

2. Economic Data:

A forecast of population growth and economic activity was provided from the REMI macro-economic model. This forecast projected future population growth, employment, personal income, and economic output (gross output). A discussion of the REMI economic forecast is included in the Assumptions Book. The discussion which follows focuses on modeling results from the ENERGY 2020 model.

ENERGY 2020 projected future housing types based on historic trends and economic activity. Housing in Wisconsin is dominated by single family dwellings. Over the next twenty years, the model projects a little change in the split between household types.

The following tables show the economic changes that result from the implementation of Policy Cases relative to the Reference Case in absolute and percentage terms. The implementation of these policies has a very minor negative impact on the overall economy. To place these changes in context, Personal Disposable Income is projected to increase by over 26% between 2006 and 2024. The changes introduced in Policy Case 1 would reduce disposable incomes by 0.1% by 2024.

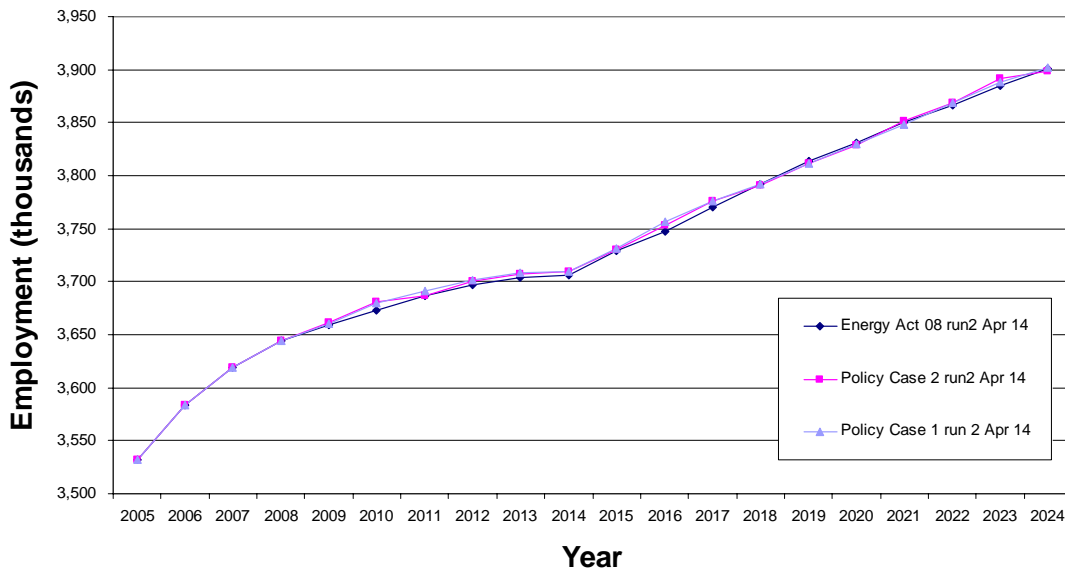
Policy Case 1:

Policy Case 1 Change from EA08:	2010	2015	2020	2024
Employment (thousands)	(6.5)	(4.4)	(8.7)	0.6
Gross State Product (Billions 2000 \$)	(0.5)	(0.4)	(0.7)	(0.0)
Real Personal Disposable Income (Billions 2000 \$)	(0.1)	(0.1)	(0.3)	(0.1)
Policy Case 1 Change from EA08				
Employment (%)	-0.2%	-0.1%	-0.2%	0.0%
Gross State Product (%)	-0.2%	-0.2%	-0.2%	0.0%
Real Personal Disposable Income (%)	-0.1%	-0.1%	-0.2%	-0.1%

Policy Case 2:

Policy Case 2 Change from EA08:	2010	2015	2020	2024
Employment (thousands)	(8.3)	0.3	(5.4)	1.5
Gross State Product (Billions 2000 \$)	(0.6)	(0.1)	(0.5)	0.1
Real Personal Disposable Income (Billions 2000 \$)	(0.2)	0.0	(0.2)	(0.1)
Policy Case 2 Change from EA08				
Employment (%)	-0.2%	0.0%	-0.1%	0.0%
Gross State Product (%)	-0.3%	0.0%	-0.2%	0.0%
Real Personal Disposable Income (%)	-0.1%	0.0%	-0.1%	-0.1%

Total Employment



The impact on employment is quite small across the overall economy. The following table shows how specific sectors are affected. Again, the impacts are less than one half of one percent by 2024 in all cases.

Policy Case 1:

Change in Employment by Sector ((%)	2010	2015	2020	2024
Paper	0.0%	0.0%	0.1%	0.3%
Other Energy Intensive Industry	0.0%	0.0%	0.0%	0.1%
Other Industry	0.3%	0.2%	-0.3%	-0.3%
Commercial	0.2%	0.0%	0.1%	0.2%

Policy Case 2:

Change in Employment by Sector ((%)	2010	2015	2020	2024
Paper	0.0%	0.0%	0.1%	0.3%
Other Energy Intensive Industry	0.0%	0.0%	0.0%	0.1%
Other Industry	0.4%	0.1%	-0.3%	-0.4%
Commercial	0.2%	0.0%	0.1%	0.1%

3. Power Sector Data:

Electricity consumption declines by over 20% from Reference Case levels by 2024. Growth in electricity sales drops in half over the period. The bulk of this reduction is due to the Enhanced EEPS standard.

Growth in Electricity Sales 2004 to 2024		
Sector	Reference	Policy
Residential	1.70%	0.80%
Commercial	1.90%	0.80%
Industrial	2.40%	1.40%
Total Sales	2.00%	1.00%

Policy Scenario - Change from Reference Case

Electricity Sales (GWh) Change from Reference (Policy minus Reference)				
Sector	2010	2015	2020	2024
Residential	(621)	(1,937)	(3,245)	(4,099)
Commercial	(1,129)	(3,668)	(5,685)	(6,832)
Industrial	(1,398)	(4,354)	(7,282)	(8,781)
Street Lights/Misc.	-	-	-	-
Resale	-	-	-	-
Total Sales	(3,148)	(9,959)	(16,212)	(19,712)
Net Imports	(2,908)	(8,464)	(13,581)	(13,727)

Generation Output (GWh/year) Change from Reference (GWh/year) Change from Reference (Policy minus Reference)				
Plant Type	2010	2015	2020	2024
Gas/Oil	(240)	(917)	(3,854)	(8,181)
Coal	-	(205)	(255)	(369)
Nuclear	-	-	-	-
Hydro	-	-	0	(0)
Landfill Gas/EFW	-	(16)	(58)	(43)
Wind	-	(308)	1,670	2,798
Other	-	(48)	(134)	(190)
Total	(240)	(1,495)	(2,631)	(5,985)

Generation Capacity (MW) Change (Policy minus Reference)				
Plant Type	2010	2015	2020	2024
Gas/Oil Combustn. Turbine	-	-	-	-
Gas/Oil Combined Cycle	-	(0)	(202)	(1,802)
Gas/Oil Steam	-	-	-	-
Coal	-	-	-	-
Nuclear	-	-	-	-
Hydro	-	-	-	-
Landfill Gas/EFW	-	(2)	(7)	(5)
Wind	-	(98)	512	855
Other	-	(8)	(20)	(27)
Total	-	(108)	282	(980)

Notes: 1. EFW = Energy from Waste

2. Other generation is primarily comprised of renewable generation sources.

- Electricity sales are reduced for all sectors as a result of combined Energy Efficiency Programs and regulations.
- Net imports decline relative to the Reference Case as a result of the decrease in electricity sales and increased renewable production.
- About one third of the decrease in fossil generation is offset by an increase in wind generation by 2024.

Absolute Values for Policy Scenario:

Electricity Sales (GWh)						
Sector	2004	2006	2010	2015	2020	2024
Residential	19,203	20,148	21,184	21,149	21,818	22,707
Commercial	21,800	22,272	22,593	22,703	23,907	25,501
Industrial	28,438	31,226	31,739	31,271	34,434	37,352
Street Lights/Misc.	400	400	400	400	400	400
Resale	20	-	-	-	-	-
Total Sales	69,861	74,046	75,916	75,523	80,559	85,960
Net Out-Flows	9,416	12,402	(4,048)	(4,598)	(861)	2,442

Generation Output (GWh/year)						
Plant Type	2004	2006	2010	2015	2020	2024
Gas/Oil	3,146	6,226	10,269	8,514	6,113	5,595
Coal	42,141	40,043	54,909	53,816	53,971	53,857
Nuclear	11,888	12,234	12,115	12,802	12,802	12,802
Hydro	1,981	1,679	1,184	1,184	1,184	1,184
Landfill Gas/EFW	114	110	133	402	886	1,240
Wind	1,175	1,349	1,283	3,066	5,684	7,765
Other	-	4	72	338	780	1,075
Total	60,445	61,644	79,964	80,121	81,420	83,518

Generation Capacity (MW)						
Plant Type	2004	2006	2010	2015	2020	2024
Gas/Oil Combustn. Turbine	5,248	6,793	4,517	4,517	4,517	4,517
Gas/Oil Combined Cycle			2,679	2,679	2,679	2,679
Gas/Oil Steam			360	383	383	383
Coal	6,785	7,464	8,560	8,441	8,441	8,441
Nuclear	1,583	1,586	1,586	1,676	1,676	1,676
Hydro	447	447	447	447	447	447
Landfill Gas/EFW	60	52	52	86	147	192
Wind	39	121	484	1,068	1,875	2,507
Other	-	-	1,703	1,746	1,820	1,870
Total	12,445	16,020	20,388	21,043	21,985	22,712

Renewable Generation as % of Sales:	2015	2020	2024
Target	10%	20%	24%
Model Results	5.0%	9%	12%

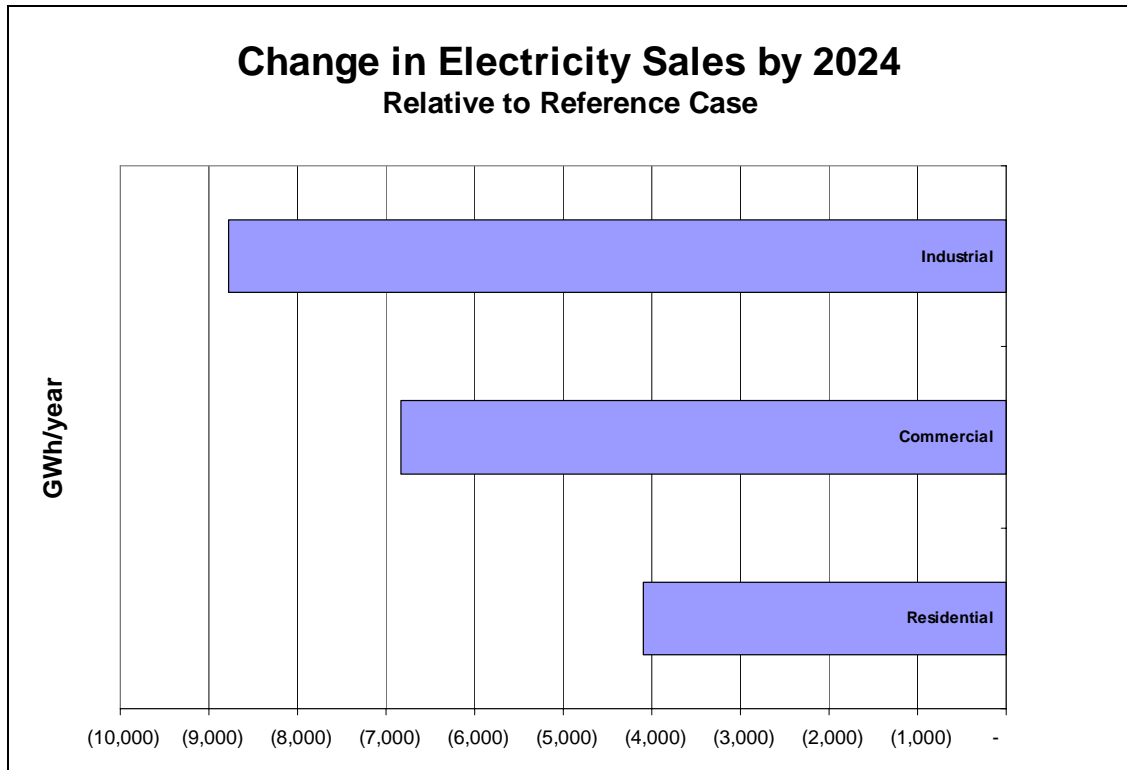
Note – The model results represent in-state generation only. Approximately half of the generation to meet the RPS is expected to come from outside of Wisconsin.

Change in Region:

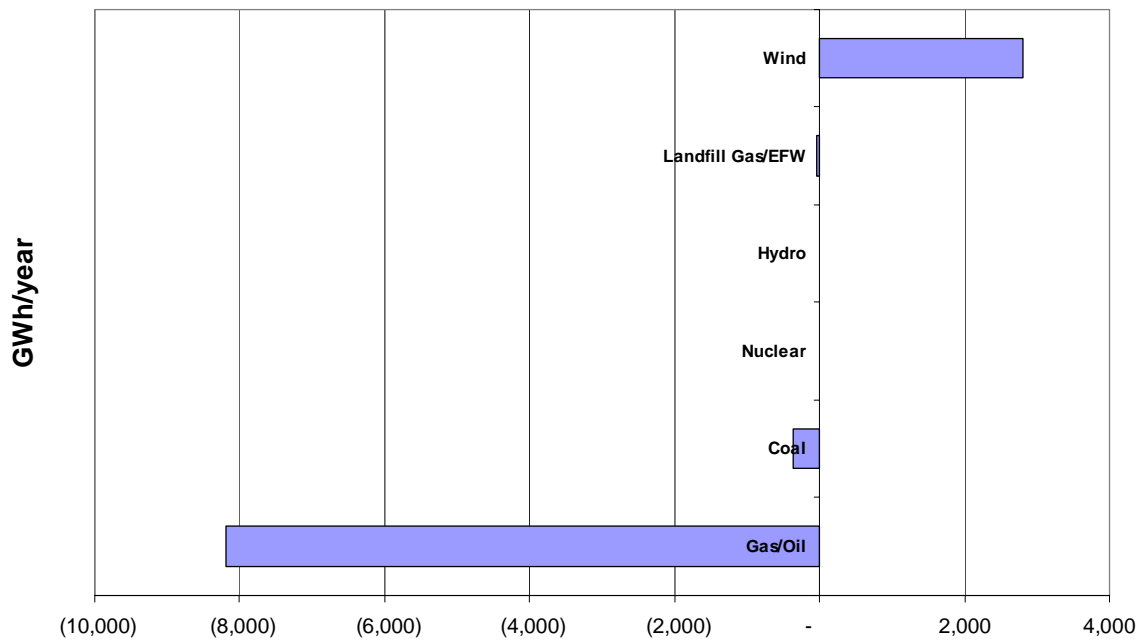
Electricity Sales (GWh) Change from Reference (Policy minus Reference)				
Sector	2010	2015	2020	2024
Residential	16	84	255	420
Commercial	10	89	365	630
Industrial	(15)	(13)	651	1,599
Street Lights/Misc.	-	-	-	-
Total Sales	11	160	1,271	2,649

Generation Output (GWh/year) Change from Reference (GWh/year) Change from Reference (Policy minus Reference)				
Plant Type	2010	2015	2020	2024
Gas/Oil	(487)	(2,058)	(2,442)	(1,583)
Coal	-	(948)	(2,305)	(3,418)
Nuclear	-	-	-	-
Hydro	-	-	-	-
Landfill Gas/EFW	-	-	6	140
Wind	-	33	2,843	4,868
Other	-	(3)	(25)	(185)
Total	(487)	(2,976)	(1,923)	(178)

- Sales outside of Wisconsin increase very slightly (0.3% by 2024).
- Fossil generation decreases in the Region both as a result of the change in sales and the increase in wind generation needed to meet RPS requirements.
- Total generation decreases outside the Region by about 10,000 GWh by 2024 relative to Reference Case implying that as imports into Wisconsin decrease the generation that had been used to supply these imports is used outside the Region.



Change in Generation Output by 2024 Relative to Reference Case



Transportation Data:

Marginal Passenger Vehicle Efficiency (miles/gallon)				
	2010	2015	2020	2024
Light Gas Vehicles	0.6	3.0	5.3	7.1
Medium Gas Vehicles	0.6	2.6	4.7	6.3
Large Gas Vehicles	0.6	2.6	4.1	4.9
Large Diesel	0.6	2.6	4.2	5.0
	2010	2015	2020	2024
Ethanol as a % of Gasoline Used for Passenger Transportation	0.3%	1.9%	4.4%	6.4%

- Passenger vehicle efficiencies improve relative to the Reference Case reflecting the more stringent standards under the California Cars standard.
- Ethanol use increases as a percentage of total gasoline use meeting the requirements of the Low Carbon Fuel Standard (Note: The mix of corn, cellulosic and advanced ethanol is assumed to change in proportion as specified in the Energy Independence and Security Act).

Distance Travelled (millions of vehicle miles travelled)					
<i>Change from Reference</i>	2010	2015	2020	2024	Change in Growth Rate
Passenger	31	(8,456)	(13,408)	(16,077)	-1.4%
Freight	9	13	19	14	0.0%
Passenger Miles/person	4	(1,450)	(2,217)	(2,562)	-1.4%

- Passenger VMT declines by about 24% relative to the Reference Case, growing at about 0.6% per year over the period rather than almost 2% per year over the period to 2024.

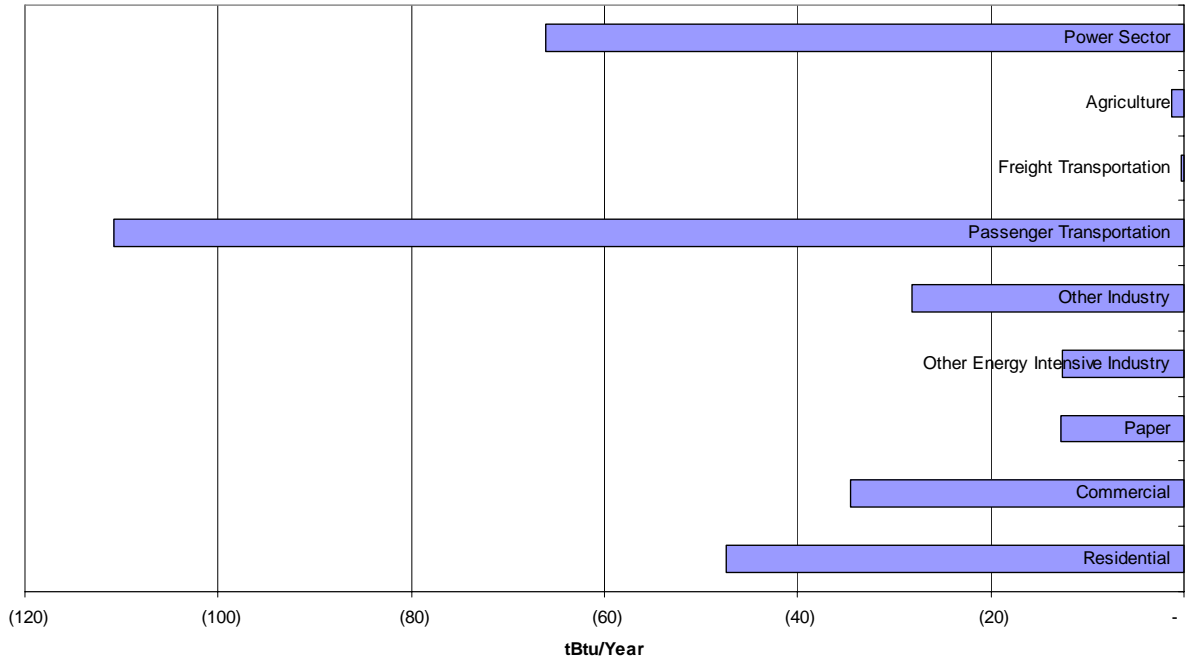
Fuel Use data:

Total Energy Use (TBtu/year) - Change (Policy minus Reference)				
Sector	2010	2015	2020	2024
Residential	(6.9)	(21.5)	(37.0)	(47.5)
Commercial	(6.9)	(19.8)	(29.0)	(34.5)
Paper	(2.7)	(6.7)	(10.4)	(12.7)
Other Energy Intensive Industry	(2.6)	(7.1)	(10.7)	(12.6)
Other Industry	(5.6)	(15.3)	(23.7)	(28.1)
Passenger Transportation	(7.4)	(71.2)	(98.4)	(110.9)
Freight Transportation	0.2	0.4	(0.5)	(0.2)
Agriculture	(0.3)	(0.7)	(1.0)	(1.2)
Power Sector	(1.9)	(10.7)	(36.4)	(66.0)
Total	(33.9)	(152.7)	(247.0)	(313.7)

Total Energy Use (TBtu/year) - Change (Policy minus Reference)				
Fuel Type	2010	2015	2020	2024
Aviation Fuel	(0.1)	(3.1)	(4.9)	(5.8)
Biomass	(0.4)	(1.5)	(3.0)	(4.0)
Coal	(1.0)	(5.5)	(9.0)	(12.9)
Diesel	(0.1)	(1.3)	(2.9)	(2.9)
Ethanol	0.7	0.2	0.7	1.4
Electric	(10.7)	(34.0)	(55.3)	(67.3)
Landfill Gas	-	(0.2)	(0.8)	(0.6)
LPG	(0.0)	(0.0)	(0.0)	(0.1)
Gasoline	(7.7)	(66.6)	(92.1)	(104.0)
Natural Gas	(13.3)	(35.4)	(69.3)	(103.4)
Nuclear	-	-	-	-
Oil, Unspecified	(1.0)	(3.5)	(7.0)	(9.5)
Solar	(0.3)	(1.1)	(1.9)	(2.4)
Other	0.0	(0.6)	(1.6)	(2.3)
Total	(33.9)	(152.7)	(247.0)	(313.7)

- Energy requirements decrease across all sectors and across all fuels except ethanol; which more than doubles as it replaces gasoline as part of the LCFS.
- Gasoline requirements decrease by 37% by 2024 while natural gas use declines 22% compared to the Reference Case.
- Regionally fuel use is unchanged except in the power sector where fuel use declines by less than 1%.

Change in Fuel Use by Sector Policy Case minus Reference Case



Energy Price Data:

- Prices for oil, gas, biomass and coal are specified exogenously. The model assumes that national and world prices are unaffected by changes within Wisconsin.

Energy Prices (% Change from Reference)		2010	2015	2020	2024
Electricity	Units				
Residential	MWh	9.4%	18.1%	10.9%	6.7%
Commercial	MWh	11.3%	22.0%	13.5%	8.5%
Industrial	MWh	13.4%	26.0%	15.9%	10.0%
Average Retail	MWh	11.3%	22.0%	13.5%	8.5%

- Electricity prices rise for all sectors as energy usage declines and the costs of the Enhanced EEPs and RPS are reflected in rates.

Change in Energy Costs (million 2005\$)

Change in Energy Cost (million 2005 \$)				
	2010	2015	2020	2024
Residential	-2%	1%	-10%	-15%
Commercial	4%	5%	-7%	-13%
Industrial	6%	8%	-5%	-12%

- For the commercial and industrial sectors actual energy costs rise in the early years, but these increases are eventually overtaken by energy savings as a result of energy efficiency standards and programs.
- For the residential sector, energy costs decline over most of the period as a result of increased energy efficiency.

Emissions Data:

Emissions rise slightly by 2010, decreasing slightly by 2015 and remaining below 2010 levels until 2024. Compared to the Reference Case emissions drop by just under 16 Mt by 2024.

Absolute Values for Policy Scenario:

GHG Emissions (Mt)	2004	2006	2010	2015	2020	2024	Average Annual % Change
Residential	13.1	12.9	12.9	12.5	12.1	12.0	-0.4%
Commercial	5.9	5.6	5.0	4.2	3.9	3.8	-2.2%
Pulp & Paper	5.6	5.8	5.5	5.1	5.5	5.9	0.3%
Other Energy Intensive Industry	2.3	2.4	2.3	2.1	2.2	2.3	0.0%
Other Industry	8.9	9.4	9.5	9.8	10.9	11.7	1.4%
Agriculture/ Forestry	11.9	12.2	12.8	13.7	15.0	16.1	1.5%
Passenger Transport	21.6	21.4	21.3	16.3	13.6	12.8	-2.7%
Freight Transport	13.1	12.7	12.4	12.8	13.5	14.3	0.4%
Power Sector	45.6	49.9	59.2	56.8	55.9	55.5	1.0%
Waste & Wastewater	3.2	3.5	3.9	4.6	5.3	5.9	3.0%
Total Gross Emissions	131.3	135.8	144.7	137.8	137.9	140.4	0.3%
Land Use - Forestry	(8.2)	(8.2)	(8.20)	(8.21)	(8.21)	(8.22)	0.0%
Total Net Emissions	123.1	127.6	136.5	129.5	129.7	132.2	0.4%

Change from Reference: Wisconsin

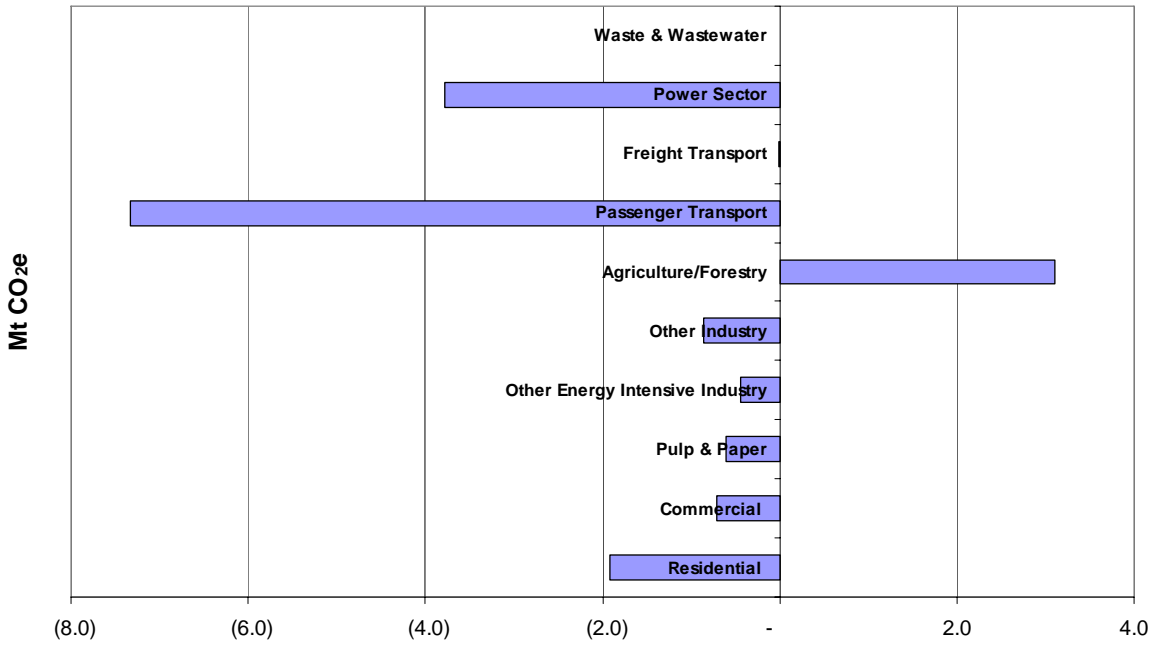
GHG Emissions (Mt) - Change (Policy minus Reference)				
	2010	2015	2020	2024
Residential	(0.3)	(0.8)	(1.5)	(1.9)
Commercial	(0.2)	(0.5)	(0.6)	(0.7)
Pulp & Paper	(0.1)	(0.3)	(0.5)	(0.6)
Other Energy Intensive Industry	(0.1)	(0.3)	(0.4)	(0.4)
Other Industry	(0.2)	(0.5)	(0.7)	(0.9)
Agriculture/Forestry	(0.1)	(0.0)	(0.0)	(0.0)
Passenger Transport	(0.5)	(4.7)	(6.5)	(7.3)
Freight Transport	0.0	0.0	(0.0)	(0.0)
Power Sector	(0.1)	(0.6)	(2.0)	(3.8)
Waste & Wastewater	0.0	0.0	(0.0)	0.0
Total Gross Emissions	(1.5)	(7.6)	(12.2)	(15.7)
Land Use - Forestry	(0.00)	(0.01)	(0.01)	(0.02)
Total Net Emissions	(1.5)	(7.6)	(12.2)	(15.7)

Change from Reference: Region

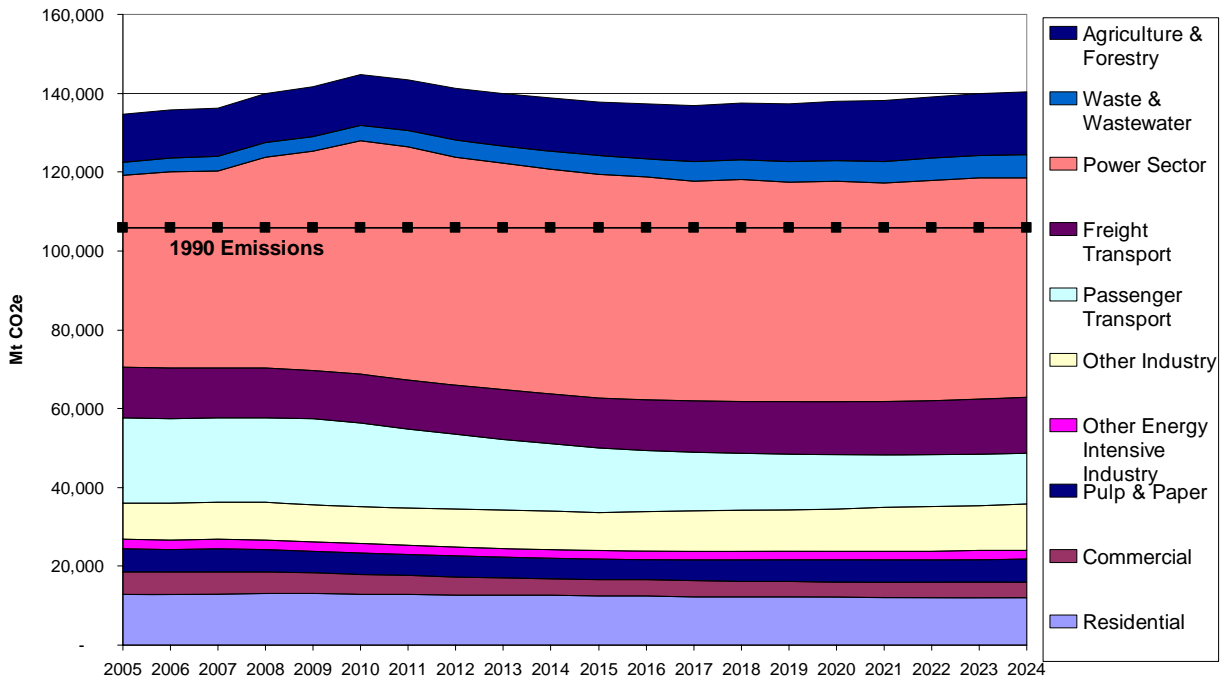
GHG Emissions (Mt) - Change (Policy minus Reference)				
	2010	2015	2020	2024
Residential	(0.0)	(0.0)	(0.0)	(0.1)
Commercial	(0.0)	(0.0)	(0.1)	(0.1)
Pulp & Paper	0.0	0.0	0.0	0.0
Other Energy Intensive Industry	(0.0)	(0.0)	(0.1)	(0.1)
Other Industry	0.0	0.0	(0.0)	(0.1)
Agriculture/Forestry	-	-	-	-
Passenger Transport	(0.0)	(0.0)	(0.0)	(0.0)
Freight Transport	-	-	-	-
Power Sector	(0.3)	(2.3)	(3.9)	(4.9)
Waste & Wastewater	-	-	-	-
Total Gross Emissions	(0.3)	(2.3)	(4.1)	(5.2)
Land Use - Forestry	-	-	-	-
Total Net Emissions	(0.3)	(2.3)	(4.1)	(5.2)

- The only significant change in the Region occurs in the power sector where emissions decline by approximately **5 Mt**. Emissions from the power sector in the rest of the US decline by a further **6 Mt** as a result of changes initiated in Wisconsin.

Change in GHG Emissions in 2024 Relative to the Reference Case



GHG Emissions - Reference Case



Note – Graph shows Gross emissions and does not include sequestration

Policy Case 2

Policy Case 2 includes all policies except Cap and Trade and California Cars. For the most part, the results of Policy Case 2 mirror those for Policy Case 1. There are no changes to the electric sector or for building energy use. The changes resulting from the removal of the California Cars policy impact the transportation sector and resulting energy use and emissions. The policy run excluding California Cars shows no change in passenger VMT and only a very minor change in the level of ethanol as a percentage of gasoline.

Marginal Vehicle Efficiency (miles/gallon) - Change (Policy minus Reference)				
	2010	2015	2020	2024
Light Gas Vehicles	(0.0)	(0.3)	(0.5)	(0.5)
Medium Vehicles	(0.0)	(0.3)	(0.5)	(0.5)
Heavy Vehicles	(0.0)	(0.1)	(0.1)	(0.1)
Heavy Diesel	(0.0)	(0.1)	(0.1)	(0.1)
	2010	2015	2020	2024
Ethanol as a % of Gasoline Used for Passenger Transportation	0.4%	2.2%	4.7%	6.6%

- Without the California Cars policy, vehicle efficiency changes only marginally in response to changes in energy price (due to the Low Carbon Fuel standard).

Total Energy Use (TBtu/year) - Change (Policy minus Reference)				
Sector	2010	2015	2020	2024
Residential	(26.8)	(45.3)	(64.4)	(76.9)
Commercial	(7.5)	(19.6)	(27.9)	(33.2)
Paper	(3.5)	(9.6)	(13.2)	(15.9)
Other Energy Intensive Industry	(3.5)	(8.5)	(11.7)	(13.8)
Other Industry	(7.6)	(18.7)	(26.1)	(30.7)
Passenger Transportation	3.5	(43.0)	(63.7)	(73.0)
Freight Transportation	37.6	39.6	44.9	49.2
Agriculture	(0.3)	(0.8)	(1.1)	(1.3)
Power Sector	(2.3)	(12.1)	(50.5)	(78.4)
Total	(10.3)	(118.0)	(213.8)	(274.0)

- The decrease in energy use for passenger transportation is approximately 39 tBtu lower without the California Cars policy. The change from the policy case for all other sectors remain unchanged.

GHG Emissions (Mt) - Change (Policy minus Reference)				
	2010	2015	2020	2024
Residential	(0.3)	(0.8)	(1.5)	(1.9)
Commercial	(0.2)	(0.5)	(0.6)	(0.7)
Pulp & Paper	(0.1)	(0.3)	(0.5)	(0.6)
Other Energy Intensive Industry	(0.1)	(0.3)	(0.4)	(0.4)
Other Industry	(0.2)	(0.5)	(0.7)	(0.9)
Agriculture/Forestry	(0.1)	(0.0)	(0.0)	(0.0)
Passenger Transport	(0.0)	(3.1)	(4.5)	(5.2)
Freight Transport	0.0	0.0	(0.0)	0.0
Power Sector	(0.1)	(0.6)	(2.0)	(3.8)
Waste & Wastewater	0.0	0.0	(0.0)	0.0
Total Gross Emissions	(1.0)	(6.0)	(10.2)	(13.5)
Land Use - Forestry	-	-	-	-
Total Net Emissions	(1.0)	(6.0)	(10.2)	(13.5)

- Total GHG emissions are approximately 2.2 Mt less than in Policy Case 1 which included the California Cars policy.
- It should be noted that when modelled as a stand-alone policy California Cars reduced emissions by 2.9 Mt. This reduction is decreased by the VMT reduction policy and the introduction of the low carbon fuel standard.

The following chart shows the net emissions for the two policy cases including the reductions which occur outside of Wisconsin.

Change in Net GHG Emissions (Including Out-of-State Reductions)

