

## **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: 23 June 2008

Re: **High Energy Price Sensitivity Run – Policy Case 01**

The following describes the ENERGY 2020 model outputs for a sensitivity run in which energy supply prices were increased by 50% from levels used in the Reference Case. These cost increases were applied to the world price of oil, the well head price for natural gas, as well as coal and biomass prices. For this scenario, the model was set up to assume that new generation would be built to meet reserve margin requirements.

Two policy cases were modeled under this high price scenario: 1) the Reference Case, which includes the impacts of the Energy Independence and Security Act (EISA), and 2) Policy Case 01 which includes all policies approved for modeling by the Task Force except for the Cap & Trade policy. The results presented below compare the High Energy Price Policy Case 01 to the High Energy Price Reference Case. More detailed results have been provided to the TAG in the form of Excel spreadsheets which summarize changes resulting for Wisconsin, the surrounding states and the rest of the US and Canada. A comparison of the High Energy Price Reference Case to the original Reference Case is presented in a separate memorandum.

The effects of the proposed policies were modeled for the states which were included in the Cap and Trade market for modeling purposes, the surrounding region and the rest of the U.S. and Canada. In the results which follow, these areas are referred to as:

- The Rest of the Market - includes the neighbouring states which signed the MWGA Accord (Iowa, Illinois, Minnesota, and Michigan).
- The Rest of the Region – includes the remaining states originally defined as the Region but which are assumed not to be included in the Cap and Trade market (Indiana, Missouri, and Ohio).
- The Rest of the US and Canada.

The results for these groups are additive, in that no state is included in more than one category. The only policies implemented in Wisconsin that were found to

have an impact outside of the state are those which affected the electricity sector. Other policies had little or no impact beyond Wisconsin.

The data inputs and assumptions underlying this Reference Case are described in the Assumptions Book.

### 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

Policy Case 01 includes all policies approved for modeling by the Task Force except Cap and Trade. The table below lists the individual policies modeled as part of this Policy Case:

Policy No.	Policy Title
C&EE 01	Enhanced Energy Efficiency Program
C&EE 02	Residential & Commercial Energy Efficiency & Green Building Codes
C&EE 03	State Appliance Efficiency Standard
C&EE04	Residential Rental Lighting Standard
F&A 01	Urban Forestry (stand alone policy)
Trans 01	CO2 Emission Standards, Commonly Called "California Car" Standards
Trans 02	Low Carbon Fuel Standard
Trans 03	Reform Planning and Funding Policies to Reduce VMT
EG 01	Enhanced Renewable Portfolio Standard

## 2. Economic Data:

The economic data used in this scenario remains unchanged from prior modeling done for the Reference Case and Policy Case 01.

The ENERGY 2020 and the REMI macro-economic models were run iteratively for Policy Case 01 with higher prices in order to capture the impacts of the change in energy prices, energy consumer and supplier responses and the implementation of Policy Case 01 on the economy as a whole.

The tables below show the economic effects of the implementation of Policy Case 01 in conjunction with a 50% increase in energy supply costs. The overall impact on the economy is positive though the impact is quite small; GRP rises by 0.5% and employment by 0.4% by 2024. To place this in context, personal disposable income is projected to rise by more than 26% by 2024. The combined impact of higher prices and the proposed policies would only change this by 0.1%.

<b>Policy Case 01 with 50% Higher Energy Prices Change from Reference Case</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Total Employment (Thous)	(0.1)	13.8	9.3	16.9
Total GRP (Bil Fixed 2000\$)	0.2	1.3	1.1	1.6
Real Disp Pers Inc per Cap (Thous Fixed 2000\$)	0.0	0.0	(0.0)	0.0

<b>Policy Case 01 with 50% Higher Energy Prices Change from Reference Case</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Total Employment (Thous)	0.0%	0.4%	0.2%	0.4%
Total GRP (Bil Fixed 2000\$)	0.1%	0.5%	0.3%	0.5%
Real Disp Pers Inc per Cap (Thous Fixed 2000\$)	0.0%	0.1%	0.0%	0.1%

Economic benefits are distributed relatively evenly between sectors as is shown in the table below. As would be expected, more energy intensive businesses benefit most from the efficiency increases resulting from the policies. Employment increases in the commercial sector as money saved on energy costs is increasingly spent in the local economy.

**Policy Case 01 with 50% Higher Energy Prices**

Employment (thousands) Change from Reference	2010	2015	2020	2024
Commercial	2	7	7	13
Paper	0	0	0	0
Energy Intensive	0	0	0	0
Other Industry	1	3	0	0

Employment (thousands) Change from Reference	2010	2015	2020	2024
Commercial	0.1%	0.3%	0.3%	0.5%
Paper	0.0%	0.2%	0.3%	0.4%
Energy Intensive	0.0%	0.4%	0.4%	0.6%
Other Industry	0.1%	0.5%	0.0%	0.1%

**3. Power Sector Data:**

The tables on the following pages show electricity sales and generation for the High Energy Price Policy Case 01; and the percentage change in these values from the High Energy Price Reference Case.

Electricity sales decrease by 17% in Wisconsin while total in-state generation decreases by 6%. As a result, imports decline by 77%. The decrease in electricity sales is slightly lower than in the original PC01 without the price increase, reflecting some fuel switching towards electricity as a result of higher fuel prices.

Renewable generation, which increased significantly in the High Energy Price Reference Case, represents a higher percentage of the reduced level of sales; particularly in the period prior to 2020.

Generation outside of the state declines as Wisconsin's power imports decline. Sales outside of the state show only minor changes as rates reflect changes in the power system as a result of Wisconsin policies.

**Wisconsin – Absolute Values:**

Sales (GWh)	2010	2015	2020	2024
Residential	21,241	21,190	21,863	22,707
Commercial	22,676	22,800	24,075	25,636
Industrial	31,911	31,418	34,615	37,430
Street Lights/Misc.	400	400	400	400
Resale	-	-	-	-
<b>Total Sales</b>	<b>76,228</b>	<b>75,808</b>	<b>80,953</b>	<b>86,173</b>
Imports	1,767	(290)	1,212	3,972

**Wisconsin – Absolute Values:**

<b>Generation Output (GWh/year)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil	4,678	4,724	4,294	4,255
Coal	54,908	53,816	53,816	53,743
Nuclear	12,115	12,802	12,802	12,802
Hydro	1,184	1,184	1,184	1,184
Landfill Gas/EFW	137	544	1,210	1,533
Wind	1,351	2,762	6,132	8,380
Other	88	267	303	304
<b>Total</b>	<b>74,461</b>	<b>76,098</b>	<b>79,741</b>	<b>82,201</b>

<b>Generation Capacity (MW)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil Combustn. Turbine	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	8,560	8,441	8,441	8,441
Nuclear	1,586	1,676	1,676	1,676
Hydro	435	435	435	435
Landfill Gas/EFW	52	103	188	229
Wind	507	975	2,016	2,699
Other	15	44	50	51
<b>Total</b>	<b>18,711</b>	<b>19,254</b>	<b>20,385</b>	<b>21,109</b>

- Notes: 1. EFW = Energy from Waste  
 2. Other generation is primarily comprised of renewable generation sources.

**Wisconsin – Change from High Energy Price Reference Case:**

<b>Sales (GWh)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	(609)	(1,776)	(2,910)	(3,666)
Commercial	(1,207)	(3,499)	(5,237)	(6,260)
Industrial	(1,368)	(4,119)	(6,743)	(8,206)
Street Lights/Misc.	-	-	-	-
Resale	-	-	-	-
<b>Total Sales</b>	<b>(3,184)</b>	<b>(9,394)</b>	<b>(14,890)</b>	<b>(18,132)</b>
Imports	(2,934)	(8,707)	(14,991)	(13,132)

<b>Generation Output (GWh/year)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil	(250)	(170)	(1,918)	(2,597)
Coal	-	(205)	(410)	(255)
Nuclear	-	-	-	-
Hydro	-	-	-	0
Landfill Gas/EFW	-	(48)	350	(1,472)
Wind	-	(253)	2,066	(383)
Other	-	(12)	13	(294)
<b>Total</b>	<b>(250)</b>	<b>(687)</b>	<b>101</b>	<b>(5,000)</b>

<b>Generation Capacity (MW)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil Combustn. Turbine	-	-	-	-
Gas/Oil Combined Cycle	-	-	-	-
Gas/Oil Steam	-	-	-	-
Coal	-	-	-	-
Nuclear	-	-	-	-
Hydro	-	-	-	-
Landfill Gas/EFW	-	(6)	44	(186)
Wind	-	(81)	637	(107)
Other	-	(2)	2	(48)
<b>Total</b>	<b>-</b>	<b>(89)</b>	<b>684</b>	<b>(340)</b>

<b>Renewable Generation as a Percentage of Total Sales:</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
<b>Target</b>	10%	20%	24%
<b>Model Results</b>	4.7	9.4	11.9

\* Renewables defined as wind, solar, EFW, LFG and biomass.

*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.*

**Rest of Market Area: Change from High Energy Price Reference Case**

<b>Sales (GWh)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	(18)	(43)	8	93
Commercial	(19)	(55)	(6)	102
Industrial	(103)	(377)	(339)	(46)
Street Lights/Misc.	-	-	-	-
Resale	-	-	-	-
<b>Total Sales</b>	<b>(140)</b>	<b>(475)</b>	<b>(337)</b>	<b>149</b>

<b>Generation Output (GWh/year)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil	(247)	(1,946)	(3,448)	(3,947)
Coal	(5)	(26)	(26)	(16)
Nuclear	-	-	-	-
Hydro	-	-	-	(0)
Landfill Gas/EFW	-	(4)	427	677
Wind	-	(18)	2,768	4,503
Other	-	(1)	155	208
<b>Total</b>	<b>(252)</b>	<b>(1,995)</b>	<b>(124)</b>	<b>1,425</b>

**Rest of Region: Change from High Energy Price Reference Case**

<b>Sales (GWh)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	-	34	106	168
Commercial	-	33	141	241
Industrial	-	95	388	662
Street Lights/Misc.	-	-	-	-
Resale	-	-	-	-
<b>Total Sales</b>	<b>-</b>	<b>162</b>	<b>635</b>	<b>1,071</b>

<b>Generation Output (GWh/year)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil	(83)	(1,314)	(1,427)	(836)
Coal	-	-	(50)	110
Nuclear	-	-	-	-
Hydro	-	-	-	-
Landfill Gas/EFW	-	0	-	-
Wind	-	-	-	-
Other	-	(4)	4	4
<b>Total</b>	<b>(83)</b>	<b>(1,318)</b>	<b>(1,474)</b>	<b>(721)</b>

**Rest of US and Canada: Change from High Energy Price Reference Case**

<b>Sales (GWh)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	(6)	23	114	227
Commercial	-	-	(1)	-
Industrial	(12)	15	88	189
Street Lights/Misc.	-	-	-	-
Resale	-	-	-	-
<b>Total Sales</b>	<b>(18)</b>	<b>38</b>	<b>201</b>	<b>416</b>

<b>Generation Output (GWh/year)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Gas/Oil	(984)	(1,094)	(2,295)	(1,961)
Coal	(1,629)	(4,396)	(10,460)	(9,722)
Nuclear	-	-	-	-
Hydro	-	-	-	(1)
Landfill Gas/EFW	-	-	-	-
Wind	(4)	(8)	277	(8)
Other	0	(1)	3	3
<b>Total</b>	<b>(2,617)</b>	<b>(5,499)</b>	<b>(12,476)</b>	<b>(11,688)</b>

#### 4. Transportation Data:

The following table shows the change in average passenger vehicle efficiency resulting from the policy. The changes relative to the Reference Case with high prices is very similar to the changes for PC01 vs. the original Reference Case.

Freight VMT, which decreased with the imposition of higher fuel prices, does not show any further decrease under the policies represented in PC01.

#### Wisconsin – Change from High Energy Price Reference Case

<b>Marginal Passenger Vehicle Efficiency (miles/gallon)</b>				
	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
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
<b>Ethanol as a % of Gasoline Used for Passenger Transportation</b>				
Policy Case	0.3%	1.9%	4.4%	6.4%

<b>Distance Travelled (millions of VMT)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Passenger	0.0%	-15.1%	-22.2%	-24.9%
Freight	0.0%	0.0%	0.0%	0.0%
Passenger (miles per person)	0.0%	-15.1%	-22.2%	-24.9%

#### 5. Fuel Use data:

Total fuel use declines by 242 tBu by 2024 compared to a 314 tBu reduction between PC01 and the Reference Case without high prices. The overall change from the Reference Case, however, is approximately the same as the imposition of higher energy prices reduced total energy use by about 70 tBu from the original Reference Case levels.

Changes in fuel use show a very similar pattern to the changes between the original Policy Case 01 and the original Reference Case.

**Wisconsin – Change from High Energy Price Reference Case:**

<b>Total Energy Use (TBtu)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	(6)	(17)	(30)	(38)
Commercial	(7)	(19)	(28)	(33)
Paper	(2)	(5)	(8)	(10)
Other Energy Intensive Industry	(2)	(6)	(9)	(10)
Other Industry	(5)	(13)	(20)	(24)
Agriculture / Forestry	(0)	(1)	(1)	(1)
Passenger Transport	(0)	(46)	(67)	(76)
Freight Transport	-	-	-	-
Power Sector	(3)	(5)	(17)	(50)
<b>Total</b>	<b>(25)</b>	<b>(112)</b>	<b>(179)</b>	<b>(242)</b>

<b>Total Energy Use</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Residential	-2.0%	-5.9%	-9.7%	-12.0%
Commercial	-4.1%	-11.4%	-15.8%	-17.8%
Paper	-2.1%	-5.3%	-7.9%	-9.1%
Other Energy Intensive Industry	-2.7%	-7.4%	-10.1%	-11.3%
Other Industry	-3.3%	-8.6%	-11.7%	-12.9%
Agriculture / Forestry	-2.7%	-7.3%	-9.9%	-11.1%
Passenger Transport	-0.1%	-14.4%	-21.3%	-24.1%
Freight Transport	0.0%	0.0%	0.0%	0.0%
Power Sector	-0.4%	-0.6%	-2.3%	-6.4%
<b>Total</b>	<b>-1.2%</b>	<b>-5.5%</b>	<b>-8.6%</b>	<b>-11.1%</b>

**Wisconsin – Change from High Energy Price Reference Case:**

<b>Total Energy Use (TBtu)</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2024</b>
Aviation Fuel	(0)	(3)	(4)	(5)
Biomass	(0)	(1)	(2)	(3)
Coal	(1)	(5)	(10)	(10)
Diesel	(0)	(1)	(2)	(2)
Ethanol	1	3	5	7
Electric	(11)	(32)	(51)	(62)
Landfill Gas	-	(1)	5	(20)
LPG	(0)	(0)	(0)	(0)
Gasoline	(1)	(45)	(65)	(76)
Natural Gas	(12)	(24)	(47)	(59)
Nuclear	-	-	-	-
Oil, Unspecified	(1)	(2)	(5)	(7)
Solar	(0)	(1)	(2)	(2)
Other	(0)	(0)	(0)	(3)
<b>Total</b>	<b>(25)</b>	<b>(112)</b>	<b>(179)</b>	<b>(242)</b>

## 6. Energy Price Data:

Electricity prices rise slightly as the costs of the RPS and EEPS affect rates. Natural gas prices also rise slightly, reflecting the Enhanced EEPS. Gasoline prices show no change from the High Energy Price Reference Case. Rate increases are slightly lower than in the original PC01 case reflecting the fact that part of the RPS requirement is already met by the market in response to higher fuel prices.

By contrast, actual energy costs, calculated by multiplying energy prices by consumption, decrease across all sectors as efficiency improvements and reduced energy use more than offset cost increases. The table below presents the total cost for electrical energy by sector as well as for gasoline.

### Change from High Energy Price Reference Case:

Electricity Prices	2010	2015	2020	2024
Residential	8.7%	15.4%	9.1%	5.3%
Commercial	10.3%	18.1%	11.0%	6.5%
Industrial	12.1%	20.8%	12.4%	7.4%
Average Retail	10.3%	18.1%	11.0%	6.5%

Residential Energy Prices	2010	2015	2020	2024
Electricity (2005 \$ per MWh)	8.7%	15.4%	9.1%	5.3%
Natural Gas (2007 \$ per mmBTu)	0.9%	1.6%	1.4%	1.2%
Gasoline (2007 \$ per gallon)	0.0%	0.0%	0.0%	0.0%

Total Cost of Energy	2010	2015	2020	2024
Residential Electricity	5.6%	6.5%	-3.7%	-9.3%
Commercial Electricity	-4.2%	-11.9%	-16.7%	-18.7%
Industrial Electricity	-4.1%	-11.6%	-16.3%	-18.0%
Gasoline Passenger	0.0%	-14.4%	-21.3%	-24.1%

## 7. Emission Data:

The decrease in energy use and increase in renewable energy supply results in a decrease in GHG emissions of about 12 Mt by 2024 relative to the High Energy Price Reference Case. The pattern of these reductions reflects the changes in energy use described above.

Outside of Wisconsin emission changes reflect adjustments in the power sector. Emissions decrease by 2 Mt in the rest of the market, by 1 Mt in the rest of the Region and by 11 Mt in the rest of US and Canada as electricity use is decreased and more power is supplied from emission-free renewable sources. The overall change in emissions, counting reductions within and outside of Wisconsin amounts to about 25.8 Mt.

**Wisconsin Absolute Emissions: High Energy Price Policy Case 01**

GHG Emissions (Mt)	2010	2015	2020	2024
Residential	12.9	12.4	12.0	11.9
Commercial	5.0	4.2	3.8	3.8
Pulp & Paper	5.4	5.0	5.4	5.8
Other Energy Intensive Industry	2.2	2.1	2.2	2.3
Other Industry	9.4	9.7	10.7	11.5
Agriculture	12.9	13.7	15.0	16.1
Passenger Transport	21.4	16.3	13.4	12.6
Freight Transport	12.1	12.0	12.5	13.1
Power Sector	56.7	55.3	55.0	54.9
Waste & Wastewater	3.9	4.6	5.3	5.9
<b>Total Gross Emissions</b>	<b>142.0</b>	<b>135.2</b>	<b>135.4</b>	<b>137.8</b>
Land Use - Forestry	(8.2)	(8.2)	(8.2)	(8.2)
<b>Total Net Emissions</b>	<b>133.8</b>	<b>127.0</b>	<b>127.2</b>	<b>129.6</b>

**Wisconsin - Change from High Energy Price Reference Case:**

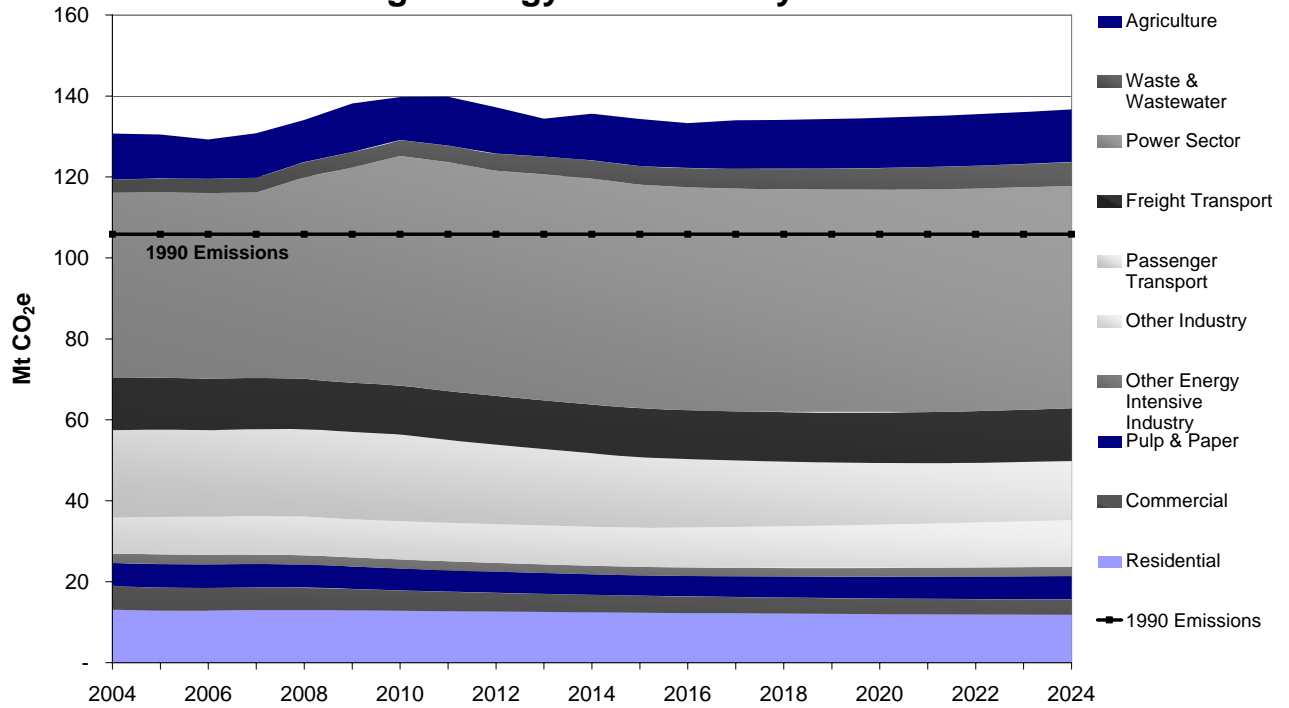
GHG Emissions	2010	2015	2020	2024
Residential	-0.2	-0.6	-1.1	-1.4
Commercial	-0.2	-0.4	-0.6	-0.7
Pulp & Paper	-0.1	-0.2	-0.3	-0.4
Other Energy Intensive Industry	-0.1	-0.2	-0.3	-0.4
Other Industry	-0.2	-0.4	-0.5	-0.7
Agriculture	0.0	0.0	0.0	0.0
Passenger Transport	0.0	-4.2	-6.3	-7.2
Freight Transport	0.0	0.0	0.0	0.0
Power Sector	-0.2	-0.2	-1.4	-1.6
Waste & Wastewater	0.0	0.0	0.0	0.0
<b>Total Gross Emissions</b>	<b>-0.8</b>	<b>-6.3</b>	<b>-10.6</b>	<b>-12.4</b>
Land Use - Forestry	0.0	0.0	0.0	0.0
<b>Total Net Emissions</b>	<b>-0.8</b>	<b>-6.3</b>	<b>-10.6</b>	<b>-12.4</b>

GHG Emissions	2010	2015	2020	2024
Residential	-1%	-5%	-8%	-11%
Commercial	-3%	-10%	-14%	-16%
Pulp & Paper	-1%	-4%	-6%	-7%
Other Energy Intensive Industry	-3%	-9%	-12%	-13%
Other Industry	-2%	-4%	-5%	-5%
Agriculture	0%	0%	0%	0%
Passenger Transport	0%	-21%	-32%	-36%
Freight Transport	0%	0%	0%	0%
Power Sector	0%	0%	-2%	-3%
Waste & Wastewater	0%	0%	0%	0%
<b>Total Gross Emissions</b>	<b>-1%</b>	<b>-4%</b>	<b>-7%</b>	<b>-8%</b>
Land Use - Forestry	0%	0%	0%	0%
<b>Total Net Emissions</b>	<b>-1%</b>	<b>-5%</b>	<b>-8%</b>	<b>-9%</b>

**Notes:**

- Carbon sequestration from land use is based on the estimate of carbon sequestration in forestry lands presented in the report prepared for the Task Force by Winrock International. This sink was not included in the WRI inventory.

### Wisconsin GHG Emissions - High Energy Prices Policy Case 01



NOTE – Graph shows gross emissions without sequestration (8.2 Mt/year)

### High Energy Price Policy Case 01 GHG Emissions - 2024

