NEXT ENERGY
ECONOMIC SECURITY THROUGH ENERGY DIVERSITY

A Study of Economic Impacts from the Implementation of a Renewable Portfolio Standard and an Energy Efficiency Program in Michigan

Produced by: NextEnergy
Prepared for: Michigan Department of Environmental Quality (MDEQ)

APPENDICES

April, 2007

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APPENDIX A – Generation Data Tables

Table A - Michigan Electric Sales (GWh)

	Base Case	EE1	EE2	RPS1	RPS2	RPS1-EE1	RPS2-EE2
2006	111,096	111,096	111,096	111,097	111,097	111,097	111,097
2007	112,323	111,894	111,585	112,327	112,327	111,899	111,588
2008	114,036	113,183	112,554	114,036	114,036	113,183	112,552
2009	115,291	114,005	113,057	115,286	115,286	113,997	113,048
2010	116,404	114,689	113,424	116,385	116,385	114,668	113,398
2011	118,506	116,358	114,768	118,473	118,473	116,321	114,729
2012	120,588	118,004	116,087	120,527	120,526	117,941	116,016
2013	122,554	119,538	117,294	122,460	122,459	119,440	117,184
2014	124,564	121,113	118,542	124,434	124,433	120,976	118,392
2015	126,620	122,730	119,836	126,447	126,446	122,554	119,650
2016	126,776	122,457	119,248	126,562	126,573	122,239	119,035
2017	127,089	122,347	118,820	126,835	126,841	122,091	118,563
2018	128,876	123,709	119,860	128,585	128,566	123,421	119,545
2019	130,792	125,207	121,034	130,464	130,409	124,884	120,639
2020	132,723	126,707	122,209	132,362	132,252	126,350	121,718
2021	134,920	128,462	123,641	134,532	134,343	128,082	123,034
2022	136,796	129,895	124,746	136,390	136,104	129,488	124,010
2023	138,695	131,351	125,868	138,287	137,896	130,927	124,998
2024	140,789	132,998	127,162	140,314	139,789	132,561	126,153
2025	142,894	134,716	128,528	142,394	141,698	134,275	127,368

Table B - Michigan Generation Capacity (MW)

	Base Case	EE1	EE2	RPS1	RPS2	RPS1-EE1	RPS2-EE2
2006	27,475	27,475	27,475	27,475	27,475	27,475	27,475
2007	27,475	27,475	27,475	27,513	27,513	27,513	27,513
2008	27,955	27,475	27,475	28,140	28,140	27,660	27,660
2009	28,115	27,475	27,475	28,213	28,213	27,733	27,733
2010	28,435	27,635	27,475	28,633	28,633	27,833	27,833
2011	28,755	27,955	27,795	28,899	28,899	28,099	27,939
2012	29,415	28,615	28,455	29,737	29,737	28,777	28,687
2013	30,014	29,054	28,394	30,322	30,322	29,362	28,772
2014	30,674	29,054	28,394	30,930	30,930	29,470	28,880
2015	30,925	29,305	28,805	31,291	31,291	29,581	29,151
2016	31,700	29,580	29,080	32,182	32,182	29,972	29,542
2017	32,098	29,978	29,478	32,602	32,790	30,392	30,400
2018	32,436	30,816	29,816	32,964	33,632	31,254	31,242
2019	33,390	31,270	30,270	33,944	35,105	31,734	31,875
2020	33,735	31,615	30,615	34,137	35,805	32,107	32,755
2021	34,333	32,033	31,213	34,760	36,968	32,390	33,918
2022	35,064	32,764	31,944	35,516	38,017	33,146	34,967
2023	35,737	33,437	32,277	36,217	39,268	33,847	35,718
2024	35,737	33,437	32,277	36,217	39,268	33,847	35,718
2025	35,737	33,437	32,277	36,217	39,268	33,847	35,718

APPENDIX A (cont.)

Table C - Base Case Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,142	2,361	3,279	148	96,597
2008	67,299	14,368	7,322	1,962	3,279	148	94,378
2009	67,299	14,368	6,705	1,812	3,279	148	93,611
2010	67,299	14,368	6,549	1,807	3,279	148	93,450
2011	67,299	14,368	9,682	2,702	3,279	148	97,478
2012	70,263	14,368	9,947	2,793	3,279	148	100,797
2013	73,226	14,368	11,750	3,266	3,279	148	106,036
2014	76,189	14,368	11,288	3,171	3,279	148	108,444
2015	77,908	14,368	11,429	3,220	3,279	148	110,352
2016	83,772	14,368	9,122	2,603	3,279	148	113,292
2017	85,658	14,368	9,175	2,628	3,279	148	115,255
2018	87,493	14,368	10,211	2,955	3,279	148	118,453
2019	91,921	14,368	10,229	2,960	3,279	148	122,904
2020	93,827	14,368	11,013	3,208	3,279	148	125,843
2021	97,882	14,368	10,390	3,036	3,279	148	129,102
2022	101,502	14,368	10,042	2,929	3,279	148	132,267
2023	104,990	14,368	9,286	2,695	3,279	148	134,766
2024	106,520	14,368	9,543	2,776	3,279	148	136,633
2025	107,052	14,368	10,341	2,912	3,279	148	138,100

Table D - Case EE1 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,076	2,344	3,279	148	96,514
2008	67,299	14,368	7,189	1,851	3,279	148	94,134
2009	67,299	14,368	6,531	1,679	3,279	148	93,305
2010	67,299	14,368	6,340	1,650	3,279	148	93,084
2011	67,299	14,368	7,764	2,057	3,279	148	94,915
2012	70,263	14,368	9,661	2,585	3,279	148	100,303
2013	73,226	14,368	10,362	2,730	3,279	148	104,112
2014	73,226	14,368	10,059	2,664	3,279	148	103,743
2015	74,945	14,368	10,270	2,730	3,279	148	105,739
2016	77,846	14,368	9,240	2,475	3,279	148	107,355
2017	79,716	14,368	9,559	2,572	3,279	148	109,642
2018	83,471	14,368	8,858	2,374	3,279	148	112,498
2019	85,664	14,368	8,778	2,352	3,279	148	114,588
2020	87,410	14,368	9,127	2,450	3,279	148	116,782
2021	89,221	14,368	8,983	2,474	3,279	148	118,473
2022	92,676	14,368	8,769	2,413	3,279	148	121,652
2023	95,999	14,368	9,310	2,574	3,279	148	125,679
2024	97,364	14,368	9,980	2,770	3,279	148	127,909
2025	97,747	14,368	10,582	3,012	3,279	148	129,136

APPENDIX A (cont.)

Table E - Case EE2 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,061	2,340	3,279	148	96,495
2008	67,299	14,368	7,141	1,838	3,279	148	94,073
2009	67,299	14,368	6,456	1,660	3,279	148	93,210
2010	67,299	14,368	6,246	1,605	3,279	148	92,945
2011	67,299	14,368	7,166	1,883	3,279	148	94,143
2012	70,263	14,368	8,541	2,249	3,279	148	98,847
2013	70,263	14,368	10,658	2,788	3,279	148	101,504
2014	70,263	14,368	10,136	2,665	3,279	148	100,858
2015	71,981	14,368	10,279	2,737	3,279	148	102,792
2016	74,882	14,368	9,111	2,445	3,279	148	104,233
2017	76,342	14,368	9,618	2,589	3,279	148	106,343
2018	77,904	14,368	9,446	2,541	3,279	148	107,685
2019	79,981	14,368	9,314	2,503	3,279	148	109,593
2020	81,612	14,368	9,609	2,586	3,279	148	111,602
2021	85,389	14,368	8,562	2,303	3,279	148	114,048
2022	88,726	14,368	8,225	2,209	3,279	148	116,954
2023	89,852	14,368	9,643	2,642	3,279	148	119,933
2024	91,091	14,368	10,242	2,847	3,279	148	121,975
2025	91,353	14,368	10,784	3,073	3,279	148	123,005

Table F - Case RPS1 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,121	2,355	3,521	148	96,812
2008	67,299	14,368	7,215	1,933	4,223	148	95,187
2009	67,299	14,368	6,547	1,747	4,749	148	94,859
2010	67,299	14,368	6,324	1,723	5,333	148	95,195
2011	67,299	14,368	8,760	2,409	5,934	148	98,919
2012	70,263	14,368	9,581	2,635	6,650	148	103,644
2013	73,226	14,368	10,721	2,916	7,271	148	108,650
2014	76,189	14,368	9,691	2,654	7,806	148	110,856
2015	77,908	14,368	9,574	2,628	8,332	148	112,958
2016	82,205	14,368	7,106	1,979	8,878	148	114,685
2017	83,884	14,368	7,832	2,152	8,987	148	117,371
2018	85,674	14,368	8,796	2,425	9,102	148	120,513
2019	90,053	14,368	9,030	2,495	9,233	148	125,327
2020	89,830	14,368	10,341	2,942	9,369	148	126,998
2021	93,842	14,368	9,685	2,762	9,493	148	130,299
2022	97,421	14,368	7,873	2,208	9,615	148	131,633
2023	100,865	14,368	7,765	2,195	9,754	148	135,095
2024	102,334	14,368	8,481	2,413	9,896	148	137,641
2025	102,824	14,368	9,491	2,608	10,019	148	139,458

APPENDIX A (cont.)

Table G - Case RPS2 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,121	2,355	3,521	148	96,812
2008	67,299	14,368	7,215	1,933	4,223	148	95,187
2009	67,299	14,368	6,547	1,747	4,749	148	94,859
2010	67,299	14,368	6,324	1,723	5,333	148	95,195
2011	67,299	14,368	8,760	2,409	5,934	148	98,919
2012	70,263	14,368	9,581	2,635	6,650	148	103,644
2013	73,226	14,368	10,721	2,916	7,271	148	108,650
2014	76,189	14,368	9,691	2,654	7,806	148	110,856
2015	77,908	14,368	9,574	2,628	8,332	148	112,958
2016	82,208	14,368	7,110	1,981	8,878	148	114,693
2017	82,526	14,368	7,977	2,191	10,065	148	117,274
2018	83,956	14,368	8,640	2,378	11,360	148	120,850
2019	87,962	14,368	8,629	2,375	12,702	148	126,184
2020	87,353	14,368	9,688	2,741	14,085	148	128,384
2021	90,945	14,368	8,620	2,443	15,538	148	132,062
2022	93,060	14,368	7,790	2,216	16,994	148	134,575
2023	96,074	14,368	5,586	1,579	18,485	148	136,240
2024	96,044	14,368	6,274	1,790	20,034	148	138,658
2025	96,050	14,368	6,671	1,839	21,631	148	140,706

Table H - Case EE2RPS2 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,054	2,338	3,521	148	96,729
2008	67,299	14,368	7,081	1,823	4,223	148	94,943
2009	67,299	14,368	6,363	1,635	4,749	148	94,563
2010	67,299	14,368	6,112	1,570	5,333	148	94,830
2011	67,299	14,368	6,833	1,775	5,934	148	96,358
2012	70,263	14,368	8,325	2,149	6,650	148	101,902
2013	73,226	14,368	8,983	2,313	7,271	148	106,309
2014	73,226	14,368	8,444	2,181	7,806	148	106,173
2015	73,463	14,368	8,906	2,304	8,332	148	107,521
2016	75,381	14,368	8,273	2,143	8,878	148	109,191
2017	76,903	14,368	8,342	2,162	8,987	148	110,910
2018	80,614	14,368	8,172	2,116	9,102	148	114,520
2019	82,759	14,368	8,132	2,105	9,233	148	116,747
2020	84,454	14,368	8,188	2,120	9,369	148	118,648
2021	86,224	14,368	7,922	2,078	9,493	148	120,233
2022	89,634	14,368	7,624	1,998	9,615	148	123,387
2023	92,910	14,368	8,268	2,175	9,754	148	127,624
2024	94,227	14,368	8,890	2,344	9,896	148	129,874
2025	94,574	14,368	9,497	2,571	10,019	148	131,177

APPENDIX A (cont.)

Table I - Case EE2RPS2 Generation Mix (GWh)

	Coal	Nuclear	Gas	Oil	Renewable	Pumped Hydro	TOTAL
2006	67,299	14,368	15,035	3,867	3,279	148	103,996
2007	67,299	14,368	9,039	2,334	3,521	148	96,709
2008	67,299	14,368	7,033	1,810	4,223	148	94,882
2009	67,299	14,368	6,288	1,616	4,749	148	94,468
2010	67,299	14,368	6,009	1,543	5,333	148	94,701
2011	67,299	14,368	6,278	1,613	5,934	148	95,641
2012	68,781	14,368	8,325	2,169	6,650	148	100,442
2013	68,781	14,368	9,850	2,556	7,271	148	102,974
2014	68,781	14,368	9,018	2,352	7,806	148	102,473
2015	69,018	14,368	9,350	2,468	8,332	148	103,684
2016	71,084	14,368	8,541	2,262	8,878	148	105,281
2017	72,168	14,368	8,812	2,337	10,065	148	107,898
2018	73,325	14,368	8,407	2,225	11,360	148	109,833
2019	72,905	14,368	8,527	2,280	12,702	148	110,931
2020	74,096	14,368	8,648	2,315	14,085	148	113,661
2021	77,405	14,368	7,616	2,035	15,538	148	117,111
2022	79,234	14,368	7,611	2,037	16,994	148	120,392
2023	79,879	14,368	7,577	2,038	18,485	148	122,495
2024	79,579	14,368	8,036	2,218	20,034	148	124,384
2025	79,322	14,368	8,150	2,280	21,631	148	125,899

APPENDIX B – Michigan Economic Impact Tables

Table J – REMI Projected Michigan Gross Regional Product

	BASE CASE	EE1			EE2			RPS1			RPS2			EE1RPS1			EE2RPS2		
			Case			Case			Case			Case			Case			Case	
	TOTAL ($Bil)	TOTAL ($Bil)	($,Mil)	PERCENT	TOTAL ($Bil)	($,Mil)	PERCENT	TOTAL ($Bil)	($,Mil)	PERCENT	TOTAL ($Bil)	($,Mil)	PERCENT	TOTAL ($Bil)	($,Mil)	PERCENT	TOTAL ($Bil)	($,Mil)	PERCENT
2006	$391.89	$391.89	$0.00	0.000%	$391.89	$0.00	0.000%	$391.89	$5.95	0.002%	$391.89	$5.95	0.002%	$391.89	$5.95	0.002%	$391.89	$5.95	0.002%
2007	$407.83	$407.86	$30.30	0.007%	$407.87	$34.85	0.009%	$407.86	$28.56	0.007%	$407.86	$28.56	0.007%	$407.89	$58.69	0.014%	$407.90	$66.07	0.016%
2008	$423.16	$423.19	$28.93	0.007%	$423.18	$19.62	0.005%	$423.20	$37.29	0.009%	$423.20	$37.29	0.009%	$423.23	$69.40	0.016%	$423.22	$62.87	0.015%
2009	$437.21	$437.24	$23.32	0.005%	$437.22	$10.56	0.002%	$437.25	$35.43	0.008%	$437.25	$35.43	0.008%	$437.27	$58.14	0.013%	$437.27	$51.48	0.012%
2010	$451.04	$451.07	$30.21	0.007%	$451.06	$18.34	0.004%	$451.08	$42.36	0.009%	$451.08	$42.36	0.009%	$451.10	$61.22	0.014%	$451.09	$51.51	0.011%
2011	$464.15	$464.17	$22.95	0.005%	$464.16	$15.17	0.003%	$464.20	$56.00	0.012%	$464.20	$56.00	0.012%	$464.21	$67.02	0.014%	$464.21	$64.70	0.014%
2012	$477.09	$477.11	$26.64	0.006%	$477.10	$14.86	0.003%	$477.15	$60.67	0.013%	$477.14	$53.25	0.011%	$477.16	$77.48	0.016%	$477.16	$75.71	0.016%
2013	$486.89	$486.93	$42.72	0.009%	$486.91	$21.76	0.004%	$486.93	$43.12	0.009%	$486.93	$35.40	0.007%	$486.97	$83.31	0.017%	$486.95	$60.52	0.012%
2014	$496.85	$496.88	$31.10	0.006%	$496.88	$31.16	0.006%	$496.89	$36.47	0.007%	$496.88	$28.63	0.006%	$496.91	$61.28	0.012%	$496.89	$42.60	0.009%
2015	$506.84	$506.90	$54.81	0.011%	$506.91	$61.68	0.012%	$506.86	$19.56	0.004%	$506.86	$11.63	0.002%	$506.92	$76.60	0.015%	$506.90	$60.94	0.012%
2016	$515.75	$515.80	$42.60	0.008%	$515.82	$71.04	0.014%	$515.75	($3.66)	(0.001%)	$515.80	$50.72	0.010%	$515.80	$48.58	0.009%	$515.87	$113.80	0.022%
2017	$524.46	$524.53	$70.86	0.014%	$524.57	$110.20	0.021%	$524.43	($31.80)	(0.006%)	$524.54	$79.22	0.015%	$524.51	$48.95	0.009%	$524.64	$181.90	0.035%
2018	$533.07	$533.16	$89.48	0.017%	$533.19	$117.00	0.022%	$533.03	($40.71)	(0.008%)	$533.15	$80.02	0.015%	$533.13	$60.79	0.011%	$533.26	$184.10	0.035%
2019	$541.71	$541.79	$83.92	0.015%	$541.84	$131.80	0.024%	$541.67	($41.02)	(0.008%)	$541.78	$66.71	0.012%	$541.76	$49.68	0.009%	$541.88	$170.10	0.031%
2020	$550.30	$550.42	$117.40	0.021%	$550.47	$164.30	0.030%	$550.25	($52.06)	(0.009%)	$550.35	$46.51	0.008%	$550.38	$75.32	0.014%	$550.50	$195.10	0.035%

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Appendix B (cont.)

Table K – REMI Projected Michigan Employment Levels

	BASE CASE	EE1			EE2			RPS1			RPS2			EE1RPS1			EE2RPS2		
			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case	
	TOTAL (,000)	TOTAL (,000)	CHANGE	PERCENT	TOTAL (,000)	CHANGE	PERCENT	TOTAL (,000)	CHANGE	PERCENT	TOTAL (,000)	CHANGE	PERCENT	TOTAL (,000)	CHANGE	PERCENT	TOTAL (,000)	CHANGE	PERCENT
2006	5,604.7	5,604.7	0	0.000%	5,604.7	0	0.000%	5,604.7	0	0.000%	5,604.7	0	0.000%	5,604.7	0	0.000%	5,604.7	0	0.000%
2007	5,667.8	5,668.1	322	0.006%	5,668.3	540	0.010%	5,668.2	420	0.007%	5,668.2	420	0.007%	5,668.5	743	0.013%	5,668.6	834	0.015%
2008	5,713.8	5,714.2	363	0.006%	5,714.2	357	0.006%	5,714.3	504	0.009%	5,714.3	504	0.009%	5,714.8	928	0.016%	5,714.6	792	0.014%
2009	5,748.0	5,748.2	260	0.005%	5,748.2	208	0.004%	5,748.4	482	0.008%	5,748.4	482	0.008%	5,748.7	715	0.012%	5,748.6	592	0.010%
2010	5,776.0	5,776.4	397	0.007%	5,776.4	385	0.007%	5,776.5	498	0.009%	5,776.5	498	0.009%	5,776.7	724	0.013%	5,776.6	558	0.010%
2011	5,798.3	5,798.6	270	0.005%	5,798.6	320	0.006%	5,799.0	651	0.011%	5,799.0	651	0.011%	5,799.0	727	0.013%	5,799.0	716	0.012%
2012	5,814.4	5,814.7	274	0.005%	5,814.8	348	0.006%	5,815.1	630	0.011%	5,815.0	514	0.009%	5,815.2	780	0.013%	5,815.2	771	0.013%
2013	5,850.5	5,851.0	531	0.009%	5,850.9	386	0.007%	5,850.9	418	0.007%	5,850.8	297	0.005%	5,851.4	906	0.015%	5,851.2	693	0.012%
2014	5,884.6	5,885.0	398	0.007%	5,885.1	548	0.009%	5,884.9	340	0.006%	5,884.8	218	0.004%	5,885.2	648	0.011%	5,885.1	512	0.009%
2015	5,917.0	5,917.7	707	0.012%	5,918.0	935	0.016%	5,917.1	83	0.001%	5,917.0	(39)	(0.001%)	5,917.9	886	0.015%	5,917.9	843	0.014%
2016	5,935.2	5,935.8	628	0.011%	5,936.4	1,158	0.020%	5,935.0	(180)	(0.003%)	5,935.7	451	0.008%	5,935.8	635	0.011%	5,936.9	1,662	0.028%
2017	5,949.8	5,950.8	999	0.017%	5,951.4	1,594	0.027%	5,949.4	(452)	(0.008%)	5,950.6	713	0.012%	5,950.6	756	0.013%	5,952.2	2,382	0.040%
2018	5,961.6	5,962.7	1,144	0.019%	5,963.1	1,571	0.026%	5,961.0	(511)	(0.009%)	5,962.3	733	0.012%	5,962.4	875	0.015%	5,963.9	2,349	0.039%
2019	5,972.6	5,973.7	1,107	0.019%	5,974.3	1,728	0.029%	5,972.2	(427)	(0.007%)	5,973.2	580	0.010%	5,973.4	827	0.014%	5,974.8	2,173	0.036%
2020	5,982.2	5,983.6	1,381	0.023%	5,984.2	1,979	0.033%	5,981.7	(436)	(0.007%)	5,982.5	358	0.006%	5,983.2	1,054	0.018%	5,984.5	2,313	0.039%

Appendix B (cont.)

Table L - REMI Projected Michigan Real Net Disposable Personal Income

	BASE CASE	EE1			EE2			RPS1			RPS2			EE1RPS1			EE2RPS2		
			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case			Difference from Base Case	
	TOTAL ($Bil)	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT	TOTAL ($Bil)	CHANGE ($,Mil)	PERCENT
2006	$293.80	$293.80	$0.00	0.000%	$293.80	$0.00	0.000%	$293.80	$0.00	0.000%	$293.80	$0.00	0.000%	$293.80	$0.00	0.000%	$293.80	$0.00	0.000%
2007	$305.21	$305.22	$11.72	0.004%	$305.23	$22.67	0.007%	$305.22	$12.57	0.004%	$305.22	$13.31	0.004%	$305.23	$24.41	0.008%	$305.24	$31.34	0.010%
2008	$313.67	$313.69	$23.10	0.007%	$313.70	$28.66	0.009%	$313.68	$12.97	0.004%	$313.68	$13.98	0.004%	$313.71	$38.12	0.012%	$313.71	$39.22	0.013%
2009	$321.35	$321.37	$20.94	0.007%	$321.37	$26.25	0.008%	$321.36	$13.95	0.004%	$321.36	$14.43	0.004%	$321.38	$32.04	0.010%	$321.38	$34.42	0.011%
2010	$328.75	$328.78	$31.19	0.009%	$328.79	$40.10	0.012%	$328.76	$7.42	0.002%	$328.76	$9.37	0.003%	$328.78	$34.42	0.010%	$328.78	$35.95	0.011%
2011	$335.97	$335.99	$29.88	0.009%	$336.00	$39.79	0.012%	$335.97	$9.80	0.003%	$335.98	$12.88	0.004%	$336.00	$32.41	0.010%	$336.01	$41.02	0.012%
2012	$342.82	$342.85	$31.98	0.009%	$342.87	$43.15	0.013%	$342.82	($0.52)	0.000%	$342.82	$0.09	0.000%	$342.85	$28.14	0.008%	$342.85	$31.62	0.009%
2013	$349.15	$349.20	$46.57	0.013%	$349.21	$53.59	0.015%	$349.14	($9.40)	(0.003%)	$349.14	($8.88)	(0.003%)	$349.19	$33.14	0.009%	$349.19	$35.06	0.010%
2014	$355.78	$355.83	$46.14	0.013%	$355.84	$63.11	0.018%	$355.76	($17.88)	(0.005%)	$355.76	($16.30)	(0.005%)	$355.80	$23.56	0.007%	$355.81	$28.87	0.008%
2015	$362.60	$362.65	$57.43	0.016%	$362.68	$82.24	0.023%	$362.56	($34.58)	(0.010%)	$362.56	($31.92)	(0.009%)	$362.62	$27.37	0.008%	$362.64	$41.81	0.012%
2016	$369.21	$369.28	$68.60	0.019%	$369.33	$112.90	0.031%	$369.16	($49.35)	(0.013%)	$369.20	($16.57)	(0.004%)	$369.24	$24.69	0.007%	$369.30	$87.40	0.024%
2017	$375.99	$376.08	$91.09	0.024%	$376.13	$140.20	0.037%	$375.92	($61.19)	(0.016%)	$375.97	($17.94)	(0.005%)	$376.02	$38.27	0.010%	$376.10	$111.10	0.030%
2018	$382.81	$382.91	$103.00	0.027%	$382.96	$151.40	0.040%	$382.74	($67.57)	(0.018%)	$382.78	($24.23)	(0.006%)	$382.86	$47.73	0.012%	$382.92	$114.50	0.030%
2019	$389.82	$389.94	$117.30	0.030%	$389.99	$170.20	0.044%	$389.76	($66.68)	(0.017%)	$389.79	($37.51)	(0.010%)	$389.88	$60.30	0.015%	$389.93	$107.30	0.028%
2020	$396.94	$397.06	$120.90	0.030%	$397.12	$180.40	0.045%	$396.87	($66.62)	(0.017%)	$396.88	($57.89)	(0.015%)	$397.00	$61.95	0.016%	$397.03	$92.25	0.023%

NEXTENERGY

Appendix B (cont.)
Table M - REMI Projected Michigan Real Disposable Personal Income (per capita basis)

	BASE CASE		EE1				EE2				RPS1			
				Per Capita Income				Per Capita Income				Per Capita Income		
	Population (thous)	Per Capita Income	Population (thous)	Projected	Change	Percent Change	Population (thous)	Projected	Change	Percent Change	Population (thous)	Projected	Change	Percent Change
2006	10,114	$29,047	10,114	$29,047	$0.00	0.000%	10,114	$29,047	$0.00	0.000%	10,114	$29,048	$0.23	0.001%
2007	10,134	$30,119	10,134	$30,120	$0.95	0.003%	10,134	$30,121	$1.86	0.006%	10,134	$30,120	$0.94	0.003%
2008	10,156	$30,885	10,156	$30,887	$1.76	0.006%	10,156	$30,887	$2.11	0.007%	10,156	$30,886	$0.75	0.002%
2009	10,181	$31,565	10,181	$31,566	$1.33	0.004%	10,181	$31,566	$1.64	0.005%	10,181	$31,565	$0.64	0.002%
2010	10,206	$32,210	10,207	$32,212	$1.99	0.006%	10,207	$32,212	$2.58	0.008%	10,207	$32,210	($0.10)	0.000%
2011	10,233	$32,833	10,233	$32,834	$1.61	0.005%	10,233	$32,835	$2.20	0.007%	10,233	$32,833	($0.03)	0.000%
2012	10,259	$33,416	10,260	$33,417	$1.57	0.005%	10,260	$33,418	$2.18	0.007%	10,260	$33,415	($1.04)	(0.003%)
2013	10,293	$33,920	10,294	$33,923	$2.53	0.007%	10,294	$33,923	$2.75	0.008%	10,294	$33,918	($1.74)	(0.005%)
2014	10,334	$34,428	10,335	$34,430	$2.14	0.006%	10,335	$34,431	$3.12	0.009%	10,334	$34,425	($2.33)	(0.007%)
2015	10,380	$34,932	10,381	$34,934	$2.70	0.008%	10,381	$34,936	$4.16	0.012%	10,380	$34,928	($3.47)	(0.010%)
2016	10,431	$35,396	10,432	$35,400	$3.21	0.009%	10,432	$35,402	$6.00	0.017%	10,431	$35,392	($4.28)	(0.012%)
2017	10,486	$35,856	10,487	$35,860	$4.52	0.013%	10,488	$35,863	$7.24	0.020%	10,486	$35,851	($4.69)	(0.013%)
2018	10,545	$36,303	10,546	$36,307	$4.79	0.013%	10,547	$36,310	$7.05	0.019%	10,544	$36,298	($4.61)	(0.013%)
2019	10,607	$36,751	10,609	$36,756	$5.24	0.014%	10,610	$36,759	$7.50	0.020%	10,606	$36,747	($3.99)	(0.011%)
2020	10,672	$37,196	10,674	$37,200	$4.70	0.013%	10,675	$37,203	$7.15	0.019%	10,671	$37,192	($3.54)	(0.010%)

	RPS2				EE1RPS1				EE2RPS2					
		Per Capita Income				Per Capita Income				Per Capita Income				
	Population (thous)	Projected	Change	Percent Change	Population (thous)	Projected	Change	Percent Change	Population (thous)	Projected	Change	Percent Change		
2006	10,114	$29,048	$0.24	0.001%	10,114	$29,048	$0.23	0.001%	10,114	$29,048	$0.23	0.001%		
2007	10,134	$30,120	$1.01	0.003%	10,134	$30,121	$1.91	0.006%	10,134	$30,121	$2.49	0.008%		
2008	10,156	$30,886	$0.84	0.003%	10,156	$30,888	$2.67	0.009%	10,156	$30,888	$2.72	0.009%		
2009	10,181	$31,565	$0.68	0.002%	10,181	$31,566	$1.71	0.005%	10,181	$31,566	$1.90	0.006%		
2010	10,207	$32,210	$0.09	0.000%	10,207	$32,211	$1.59	0.005%	10,207	$32,212	$1.72	0.005%		
2011	10,233	$32,833	$0.27	0.001%	10,233	$32,834	$1.11	0.003%	10,233	$32,835	$1.81	0.006%		
2012	10,260	$33,415	($0.90)	-0.003%	10,260	$33,416	$0.47	0.001%	10,260	$33,416	$0.64	0.002%		
2013	10,294	$33,919	($1.54)	-0.005%	10,294	$33,921	$0.67	0.002%	10,294	$33,921	$0.72	0.002%		
2014	10,334	$34,426	($1.97)	-0.006%	10,335	$34,427	($0.33)	(0.001%)	10,335	$34,428	($0.00)	0.000%		
2015	10,380	$34,929	($2.96)	-0.008%	10,381	$34,932	($0.16)	0.000%	10,381	$34,933	$0.87	0.002%		
2016	10,431	$35,395	($1.37)	-0.004%	10,432	$35,396	($0.50)	(0.001%)	10,432	$35,401	$4.15	0.012%		
2017	10,486	$35,854	($1.42)	-0.004%	10,487	$35,856	$0.53	0.001%	10,488	$35,861	$5.03	0.014%		
2018	10,545	$36,301	($1.85)	-0.005%	10,546	$36,304	$1.06	0.003%	10,547	$36,307	$4.19	0.012%		
2019	10,607	$36,748	($2.74)	-0.007%	10,608	$36,753	$1.80	0.005%	10,609	$36,754	$2.66	0.007%		
2020	10,671	$37,192	($4.04)	-0.011%	10,673	$37,197	$1.49	0.004%	10,674	$37,196	$0.64	0.002%		

APPENDIX C – Projected CO$_2$ Emissions

Table N - CO2 Emissions

	BASE CASE	EE1			EE2			RPS1			RPS2			EE1RPS1			EE2RPS2		
	TOTAL	TOTAL	Difference from Base Case		TOTAL	Difference from Base Case		TOTAL	Difference from Base Case		TOTAL	Difference from Base Case		TOTAL	Difference from Base Case		TOTAL	Difference from Base Case	
			REDUCTION (ktons/Year)	PERCENT		REDUCTION (ktons/Year)	PERCENT		REDUCTION (ktons/Year)	PERCENT		REDUCTION (ktons/Year)	PERCENT		REDUCTION (ktons/Year)	PERCENT		REDUCTION (ktons/Year)	PERCENT
	(Kilotons)	(Kilotons)			(Kilotons)			(Kilotons)			(Kilotons)			(Kilotons)			(Kilotons)		
2006	188,737	188,737	0	0.00%	188,737	0	0.00%	188,738	0	0.00%	188,738	0	0.00%	188,738	0	0.00%	188,738	0	0.00%
2007	189,480	189,426	54	0.03%	189,416	64	0.03%	189,465	15	0.01%	189,465	15	0.01%	189,413	68	0.04%	189,400	80	0.04%
2008	191,376	191,219	157	0.08%	191,173	203	0.11%	191,278	98	0.05%	191,278	98	0.05%	191,121	255	0.13%	191,073	302	0.16%
2009	193,947	193,723	225	0.12%	193,646	301	0.16%	193,775	173	0.09%	193,775	173	0.09%	193,553	394	0.20%	193,475	472	0.24%
2010	194,212	194,040	172	0.09%	193,933	279	0.14%	194,060	152	0.08%	194,060	152	0.08%	193,793	419	0.22%	193,595	617	0.32%
2011	196,729	195,029	1,700	0.86%	194,610	2,119	1.08%	196,100	629	0.32%	196,100	629	0.32%	194,325	2,405	1.22%	193,933	2,797	1.42%
2012	199,032	198,704	328	0.16%	197,529	1,503	0.76%	198,599	434	0.22%	198,597	435	0.22%	197,279	1,754	0.88%	196,175	2,857	1.44%
2013	201,293	199,867	1,426	0.71%	197,908	3,385	1.68%	200,417	876	0.44%	200,415	878	0.44%	198,775	2,519	1.25%	196,108	5,186	2.58%
2014	203,119	199,749	3,369	1.66%	197,685	5,434	2.68%	201,820	1,299	0.64%	201,819	1,300	0.64%	198,394	4,724	2.33%	195,517	7,602	3.74%
2015	204,514	201,234	3,280	1.60%	199,125	5,389	2.63%	202,987	1,526	0.75%	202,986	1,528	0.75%	198,949	5,565	2.72%	195,997	8,517	4.16%
2016	207,480	203,030	4,450	2.14%	200,779	6,702	3.23%	204,601	2,879	1.39%	204,615	2,866	1.38%	200,132	7,348	3.54%	197,224	10,256	4.94%
2017	209,134	205,285	3,849	1.84%	202,750	6,384	3.05%	206,295	2,839	1.36%	205,398	3,736	1.79%	201,429	7,706	3.68%	198,357	10,777	5.15%
2018	211,751	207,619	4,132	1.95%	204,066	7,684	3.63%	209,143	2,608	1.23%	207,667	4,084	1.93%	204,226	7,525	3.55%	199,363	12,387	5.85%
2019	215,810	209,942	5,867	2.72%	206,239	9,571	4.43%	212,934	2,875	1.33%	210,886	4,924	2.28%	206,923	8,887	4.12%	199,960	15,850	7.34%
2020	218,735	211,768	6,968	3.19%	207,912	10,824	4.95%	214,894	3,842	1.76%	212,252	6,484	2.96%	208,534	10,202	4.66%	201,082	17,654	8.07%

APPENDIX D – REMI INPUT FRACTIONS

Table O – Capital Cost Fractions

	COAL		GAS PEAKER		GAS COMBINED CYCLE		WIND		BIOMASS		ANAEROBIC DIGESTION		LANDFGILL GAS	
	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State
Forestry et al.														
Agriculture														
Oil, gas extraction	0.30%		0.30%											
Mining (except oil, gas)														
Support activities for mining														
Utilities	1.00%	1.00%												
Construction	27.00%	18.00%	13.00%	10.40%	16.00%	12.80%	13.50%	12.15%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Wood product mfg	1.00%													
Nonmetallic mineral prod mfg														
Primary metal mfg	10.00%		15.00%		18.00%		14.40%	2.88%	10.00%		10.00%		10.00%	
Fabricated metal prod mfg	30.00%		49.60%		42.00%		37.20%	3.72%	27.00%	5.40%	27.00%	5.40%	27.00%	5.40%
Machinery mfg														
Computer, electronic prod mfg	2.00%		1.00%		2.00%		0.90%		3.00%		3.00%		3.00%	
Electrical equip, appliance mfg							16.50%	5.00%	20.00%		20.00%		20.00%	
Motor vehicle mfg														
Transp equip mfg. exc. motor veh														
Furniture, related prod mfg														
Miscellaneous mfg														
Food mfg														
Beverage, tobacco prod mfg														
Textile mills														
Textile prod mills														
Apparel mfg														
Leather, allied prod mfg														
Paper mfg														
Printing, rel supp act														
Petroleum, coal prod mfg														
Chemical mfg	3.00%	0.60%	0.20%	0.04%	0.60%	0.12%			1.00%		1.00%		1.00%	
Plastics, rubber prod mfg	2.00%	0.40%	0.20%	0.04%	0.40%	0.08%								
Wholesale trade														
Retail trade														
Air transportation														
Rail transportation	2.00%	1.00%	2.00%	1.00%	2.00%	1.00%								
Water transportation														
Truck transp; Couriers, msngrs	2.00%	1.00%	2.00%	1.00%	2.00%	1.00%	1.00%	0.50%	1.00%	0.50%	1.00%	0.50%	1.00%	0.50%
Transit, ground pass transp														
Pipeline transportation														
Scenic, sightseeing transp; supp														
Warehousing, storage	2.00%	2.00%					0.90%	0.90%						
Publishing, exc Internet														
Motion picture, sound rec														
Internet serv, data proc, other														
Broadcasting, exc Int; Telecomm								0.00%						
Monetary authorities, et al.	2.60%		2.60%		2.60%		3.00%		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Sec, comm contracts, inv														
Ins carriers, rel act														
Real estate	0.40%	0.40%	0.10%	0.10%	0.10%	0.10%	1.00%	1.00%						
Rental, leasing services														
Prof, tech services	6.30%	1.89%	2.00%	0.80%	2.00%	0.80%	4.30%	4.30%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Mgmnt of companies, enterprises														
Administrative, support services	1.60%	1.00%	4.70%	4.70%	4.70%	4.70%	1.00%	1.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Waste mgmnt, remed services	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%						
Educational services														
Ambulatory health care services														
Hospitals	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Nursing, residential care facilities														
Social assistance														
Performing arts, spectator sports														
Museums et al.														
Amusement, gambling, recreation														
Accommodation	0.20%	0.20%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Food services, drinking places	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Repair, maintenance														
Personal, laundry services														
Membership assoc, organ														
Private households														
State Gov (tax revenues)	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Local Gov (tax revenues)	2.00%		2.00%		2.00%		2.00%		2.00%		2.00%		2.00%	
Federal Civilian														
Federal Military														
Farm														

All figures represent the percentage of total project costs for a single project.
Instate figures are the percentage of total project costs which will be paid to instate businesses and employees

APPENDIX D (cont.)

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Table P - O&M Cost Fractions

	COAL		GAS PEAKER		GAS COMBINED CYCLE		WIND		BIOMASS		ANAEROBIC DIGESTION		LANDFGILL GAS	
	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State	Total	In-State
Forestry et al.														
Agriculture														
Oil, gas extraction														
Mining (except oil, gas)														
Support activities for mining														
Utilities	100.00%	85.00%	100.00%	85.00%	100.00%	85.00%	100.00%	85.00%	100.00%	85.00%	100.00%	85.00%	100.00%	0.85
Construction														
Wood product mfg														
Nonmetallic mineral prod mfg														
Primary metal mfg														
Fabricated metal prod mfg														
Machinery mfg														
Computer, electronic prod mfg														
Electrical equip, appliance mfg														
Motor vehicle mfg														
Transp equip mfg. exc. motor veh														
Furniture, related prod mfg														
Miscellaneous mfg														
Food mfg														
Beverage, tobacco prod mfg														
Textile mills														
Textile prod mills														
Apparel mfg														
Leather, allied prod mfg														
Paper mfg														
Printing, rel supp act														
Petroleum, coal prod mfg														
Chemical mfg														
Plastics, rubber prod mfg														
Wholesale trade														
Retail trade														
Air transportation														
Rail transportation														
Water transportation														
Truck transp; Couriers, msngrs														
Transit, ground pass transp														
Pipeline transportation														
Scenic, sightseeing transp; supp														
Warehousing, storage														
Publishing, exc Internet														
Motion picture, sound rec														
Internet serv, data proc, other														
Broadcasting, exc Int; Telecomm														
Monetary authorities, et al.														
Sec, comm contracts, inv														
Ins carriers, rel act														
Real estate														
Rental, leasing services														
Prof, tech services														
Mgmnt of companies, enterprises														
Administrative, support services														
Waste mgmnt, remed services														
Educational services														
Ambulatory health care services														
Hospitals														
Nursing, residential care facilities														
Social assistance														
Performing arts, spectator sports														
Museums et al.														
Amusement, gambling, recreation														
Accommodation														
Food services, drinking places														
Repair, maintenance														
Personal, laundry services														
Membership assoc, organ														
Private households														
State Gov														
Local Gov														
Federal Civilian														
Federal Military														
Farm														

Table Q - Fuel Cost Fractions

	COAL Total	COAL In-State	GAS PEAKER Total	GAS PEAKER In-State	GAS COMBINED CYCLE Total	GAS COMBINED CYCLE In-State	WIND Total	WIND In-State	BIOMASS Total	BIOMASS In-State	ANAEROBIC DIGESTION Total	ANAEROBIC DIGESTION In-State	LANDFGILL GAS Total	LANDFGILL GAS In-State
Forestry et al.														
Agriculture									100.00%	100.00%	100.00%	100.00%		
Oil, gas extraction			100.00%	0.00%	100.00%	0.00%								
Mining (except oil, gas)														
Support activities for mining														
Utilities	10.00%													
Construction														
Wood product mfg														
Nonmetallic mineral prod mfg														
Primary metal mfg														
Fabricated metal prod mfg														
Machinery mfg														
Computer, electronic prod mfg														
Electrical equip, appliance mfg														
Motor vehicle mfg														
Transp equip mfg. exc. motor veh														
Furniture, related prod mfg														
Miscellaneous mfg														
Food mfg														
Beverage, tobacco prod mfg														
Textile mills														
Textile prod mills														
Apparel mfg														
Leather, allied prod mfg														
Paper mfg														
Printing, rel supp act														
Petroleum, coal prod mfg	50.00%													
Chemical mfg														
Plastics, rubber prod mfg														
Wholesale trade														
Retail trade														
Air transportation														
Rail transportation	40.00%													
Water transportation														
Truck transp; Couriers, msngrs														
Transit, ground pass transp														
Pipeline transportation														
Scenic, sightseeing transp; supp														
Warehousing, storage														
Publishing, exc Internet														
Motion picture, sound rec														
Internet serv, data proc, other														
Broadcasting, exc Int; Telecomm														
Monetary authorities, et al.														
Sec, comm contracts, inv														
Ins carriers, rel act														
Real estate														
Rental, leasing services														
Prof, tech services														
Mgmnt of companies, enterprises														
Administrative, support services														
Waste mgmnt, remed services													100.00%	100.00%
Educational services														
Ambulatory health care services														
Hospitals														
Nursing, residential care facilities														
Social assistance														
Performing arts, spectator sports														
Museums et al.														
Amusement, gambling, recreation														
Accommodation														
Food services, drinking places														
Repair, maintenance														
Personal, laundry services														
Membership assoc, organ														
Private households														
State Gov														
Local Gov														
Federal Civilian														
Federal Military														
Farm														

Table R - Energy Efficiency Cost Allocation

	TOTAL	In-State
Forestry et al.		
Agriculture		
Oil, gas extraction		
Mining (except oil, gas)		
Support activities for mining		
Utilities		
Construction	10.00%	10.00%
Wood product mfg		
Nonmetallic mineral prod mfg		
Primary metal mfg		
Fabricated metal prod mfg		
Machinery mfg		
Computer, electronic prod mfg	25.00%	12.50%
Electrical equip, appliance mfg	30.00%	9.00%
Motor vehicle mfg		
Transp equip mfg. exc. motor veh		
Furniture, related prod mfg		
Miscellaneous mfg		
Food mfg		
Beverage, tobacco prod mfg		
Textile mills		
Textile prod mills		
Apparel mfg		
Leather, allied prod mfg		
Paper mfg		
Printing, rel supp act		
Petroleum, coal prod mfg		
Chemical mfg		
Plastics, rubber prod mfg		
Wholesale trade		
Retail trade	10.00%	10.00%
Air transportation		
Rail transportation		
Water transportation		
Truck transp; Couriers, msngrs		
Transit, ground pass transp		
Pipeline transportation		
Scenic, sightseeing transp; supp		
Warehousing, storage		
Publishing, exc Internet		
Motion picture, sound rec		
Internet serv, data proc, other	5.00%	5.00%
Broadcasting, exc Int; Telecomm		
Monetary authorities, et al.		
Sec, comm contracts, inv		
Ins carriers, rel act		
Real estate		
Rental, leasing services		
Prof, tech services	10.00%	10.00%
Mgmnt of companies, enterprises		
Administrative, support services	5.00%	5.00%
Waste mgmnt, remed services		
Educational services		
Ambulatory health care services		
Hospitals		
Nursing, residential care facilities		
Social assistance		
Performing arts, spectator sports		
Museums et al.		
Amusement, gambling, recreation		
Accommodation		
Food services, drinking places		
Repair, maintenance		
Personal, laundry services		
Membership assoc, organ		
Private households		
State Gov	3.00%	3.00%
Local Gov	2.00%	
Federal Civilian		
Federal Military		
Farm		

APPENDIX E – MODELING TOOLS

1. Energy 2020

ENERGY 2020 is an integrated multi-region energy model that provides complete and detailed, all-fuel demand and supply sector simulations. These simulations can additionally include macroeconomic interactions to determine the benefits or costs to the local economy of new facilities or changing energy prices. The model can be used in regulated as well as deregulated and transitioning environments. It portrays the interaction of market competitors in a realistic, as opposed to an idealized, fashion, including transmission-system market-dynamics. Criteria Air Contaminant and Greenhouse Gas pollution emissions and costs, including allowances and trading, are endogenously determined, thereby allowing assessment of environmental risk and co-benefit impacts. Energy2020 gas been used by numerous utilities, government, and non-governmental organizations, including the U.S. Department of Energy, Environment Canada, Western Resources, Vermont Department of Public Service, Massachusetts Department of Energy Resources, Ontario Ministry of Energy, KN Energy, Minnesota Department of Public Service, Southern California Edison, Duke Energy, US EPA, etc.

ENERGY 2020 is a policy planning model. It contains hundreds of "standard" policy options and literally thousands of policy variables to create new policies. For climate change efforts some generic policy categories include tax incentives/disincentives, exogenous additions to delivered energy prices, new regulations/market structures, grants and rebates, efficiency standards, renewable energy options, consumer awareness, permit trading and consumer behaviours and their responsiveness to various options.

The model is descriptive. It simulates the physical and economic flows of energy users and suppliers. It simulates how they make decisions and how those decisions causally translate to energy-use and emissions. In ENERGY 2020, those decisions include process/shell efficiency and costs decisions, device efficiency and cost decisions, new investment market-share decisions, and utilization decisions. Weather and economic conditions affect utilization as much as the energy price conditions. The actual impacts of the climate change itself can be tested. The model accumulates both process (facility) and device capital stocks, and simulates their retirements. It calculates both the marginal and average costs and efficiencies. Process efficiency (how much energy service the household or factory needs to produce its output) determines the amount of energy that must come out of the devices (furnaces, hot water heaters, refrigerators, lights, etc.). The device efficiency deters the amount of fuel which the device must burn to produce the energy service required. In space heating, for example, the efficiency of the building shell is the process efficiency and determines how much energy must be produced by the furnace. The furnace efficiency is the device efficiency and determines how much natural gas must be burned to produce the heat needed to warm the house.

All demands are "derived." Energy services are needed to produce output. Energy is not a need unto itself. Even transportation is a derived need. The model provides transportation services. The device is the mode used to serve that need. The transportation demands are split into passenger, freight, and off-road. Rail for industry ships freight. Rail for residential transports commuters. The process efficiency determines how much transportation is needed. The model captures the movement of commuters to live near employment or industry to manufacture near demand. Part of the (endogenous) process efficiency also determines whether people take a bicycle, auto, or rapid transit.

APPENDIX E (cont.)

The economic sectors can be added, but the current configuration includes up to three classes of residential, 14 classes of commercial and in the industrial sector 24 manufacturing industries and 10 mining categories plus construction, agriculture and forestry. Each class has 6 to 8 end-uses (process heat, space heat, cooling, lighting, cooking, etc.)

Process costs (endogenously based on energy decisions) and device costs (the marginal costs of using energy from the device) determine the energy choices. These choices maximize the utility of using the energy as determined with the Qualitative Choice Theory (QCT). One important aspect of QCT is that it considers both price and preferences. It includes the extent to which market participants know of or have access to the choice. For example, some people only want large safe cars and efficiency is secondary. Some people live in rural areas and do not have access to natural gas. There may be a new heat pump technology that works well in northern climates but if it is not fully marketed/advertised, few know to select it. All the decisions (their components and information flows) that are relevant to consumer energy choice are endogenously simulated.

Additionally each demand sector, including transportation, has a self-generation sub-sector. These sectors can simulate cogeneration and distributed generation including fuel cells and micro-turbines. Lastly, each demand sector includes a demand for energy feedstocks (solvents, reactants, lubricants, asphalt, etc.)

For the electricity supply sector, each major department and business unit is fully simulated. The model endogenously determines regulatory rate-making or deregulation market-price setting depending on the regulatory regime. Generation is detailed by plant type for each energy supplier. Unit level simulation can be provided but are longer and more expensive. Centralized or decentralized dispatch -- with full accounting of transmission constraints are provided. Demand and supply "occupy" transmission "nodes" and prices can be by node. The end-use demands (for each industry and consumer class) are used to build up seasonal load duration curves. Representative hours from those curves are "dispatched" and integrated to produce season supply and primary energy demands for the utilities. The end-use aspect of the load captured noticeable changes in electric utility operations due to climate change policies that affect one end-use (or industry) more than other. The electric system is simulated as the inter-provincial/international network it actually is. Thus, all trade is accurately and dynamically captured.

The electricity sector simulates new market entrants, deregulation, capacity expansion, mergers and acquisitions, and bankruptcies. Independent power producers (IPPs) and third-party-owned distributed generation are treated as distinct companies. Utility decision making practices are estimated historically. Options allow alternative or mandated rules on new plants or additions. Renewable, as well as, conventional electric generation technologies are simulated.

Refining, primary oil production, primary gas production, coal production, and ethanol production are represented with comparable detail. The existing oil, gas, and coal sectors will determine production based on demand and losses (plus own use of fuels.) Specific production potentials for conventional on-shore and offshore oil and gas are from national sources. The utilization of other technologies (heavy oil, SynCrude, Bitumen, etc.) are then a function of additional demand. The market share (using QCT) can also be a function own-costs. Comparing world crude oil prices to domestic costs, determines total domestic production and, consequently, also net imports. Coal technologies are not explicitly simulated but losses and producer fuel use

are. For all fuels, primary energy prices are converted to delivered product prices at each province or state by considering delivery/conversion costs and any applicable taxes.   Ethanol production is currently a simple representation of the expansion of capacity based on the demand for ethanol. The sector tracks ethanol production, capacity, costs, producer consumption, and emissions.

For energy related pollution, ENERGY 2020 can keep track of the marginal pollution potential of each new consumer and energy suppler investment. These margin changes flow into a stock of embodied pollution that is used to determine the existing emission potential associated with utilizing existing energy-using capital stocks. The pollution is removed with capital stock retirements or retrofitting. The actual pollution is the average pollution potential per unit of output times the actual amount of output (utilization) of the stock. This stock represents the cars, furnaces, power plants, etc. in the economy. Stocks and pollution are calculated by end-use (or plant type or mode), technology family, economics sector, and province.

Additionally, the pollution sectors simulate all forms of allowance trading and auctions. Trading can occur only within single provinces and within single economic sectors. The logic can expand out to include just national industrial or utility sectors. All possibilities out to all-sectors with international trading can be simulated. Because the simulation is behavioural, sometimes market participants under or over estimate their allowance needs and emissions transiently stray above or below goals. The market model iterates on price as based on the balance (or imbalance) of supply and demand. As with any other commodity, the price of allowances is volatile. Some market actors get in positions where they temporarily cannot reduce emissions adequately. Investments take time to produce results. Limited information can further distort the investment process.

ENERGY 2020 has three non-energy emission categories. The simplest category is the feedstocks. Feedstocks are requirements of producing output (just like all energy.) It is a simple function of economic output. A fraction of feedstocks is assumed lost to the environment via burning or natural decomposition. Next are emissions from economic activity and industrial processes such as cement, magnesium, aluminium and nylon manufacture, to name a few. Again, these are functions of economic output. Changes in process functions to reduce these emissions per unit of output as a function of price are determined using marginal abatement cost curves. Last are reversible emissions from crops, forests, and municipal waste. Crops take in CO_2 as they grow. They expel CO_2 and CH_4 as the biomass decays. Crop production can be a net emitter or sink depending on conditions. (Emissions from fertilizer use fall under the category of economic activity emissions.)

ENERGY 2020 uses a stock-and-flow representation to capture both the absorption and decay of biomass. The stock is the sequestered CO_2. Similarly, trees absorb CO_2 as they grow. As a forest matures, the intake is less. As trees die they decay and release emissions. ENERGY 2020 uses a renewable resource regeneration simulation to capture the growth and decay patterns of trees. Losses to paper and lumber are included. Lumber becomes a long lifetime sequestering of CO_2. Paper produces a shorter life sequestering (Emissions from paper production are determined in the paper industry sector).   Municipal solid waste sequesters some biomass but after a time, the decomposition produces CO_2 and methane. Like the crop sector, stocks and flows are used to capture the dynamics and the impacts of policy options.

2. REMI Policy Insights

The Regional Economic Models, Inc. (REMI) Policy Insight model is a general equilibrium model designed to give policy-makers information on the potential economic impacts of various government activities. The model can cover the entire nation, individual states, groups of states, and sub-state regions (i.e. counties and large cities). The particular version that we used treats the state of Michigan as one region. Use of the model for policy analysis follows these four steps:

1. Formulate a policy question.
2. Generate a baseline forecast.
3. Generate an alternative forecast with affected policy variables.
4. Compare the 2 forecasts.

The baseline forecast is created by running a "Control" analysis with the model. The user then runs a policy simulation that uses our specific control as the baseline forecast and compares this to the model output that results from changing policy variables. The output can be displayed as a final level, an absolute change, or a percentage change. For instance, we can show that a policy will result in a total employment level in Michigan of 5,100,000 people, an increase of 100,000, or an increase of 2%. The values are calculated on an annual basis over a user-defined time period, with the model forecasting through the year 2050.

While the model gives a large amount of data as output, the most commonly used output variables are changes in the state employment and gross product. The primary challenge for the user is to translate various strategies into policy input variables that can be entered into the REMI Policy Insight framework. As such, an introduction to the available input variables is useful.

2.1 Input Variables

The input variables for the model fall into the following six categories, with a brief description of each:

1) **Output Block** - The Output Block linkages in the model determine local demand for components of personal consumption which depends on real income, for investment demand which depends on relative factor prices and anticipated economic activity, and for government demand which is influenced by the size of the local population. These demands are translated into industry demand which also depends on the interstate and international exports.

2) **Labor and Capital Demand Block** - The Labor and Capital Demand Block is affected by local Output. However, labor and capital utilization is also determined by Labor Productivity. This in turn depends, in part, on the relative costs of all of the factors of production.

3) **Population and Labor Supply Block** - The Population and Labor Supply Block includes policy variables that directly affect Migration, Participation Rates, Special Populations, Birth and Survival Rates, and Occupational Supply.

4) **Wage, Price, and Profit Block** - The Wage, Price, and Profit Block includes policy variables that directly affect wage rates, the cost of doing business, fuel costs, consumer, housing and land prices, as well as industry prices.

5) **Market Shares Block** - The Market Shares Block includes policy variables that directly affect industries' shares of local and export markets. The share of local markets can be increased by increasing the Regional Purchase Coefficients, which represent the proportion of local demand that is supplied locally. The proportion of national and international markets can be changed using the Export Market Share and Import Market Share variables. These shares can be changed for individual industries or for the entire set of private industries at once.

6) **Fiscal Calibration Block** - The Fiscal Calibration Category includes policy variables that can adjust state and local government revenue and expenditures. The model incorporates the most recent Census of Governments data to obtain the revenue and expenditure amounts for every state government and for the county governments using state averages. Government tax and revenue policy changes must be input as policy variables in the first five blocks.

Within each of these blocks are a number of sub-categories, with these sub-categories further divided into the policy variables. Specific policy variables can be defined in several different ways. Before describing the policy variables, the different ways of defining them should be established. The primary ways are by sector and by share or amount.

2.2 Definition by Sector (Sect)

The REMI model divides the state of Michigan's economy into 66 different sectors. For some variables, it is possible to define the variable for each sector individually. For example, one may want to know what the effect would be of increasing the price of electricity for vehicle manufacturing by 10%. The 62 sectors are listed in Table S, below.

Table S - REMI Economic Sectors

Forestry	Agriculture	Oil/gas extraction	Mining (except oil/gas)
Support activities for mining	Utilities	Construction	Wood product manufacturing
Nonmetallic mineral production manufacturing	Primary metal manufacturing	Fabricated metal product manufacturing	Machinery manufacturing
Computer/electronic product manufacturing	Electrical equipment/appliance manufacturing	Motor Vehicle manufacturing	Transportation equipment (excluding motor vehicle.)
Furniture/related product manufacturing	Miscellaneous manufacturing	Food manufacturing	Beverage/tobacco products manufacturing
Textile mills	Textile product manufacturing	Apparel manufacturing	Leather/Allied product manufacturing
Paper manufacturing	Printing/Related support activity	Petroleum/coal product manufacturing	Chemical manufacturing
Plastics/rubber manufacturing	Wholesale trade	Retail trade	Air transportation
Rail transportation	Water transportation	Truck transportation/ couriers/ messengers	Transit/ground passenger transportation
Pipeline transport	Scenic/ sightseeing transportation/ supply	Warehousing/ storage	Publishing (excluding internet)
Motion picture/sound recording	Internet service/data processing	Broadcasting (excluding internet)/ telecomm	Monetary authority
Security/communication/ contracts	Insurance carriers	Real estate	Rental/leasing services
Professional/technical services	Management of Companies/ Enterprises	Admin/support services	Waste management/ remediation
Educational services	Ambulatory health care services	Hospitals	Nursing/ Residential care facilities
Social assistance	Performing arts/spectator sports	Museums	Amusement/gambling/ recreation
Accommodations	Food services/drinking places	Repair/ Maintenance	Personal/laundry services
Membership associations/organizations	Private households		

2.3 Definition by Industrial or Commercial Enterprises (I/C)

Instead of dividing the economy into the 62 sectors listed above, some variables only make the distinction between industrial and commercial enterprises.

2.4 Consumer Spending (CS)

Consumer spending options are listed in Table T below.

Table T - REMI Consumer Spending Options

Vehicles and Parts	Computers and Furniture	Other Durables
Food and Beverages	Clothing and Shoes	Gasoline and Oil
Fuel Oil and Coal	Other Non-durables	Housing
Household Operation	Transportation	Medical Care
Other Services		

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2.5 Variable Input Methods

Most variables allow the modeler to express the policy in either a change in the share (percentage), the amount (absolute value), or both. This is true when the variable applies to a single sector or to the whole economy. For example, one could express the variable as an increase in the price of electricity of 10% or the equivalent dollar amount, and this can be applied to an individual sector or to the entire state.