

## APPENDIX A | RESIDENTIAL MEASURE DETAIL

DTE (Michigan)		Measure Assumption Tab															
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Per Unit Winter NCP kW	Base Fuel Use	% Fuel Savings	Per unit Fuel Savings	Useful Life	Measure Cost	Measure Description	UCT Ratio
2009	Appliances	ENERGY STAR Dishwasher - gas water heater	SF	All	ROB	135.08	12%	16.28	0.050	0.050	0.8	12%	0.094	10	\$10.00	Installation of high efficiency dishwashers in homes with dishwashers and gas water heaters	7.05
2010	Appliances	Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	SF	All	ROB	241.66	35%	84.00	0.012	0.012	1.4	27%	0.369	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with electric water heating and gas dryers	2.22
2012	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	SF	All	ROB	42.29	39%	16.65	0.002	0.002	2.0	29%	0.598	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and gas dryers	1.25
2013	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	SF	All	ROB	398.73	27%	108.20	0.015	0.015	0.8	35%	0.285	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and electric dryers	2.57
2015	Appliances	ENERGY STAR Gas Clothes Dryers	SF	All	ROB	134.72	18%	24.78	0.088	0.088	2.4	18%	0.444	14	\$152.00	Installation of high efficiency replacement gas clothes dryers	0.36
2021	Appliances	ENERGY STAR Dishwasher - gas water heater	SF	All	NC	135.08	12%	16.28	0.050	0.050	0.8	12%	0.094	10	\$10.00	Installation of high efficiency dishwashers in homes with dishwashers and gas water heaters	7.05
2022	Appliances	Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	SF	All	NC	241.66	35%	84.00	0.012	0.012	1.4	27%	0.369	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with electric water heating and gas dryers	2.22
2024	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	SF	All	NC	42.29	39%	16.65	0.002	0.002	2.0	29%	0.598	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and gas dryers	1.25
2025	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	SF	All	NC	398.73	27%	108.20	0.015	0.015	0.8	35%	0.285	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and electric dryers	2.57
2027	Appliances	ENERGY STAR Gas Clothes Dryers	SF	All	NC	134.72	18%	24.78	0.088	0.088	2.4	18%	0.444	14	\$152.00	Installation of high efficiency replacement gas clothes dryers	0.36
2037	Appliances	ENERGY STAR Dishwasher - gas water heater	MF	All	ROB	135.08	12%	16.28	0.050	0.050	0.8	12%	0.094	10	\$10.00	Installation of high efficiency dishwashers in homes with dishwashers and gas water heaters	7.05
2038	Appliances	Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	MF	All	ROB	241.66	35%	84.00	0.012	0.012	1.4	27%	0.369	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with electric water heating and gas dryers	2.22
2040	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	MF	All	ROB	42.29	39%	16.65	0.002	0.002	2.0	29%	0.598	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and gas dryers	1.25
2041	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	MF	All	ROB	398.73	27%	108.20	0.015	0.015	0.8	35%	0.285	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and electric dryers	2.57
2043	Appliances	ENERGY STAR Gas Clothes Dryers	MF	All	ROB	134.72	18%	24.78	0.088	0.088	2.4	18%	0.444	14	\$152.00	Installation of high efficiency replacement gas clothes dryers	0.36
2049	Appliances	ENERGY STAR Dishwasher - gas water heater	MF	All	NC	135.08	12%	16.28	0.050	0.050	0.8	12%	0.094	10	\$10.00	Installation of high efficiency dishwashers in homes with dishwashers and gas water heaters	7.05
2050	Appliances	Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	MF	All	NC	241.66	35%	84.00	0.012	0.012	1.4	27%	0.369	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with electric water heating and gas dryers	2.22
2052	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	MF	All	NC	42.29	39%	16.65	0.002	0.002	2.0	29%	0.598	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and gas dryers	1.25
2053	Appliances	Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	MF	All	NC	398.73	27%	108.20	0.015	0.015	0.8	35%	0.285	11	\$36.57	Installation of ENERGY STAR replacement clothes washer in homes with gas water heating and electric dryers	2.57
2055	Appliances	ENERGY STAR Gas Clothes Dryers	MF	All	NC	134.72	18%	24.78	0.088	0.088	2.4	18%	0.444	14	\$152.00	Installation of high efficiency replacement gas clothes dryers	0.36
4001	Water Heating	Pipe Wrap - gas water heater	SF	NLI	RETRO	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	1.64
4003	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	SF	NLI	RETRO	-	-	0.00	0.000	0.000	36.7	6%	2.200	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in homes with gas water heaters	3.38
4004	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	SF	NLI	RETRO	-	-	0.00	0.000	0.000	36.7	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in homes with gas water heaters	2.26
4009	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	SF	NLI	RETRO	-	-	0.00	0.000	0.000	3.9	55%	2.104	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	11.64
4010	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	SF	NLI	RETRO	-	-	0.00	0.000	0.000	0.6	54%	0.300	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	1.66
4011	Water Heating	Pipe Wrap - gas water heater	SF	LI	DI	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	0.82
4013	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	SF	LI	DI	-	-	0.00	0.000	0.000	36.7	6%	2.200	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in homes with gas water heaters	1.69
4014	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	SF	LI	DI	-	-	0.00	0.000	0.000	36.7	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in homes with gas water heaters	1.13
4019	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	SF	LI	DI	-	-	0.00	0.000	0.000	3.9	55%	2.104	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	5.82
4020	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	SF	LI	DI	-	-	0.00	0.000	0.000	0.6	54%	0.300	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	0.83
4022	Water Heating	TubSpout with Showerhead 1.5 GPM, gas DHW	SF	All	RETRO	-	-	0.00	0.000	0.000	0.0	-	1.855	10	\$48.70	Installation of TubSpout technology in homes with low flow shower heads and gas water heating	2.00
4023	Water Heating	Shower Start 2.0 gpm gas water heater	SF	All	RETRO	-	-	0.00	0.000	0.000	0.4	94%	0.361	10	\$38.20	Installation of thermostatic restriction valve on a 2.0 gpm showerhead in homes with a gas water heater	0.50
4026	Water Heating	High Efficiency Gas Water Heater 0.67 EF, <= 55 gallons	SF	All	ROB	-	-	0.00	0.000	0.000	20.0	11%	2.100	13	\$440.00	Installing an efficient (0.67 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.30
4027	Water Heating	Super Efficiency Gas Water Heater 0.80 EF, <= 55 gallons	SF	All	ROB	-	-	0.00	0.000	0.000	20.0	25%	5.000	13	\$520.00	Installing an efficient (0.80 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.61
4028	Water Heating	Instant Gas Water Heater	SF	All	ROB	-	-	0.00	0.000	0.000	20.0	27%	5.400	20	\$602.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.73
4030	Water Heating	Solar Domestic Hot Water - gas water heater	SF	All	ROB	-	-	0.00	0.000	0.000	20.0	48%	9.500	20	\$4,500.00	Installing a solar domestic water heater in homes with gas water heating	0.17
4032	Water Heating	Gravity Film Heat Exchanger GFX gas water heater	SF	All	RETRO	-	-	0.00	0.000	0.000	20.0	5%	1.015	20	\$1,022.00	Installing a gravity film heat exchanger in homes with gas water heating	0.08
4033	Water Heating	Pipe Wrap - gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	1.64
4035	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	36.7	6%	2.200	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in homes with gas water heaters	3.38
4036	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	36.7	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in homes with gas water heaters	2.26
4041	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	3.9	55%	2.104	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	11.64
4042	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	0.6	54%	0.300	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	1.66
4044	Water Heating	TubSpout with Showerhead 1.5 GPM, gas DHW	SF	All	NC	-	-	0.00	0.000	0.000	0.0	-	1.855	10	\$48.70	Installation of TubSpout technology in homes with low flow shower heads and gas water heating	2.00
4045	Water Heating	Shower Start 2.0 gpm gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	0.4	94%	0.361	10	\$38.20	Installation of thermostatic restriction valve on a 2.0 gpm showerhead in homes with a gas water heater	0.50
4048	Water Heating	High Efficiency Gas Water Heater 0.67 EF, <= 55 gallons	SF	All	NC	-	-	0.00	0.000	0.000	20.0	11%	2.100	13	\$440.00	Installing an efficient (0.67 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.30

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4049	Water Heating	Super Efficiency Gas Water Heater 0.80 EF, <= 55 gallons	SF	All	NC	-	-	0.00	0.000	0.000	20.0	25%	5.000	13	\$520.00	Installing an efficient (0.80 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.61		
4050	Water Heating	Instant Gas Water Heater	SF	All	NC	-	-	0.00	0.000	0.000	20.0	27%	5.400	20	\$602.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.73		
4052	Water Heating	Solar Domestic Hot Water - gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	20.0	48%	9.500	20	\$4,500.00	Installing a solar domestic water heater in homes with gas water heating	0.17		
4054	Water Heating	Gravity Film Heat Exchanger GFX gas water heater	SF	All	NC	-	-	0.00	0.000	0.000	20.0	5%	1.015	20	\$1,022.00	Installing a gravity film heat exchanger in homes with gas water heating	0.08		
4055	Water Heating	Pipe Wrap - gas water heater	MF	NLI	RETRO	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	1.64		
4057	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	MF	NLI	RETRO	-	-	0.00	0.000	0.000	35.9	6%	2.150	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in hoes with gas water heaters	3.30		
4058	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	MF	NLI	RETRO	-	-	0.00	0.000	0.000	35.9	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in hoes with gas water heaters	2.26		
4063	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	MF	NLI	RETRO	-	-	0.00	0.000	0.000	2.8	55%	1.522	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	8.42		
4064	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	MF	NLI	RETRO	-	-	0.00	0.000	0.000	0.6	55%	0.310	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	1.72		
4065	Water Heating	Pipe Wrap - gas water heater	MF	LI	DI	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	0.82		
4067	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	MF	LI	DI	-	-	0.00	0.000	0.000	35.9	6%	2.150	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in homes with gas water heaters	1.65		
4068	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	MF	LI	DI	-	-	0.00	0.000	0.000	35.9	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in homes with gas water heaters	1.13		
4073	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	MF	LI	DI	-	-	0.00	0.000	0.000	2.8	55%	1.522	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	4.21		
4074	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	MF	LI	DI	-	-	0.00	0.000	0.000	0.6	55%	0.310	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	0.86		
4076	Water Heating	TubSpout with Showerhead 1.5 GPM, gas DHW	MF	All	RETRO	-	-	0.00	0.000	0.000	0.0	-	1.813	10	\$48.70	Installation of TubSpout technology in homes with low flow shower heads and gas water heating	1.96		
4077	Water Heating	Shower Start 2.0 gpm gas water heater	MF	All	RETRO	-	-	0.00	0.000	0.000	0.4	94%	0.353	10	\$38.20	Installation of thermostatic restriction valve on a 2.0 gpm showerhead in homes with a gas water heater	0.49		
4080	Water Heating	High Efficiency Gas Water Heater 0.67 EF, <= 55 gallons	MF	All	ROB	-	-	0.00	0.000	0.000	16.8	10%	1.700	13	\$440.00	Installing an efficient (0.67 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.24		
4081	Water Heating	Super Efficiency Gas Water Heater 0.80 EF, <= 55 gallons	MF	All	ROB	-	-	0.00	0.000	0.000	16.8	25%	4.200	13	\$520.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.51		
4082	Water Heating	Instant Gas Water Heater	MF	All	ROB	-	-	0.00	0.000	0.000	16.8	27%	4.500	20	\$602.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.61		
4084	Water Heating	Solar Domestic Hot Water - gas water heater	MF	All	ROB	-	-	0.00	0.000	0.000	16.8	57%	9.500	20	\$4,500.00	Installing a solar domestic water heater in homes with gas water heating	0.17		
4086	Water Heating	Gravity Film Heat Exchanger GFX gas water heater	MF	All	RETRO	-	-	0.00	0.000	0.000	16.8	4%	0.658	20	\$1,022.00	Installing a gravity film heat exchanger in homes with gas water heating	0.05		
4087	Water Heating	Pipe Wrap - gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	2.0	65%	1.300	20	\$65.00	Installing pipe wrap on hot water lines in homes that have gas water heaters	1.64		
4089	Water Heating	Low Flow Showerheads 1.5 gpm gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	35.9	6%	2.150	10	\$34.20	Installation of low flow showerheads (1.5 gpm) in homes with gas water heaters	3.30		
4090	Water Heating	Low Flow Showerheads 1.0 gpm gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	35.9	4%	1.470	10	\$34.20	Installation of low flow showerheads (1.0 gpm) in homes with gas water heaters	2.26		
4095	Water Heating	Low Flow Kitchen Faucet Aerators - 1.0 gpm gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	2.8	55%	1.522	10	\$9.50	Installing 1.0 gpm low flow kitchen faucet aerators in homes with gas water heating	8.42		
4096	Water Heating	Low Flow Bathroom Faucet Aerators - 1.0 gpm gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	0.6	55%	0.310	10	\$9.50	Installing 1.0 gpm low flow bathroom faucet aerators in homes with gas water heating	1.72		
4098	Water Heating	TubSpout with Showerhead 1.5 GPM, gas DHW	MF	All	NC	-	-	0.00	0.000	0.000	0.0	-	1.813	10	\$48.70	Installation of TubSpout technology in homes with low flow shower heads and gas water heating	1.96		
4099	Water Heating	Shower Start 2.0 gpm gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	0.4	94%	0.353	10	\$38.20	Installation of thermostatic restriction valve on a 2.0 gpm showerhead in homes with a gas water heater	0.49		
4102	Water Heating	High Efficiency Gas Water Heater 0.67 EF, <= 55 gallons	MF	All	NC	-	-	0.00	0.000	0.000	16.8	10%	1.700	13	\$440.00	Installing an efficient (0.67 EF) replacement gas storage tank water heater instead of a standard efficiency gas storage tank water heater	0.24		
4103	Water Heating	Super Efficiency Gas Water Heater 0.80 EF, <= 55 gallons	MF	All	NC	-	-	0.00	0.000	0.000	16.8	25%	4.200	13	\$520.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.51		
4104	Water Heating	Instant Gas Water Heater	MF	All	NC	-	-	0.00	0.000	0.000	16.8	27%	4.500	20	\$602.00	Installing an efficient replacement instantaneous gas tankless water heater instead of a standard efficiency gas storage tank water heater	0.61		
4106	Water Heating	Solar Domestic Hot Water - gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	16.8	57%	9.500	20	\$4,500.00	Installing a solar domestic water heater in homes with gas water heating	0.17		
4108	Water Heating	Gravity Film Heat Exchanger GFX gas water heater	MF	All	NC	-	-	0.00	0.000	0.000	16.8	4%	0.658	20	\$1,022.00	Installing a gravity film heat exchanger in homes with gas water heating	0.05		
5001	HVAC Shell	Infiltration reduction - 30%	SF	NLI	RETRO	-	-	56.41	0.071	0.112	-	-	6.884	13	\$190.08	Air sealing (30% infiltration reduction) in homes with gas heating and central AC	3.00		
5002	HVAC Shell	Infiltration reduction - 50%	SF	NLI	RETRO	-	-	96.70	0.119	0.189	-	-	11.435	13	\$190.08	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	5.01		
5003	HVAC Shell	Crawlspace Wall Insulation	SF	NLI	RETRO	-	-	-46.66	-0.026	-0.027	-	-	3.151	25	\$552.11	Installing crawlspace wall insulation in homes with unconditioned crawlspaces and gas heating and central AC	0.33		
5004	HVAC Shell	Basement Wall Insulation	SF	NLI	RETRO	-	-	-39.11	-0.048	-0.052	-	-	9.214	25	\$1,104.21	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.64		
5005	HVAC Shell	Floor Insulation	SF	NLI	RETRO	-	-	-61.73	-0.025	-0.026	-	-	5.233	25	\$819.88	Installing floor wall insulation in homes with unconditioned basements or crawl spaces and gas heating and central AC	0.44		
5006	HVAC Shell	Wall Insulation	SF	NLI	RETRO	-	-	110.44	0.096	0.113	-	-	11.168	25	\$3,041.11	Installing wall insulation in homes with gas heating and central AC	0.44		
5007	HVAC Shell	R-38 Roof Insulation	SF	NLI	RETRO	-	-	42.77	0.046	0.043	-	-	4.233	20	\$1,553.26	Installing R-38 roof insulation in homes with poor attic insulation and gas heating and central AC	0.30		
5008	HVAC Shell	R-60 Roof Insulation	SF	NLI	RETRO	-	-	60.38	0.065	0.068	-	-	5.967	20	\$3,351.78	Installing R-60 roof insulation in homes with mediocre attic insulation and gas heating and central AC	0.20		
5009	HVAC Shell	Infiltration reduction - 30%	SF	NLI	RETRO	-	-	29.92	0.000	0.000	-	-	7.155	13	\$190.08	Air sealing (30% infiltration reduction) in homes with gas heating and no central AC	2.50		
5010	HVAC Shell	Infiltration reduction - 50%	SF	NLI	RETRO	-	-	49.90	0.000	0.000	-	-	11.922	13	\$190.08	Air sealing (50% infiltration reduction) in homes with gas heating and no central AC	4.16		
5011	HVAC Shell	Crawlspace Wall Insulation	SF	NLI	RETRO	-	-	11.81	0.000	0.000	-	-	4.356	25	\$552.11	Installing crawlspace wall insulation in homes with unconditioned crawlspaces and gas heating and no central AC	0.74		
5012	HVAC Shell	Basement Wall Insulation	SF	NLI	RETRO	-	-	33.90	0.000	0.000	-	-	9.859	25	\$1,104.21	Installing basement wall insulation in homes with unconditioned basements and gas heating and no central AC	0.85		
5013	HVAC Shell	Floor Insulation	SF	NLI	RETRO	-	-	20.15	0.000	0.000	-	-	4.215	25	\$819.88	Installing floor wall insulation in homes with unconditioned basements or crawl spaces and gas heating and no central AC	0.50		
5014	HVAC Shell	Wall Insulation	SF	NLI	RETRO	-	-	46.23	0.000	0.000	-	-	11.498	25	\$3,041.11	Installing wall insulation in homes with gas heating and no central AC	0.36		

DTE (Michigan)		Measure Assumption Tab															
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5015	HVAC Shell	R-38 Roof Insulation	SF	NLI	RETRO	-	-	17.58	0.000	0.000	-	-	4.737	20	\$1,553.26	Installing R-38 roof insulation in homes with poor attic insulation and gas heating and no central AC	0.26
5016	HVAC Shell	R-60 Roof Insulation	SF	NLI	RETRO	-	-	24.59	0.000	0.000	-	-	6.519	20	\$3,351.78	Installing R-60 roof insulation in homes with mediocre attic insulation and gas heating and no central AC	0.17
5025	HVAC Shell	Infiltration reduction - 50%	SF	LI	DI	-	-	96.70	0.119	0.189	-	-	11.435	13	\$190.08	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	2.50
5026	HVAC Shell	Crawlspace Wall Insulation	SF	LI	DI	-	-	-46.66	-0.026	-0.027	-	-	3.151	25	\$552.11	Installing crawlspace wall insulation in homes with unconditioned crawlspaces and gas heating and central AC	0.17
5027	HVAC Shell	Basement Wall Insulation	SF	LI	DI	-	-	-39.11	-0.048	-0.052	-	-	9.214	25	\$1,104.21	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.32
5028	HVAC Shell	Floor Insulation	SF	LI	DI	-	-	-61.73	-0.025	-0.026	-	-	5.233	25	\$819.88	Installing floor wall insulation in homes with unconditioned basements or crawl spaces and gas heating and central AC	0.22
5029	HVAC Shell	Wall Insulation	SF	LI	DI	-	-	110.44	0.096	0.113	-	-	11.168	25	\$3,041.11	Installing wall insulation in homes with gas heating and central AC	0.22
5030	HVAC Shell	R-38 Roof Insulation	SF	LI	DI	-	-	42.77	0.046	0.043	-	-	4.233	20	\$1,553.26	Installing R-38 roof insulation in homes with poor attic insulation and gas heating and central AC	0.15
5031	HVAC Shell	R-60 Roof Insulation	SF	LI	DI	-	-	60.38	0.065	0.068	-	-	5.967	20	\$3,351.78	Installing R-60 roof insulation in homes with mediocre attic insulation and gas heating and central AC	0.10
5032	HVAC Shell	Infiltration reduction - 50%	SF	LI	DI	-	-	49.90	0.000	0.000	-	-	11.922	13	\$190.08	Air sealing (50% infiltration reduction) in homes with gas heating and no central AC	2.08
5033	HVAC Shell	Crawlspace Wall Insulation	SF	LI	DI	-	-	11.81	0.000	0.000	-	-	4.356	25	\$552.11	Installing crawlspace wall insulation in homes with unconditioned crawlspaces and gas heating and no central AC	0.37
5034	HVAC Shell	Basement Wall Insulation	SF	LI	DI	-	-	33.90	0.000	0.000	-	-	9.859	25	\$1,104.21	Installing basement wall insulation in homes with unconditioned basements and gas heating and no central AC	0.42
5035	HVAC Shell	Floor Insulation	SF	LI	DI	-	-	20.15	0.000	0.000	-	-	4.215	25	\$819.88	Installing floor wall insulation in homes with unconditioned basements or crawl spaces and gas heating and no central AC	0.25
5036	HVAC Shell	Wall Insulation	SF	LI	DI	-	-	46.23	0.000	0.000	-	-	11.498	25	\$3,041.11	Installing wall insulation in homes with gas heating and no central AC	0.18
5037	HVAC Shell	R-38 Roof Insulation	SF	LI	DI	-	-	17.58	0.000	0.000	-	-	4.737	20	\$1,553.26	Installing R-38 roof insulation in homes with poor attic insulation and gas heating and no central AC	0.13
5038	HVAC Shell	R-60 Roof Insulation	SF	LI	DI	-	-	24.59	0.000	0.000	-	-	6.519	20	\$3,351.78	Installing R-60 roof insulation in homes with mediocre attic insulation and gas heating and no central AC	0.08
5046	HVAC Shell	Duct Insulation	SF	All	RETRO	-	-	0.05	0.023	0.025	-	-	2.236	20	\$380.16	Adding duct insulation in homes with gas heating and central AC	0.58
5047	HVAC Shell	Duct location	SF	All	RETRO	-	-	75.19	0.070	0.081	-	-	7.871	30	\$1,188.00	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and central AC	0.85
5048	HVAC Shell	Duct sealing 15% leakage base	SF	All	RETRO	-	-	18.72	0.028	0.035	-	-	0.923	18	\$341.86	Duct sealing (15% leakage reduction) in homes with gas heating and central AC	0.39
5049	HVAC Shell	Duct sealing 30% leakage base	SF	All	RETRO	-	-	57.15	0.074	0.085	-	-	2.368	18	\$341.86	Duct sealing (30% leakage reduction) in homes with gas heating and central AC	1.04
5050	HVAC Shell	Door weatherstripping	SF	All	RETRO	-	-	12.80	0.000	0.000	-	-	0.394	5	\$86.00	Installing door weatherstripping - savings estimate weighted across heating/cooling combinations	0.19
5051	HVAC Shell	R0 to R19 kneewalls	SF	All	RETRO	-	-	75.95	0.084	0.092	-	-	7.284	20	\$172.53	Installing R19 kneewall insulation in homes with no kneewall insulation in homes with gas heating and central AC	4.73
5052	HVAC Shell	R6 to R19 kneewalls	SF	All	RETRO	-	-	25.05	0.027	0.028	-	-	2.995	20	\$162.53	Installing R19 kneewall insulation in homes with R6 kneewall insulation in homes with gas heating and central AC	1.94
5053	HVAC Shell	Rim Joist Insulation	SF	All	RETRO	-	-	34.89	0.026	0.030	-	-	3.456	25	\$179.92	Installing rim joist insulation in homes with gas heating and central AC	2.24
5055	HVAC Shell	Window Replacement	SF	All	RETRO	-	-	313.16	0.315	0.360	-	-	12.126	25	\$1,018.42	Replacing inefficient windows at the end of useful life with efficient windows in homes with gas heating and central AC	2.02
5056	HVAC Shell	Original double hung window with low U storm	SF	All	RETRO	-	-	734.09	0.694	0.807	-	-	25.504	25	\$3,564.00	Retrofitting inefficient windows with efficient alternatives in homes with gas heating and central AC	1.25
5057	HVAC Shell	Duct Insulation	SF	All	RETRO	-	-	-13.81	0.000	0.000	-	-	2.239	20	\$380.16	Adding duct insulation in homes with gas heating and no central AC	0.44
5058	HVAC Shell	Duct location	SF	All	RETRO	-	-	10.36	0.000	0.000	-	-	9.200	30	\$1,188.00	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and no central AC	0.77
5059	HVAC Shell	Duct sealing 15% leakage base	SF	All	RETRO	-	-	4.56	0.000	0.000	-	-	0.927	18	\$341.86	Duct sealing (15% leakage reduction) in homes with gas heating and no central AC	0.22
5060	HVAC Shell	Duct sealing 30% leakage base	SF	All	RETRO	-	-	14.43	0.000	0.000	-	-	2.367	18	\$341.86	Duct sealing (30% leakage reduction) in homes with gas heating and no central AC	0.57
5061	HVAC Shell	R0 to R19 kneewalls	SF	All	RETRO	-	-	29.82	0.000	0.000	-	-	7.559	20	\$172.53	Installing R19 kneewall insulation in homes with no kneewall insulation in homes with gas heating and no central AC	3.76
5062	HVAC Shell	R6 to R19 kneewalls	SF	All	RETRO	-	-	11.13	0.000	0.000	-	-	3.049	20	\$162.53	Installing R19 kneewall insulation in homes with R6 kneewall insulation in homes with gas heating and no central AC	1.60
5063	HVAC Shell	Rim Joist Insulation	SF	All	RETRO	-	-	0.00	0.000	0.000	-	-	3.536	25	\$179.92	Installing rim joist insulation in homes with gas heating and no central AC	1.79
5064	HVAC Shell	Window Film	SF	All	RETRO	-	-	-36.96	0.000	0.000	-	-	-8.143	10	\$365.46	Installing window film on inefficient existing windows in homes with gas heating and no central AC	-1.23
5065	HVAC Shell	Window Replacement	SF	All	RETRO	-	-	51.04	0.000	0.000	-	-	12.479	25	\$1,018.42	Replacing inefficient windows at the end of useful life with efficient windows in homes with gas heating and no central AC	1.17
5066	HVAC Shell	Original double hung window with low U storm	SF	All	RETRO	-	-	146.67	0.000	0.000	-	-	25.489	25	\$3,564.00	Retrofitting inefficient windows with efficient alternatives in homes with gas heating and no central AC	0.70
5067	HVAC Shell	HW pipe insulation	SF	All	RETRO	-	-	-8.94	0.000	0.000	-	-	29.119	11	\$1,404.58	Installing hot water pipe insulation on boiler pipes in homes with boilers	1.16
5068	HVAC Shell	Steam pipe insulation	SF	All	RETRO	-	-	-14.95	0.000	0.000	-	-	49.230	11	\$1,404.58	Installing steam pipe insulation on boiler pipes in homes with boilers	1.97
5074	HVAC Shell	R6 to R19 kneewalls	SF	All	RETRO	-	-	555.27	0.028	0.027	-	-	0.590	20	\$162.53	Installing R19 kneewall insulation in homes with R6 kneewall insulation in homes with electric heating and central AC	4.09
5076	HVAC Shell	Window Film	SF	All	RETRO	-	-	-1337.08	0.369	0.317	-	-	-0.020	10	\$365.46	Installing window film on inefficient existing windows in homes with electric heating and central AC	-1.23
5079	HVAC Shell	Infiltration reduction - 30%	SF	All	NC	-	-	28.31	0.018	0.028	-	-	3.611	13	\$190.08	Air sealing (30% infiltration reduction) in homes with gas heating and central AC	1.44
5080	HVAC Shell	Infiltration reduction - 50%	SF	All	NC	-	-	46.02	0.029	0.046	-	-	6.012	13	\$190.08	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	2.39
5081	HVAC Shell	Duct Insulation	SF	All	NC	-	-	7.11	0.029	0.030	-	-	1.663	20	\$380.16	Adding duct insulation in homes with gas heating and central AC	0.51
5082	HVAC Shell	Duct location	SF	All	NC	-	-	58.05	0.039	0.044	-	-	6.598	30	\$1,188.00	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and central AC	0.67
5083	HVAC Shell	Duct sealing 15% leakage base	SF	All	NC	-	-	11.218	0.015	0.018	-	-	0.340	18	\$341.86	Duct sealing (15% leakage reduction) in homes with gas heating and central AC	0.18



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5084	HVAC Shell	Duct sealing 30% leakage base	SF	All	NC	-	-	29.423	0.041	0.046	-	-	0.920	18	\$341.86	Duct sealing (30% leakage reduction) in homes with gas heating and central AC	0.48			
5085	HVAC Shell	Door weatherstripping	SF	All	NC	-	-	0.000	0.000	0.000	-	-	0.000	5	\$86.00	Installing door weatherstripping - savings estimate weighted across heating/cooling combinations	0.00			
5086	HVAC Shell	Basement Wall Insulation	SF	All	NC	-	-	-1.652	-0.017	-0.028	-	-	3.651	25	\$1,104.21	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.27			
5087	HVAC Shell	Floor Insulation	SF	All	NC	-	-	-6.083	0.000	0.000	-	-	0.642	25	\$819.88	Installing floor wall insulation in homes with unconditioned basements or crawl spaces and gas heating and central AC	0.06			
5088	HVAC Shell	Crawlspace Wall Insulation	SF	All	NC	-	-	-1.863	0.000	0.000	-	-	0.074	25	\$552.11	Installing crawlspace wall insulation in homes with unconditioned crawlspaces and gas heating and central AC	0.01			
5089	HVAC Shell	Wall Insulation	SF	All	NC	-	-	34.966	0.000	0.028	-	-	3.249	25	\$3,041.11	Installing wall insulation in homes with gas heating and central AC	0.11			
5091	HVAC Shell	Window Replacement	SF	All	NC	-	-	75.944	0.007	0.099	-	-	1.305	25	\$1,018.42	Installing efficient windows in homes with gas heating and central AC	0.21			
5092	HVAC Shell	Infiltration reduction - 30%	MF	NLI	RETRO	-	-	29.948	0.040	0.073	-	-	3.576	13	\$101.16	Air sealing (30% infiltration reduction) in homes with gas heating and central AC	2.98			
5093	HVAC Shell	Infiltration reduction - 50%	MF	NLI	RETRO	-	-	50.891	0.071	0.130	-	-	5.984	13	\$101.16	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	5.04			
5094	HVAC Shell	Basement Wall Insulation	MF	NLI	RETRO	-	-	-20.080	-0.019	-0.026	-	-	4.435	25	\$581.78	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.59			
5095	HVAC Shell	Wall Insulation	MF	NLI	RETRO	-	-	46.189	0.032	0.039	-	-	6.507	25	\$1,670.90	Installing wall insulation in homes with gas heating and central AC	0.42			
5096	HVAC Shell	Roof Insulation	MF	NLI	RETRO	-	-	48.543	0.032	0.033	-	-	4.148	25	\$638.11	Installing roof insulation in homes with gas heating and central AC	0.77			
5097	HVAC Shell	Infiltration reduction - 30%	MF	NLI	RETRO	-	-	14.135	0.000	0.000	-	-	3.445	13	\$101.16	Air sealing (30% infiltration reduction) in homes with gas heating and no central AC	2.26			
5098	HVAC Shell	Infiltration reduction - 50%	MF	NLI	RETRO	-	-	23.375	0.000	0.000	-	-	5.766	13	\$101.16	Air sealing (50% infiltration reduction) in homes with gas heating and no central AC	3.78			
5099	HVAC Shell	Basement Wall Insulation	MF	NLI	RETRO	-	-	16.342	0.000	0.000	-	-	4.748	25	\$581.78	Installing basement wall insulation in homes with unconditioned basements and gas heating and no central AC	0.78			
5100	HVAC Shell	Wall Insulation	MF	NLI	RETRO	-	-	24.402	0.000	0.000	-	-	5.868	25	\$1,670.90	Installing wall insulation in homes with gas heating and no central AC	0.34			
5101	HVAC Shell	Roof Insulation	MF	NLI	RETRO	-	-	15.625	0.000	0.000	-	-	4.176	25	\$638.11	Installing roof insulation in homes with gas heating and no central AC	0.62			
5107	HVAC Shell	Infiltration reduction - 50%	MF	LI	DI	-	-	50.891	0.071	0.130	-	-	5.984	13	\$101.16	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	2.52			
5108	HVAC Shell	Basement Wall Insulation	MF	LI	DI	-	-	-20.080	-0.019	-0.026	-	-	4.435	25	\$581.78	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.30			
5109	HVAC Shell	Wall Insulation	MF	LI	DI	-	-	46.189	0.032	0.039	-	-	6.507	25	\$1,670.90	Installing wall insulation in homes with gas heating and central AC	0.21			
5110	HVAC Shell	Roof Insulation	MF	LI	DI	-	-	48.543	0.032	0.033	-	-	4.148	25	\$638.11	Installing roof insulation in homes with gas heating and central AC	0.39			
5111	HVAC Shell	Infiltration reduction - 50%	MF	LI	DI	-	-	23.375	0.000	0.000	-	-	5.766	13	\$101.16	Air sealing (50% infiltration reduction) in homes with gas heating and no central AC	1.89			
5112	HVAC Shell	Basement Wall Insulation	MF	LI	DI	-	-	16.342	0.000	0.000	-	-	4.748	25	\$581.78	Installing basement wall insulation in homes with unconditioned basements and gas heating and no central AC	0.39			
5113	HVAC Shell	Wall Insulation	MF	LI	DI	-	-	24.402	0.000	0.000	-	-	5.868	25	\$1,670.90	Installing wall insulation in homes with gas heating and no central AC	0.17			
5114	HVAC Shell	Roof Insulation	MF	LI	DI	-	-	15.625	0.000	0.000	-	-	4.176	25	\$638.11	Installing roof insulation in homes with gas heating and no central AC	0.31			
5119	HVAC Shell	Duct Insulation	MF	All	RETRO	-	-	40.888	0.064	0.069	-	-	2.426	20	\$202.32	Adding duct insulation in homes with gas heating and central AC	1.72			
5120	HVAC Shell	Duct location	MF	All	RETRO	-	-	81.138	0.127	0.153	-	-	4.888	30	\$632.25	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and central AC	1.32			
5121	HVAC Shell	Duct sealing 15% leakage base	MF	All	RETRO	-	-	14.388	0.015	0.016	-	-	0.767	18	\$181.94	Duct sealing (15% leakage reduction) in homes with gas heating and central AC	0.53			
5122	HVAC Shell	Duct sealing 30% leakage base	MF	All	RETRO	-	-	39.214	0.040	0.044	-	-	2.048	18	\$181.94	Duct sealing (30% leakage reduction) in homes with gas heating and central AC	1.43			
5123	HVAC Shell	Door weatherstripping	MF	All	RETRO	-	-	9.188	0.003	0.004	-	-	0.213	5	\$43.00	Installing door weatherstripping - savings estimate weighted across heating/cooling combinations	0.26			
5125	HVAC Shell	Window Replacement	MF	All	RETRO	-	-	150.894	0.143	0.162	-	-	5.972	25	\$542.00	Replacing inefficient windows at the end of useful life with efficient windows in homes with gas heating and central AC	1.81			
5126	HVAC Shell	Original double hung window with low U storm	MF	All	RETRO	-	-	671.964	0.660	0.734	-	-	46.728	25	\$1,896.75	Retrofitting inefficient windows with efficient alternatives in homes with gas heating and central AC	3.30			
5127	HVAC Shell	Duct Insulation	MF	All	RETRO	-	-	0.352	0.000	0.000	-	-	2.426	20	\$202.32	Adding duct insulation in homes with gas heating and no central AC	0.98			
5128	HVAC Shell	Duct location	MF	All	RETRO	-	-	5.559	0.000	0.000	-	-	4.890	30	\$632.25	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and no central AC	0.77			
5129	HVAC Shell	Duct sealing 15% leakage base	MF	All	RETRO	-	-	3.651	0.000	0.000	-	-	0.766	18	\$181.94	Duct sealing (15% leakage reduction) in homes with gas heating and no central AC	0.34			
5130	HVAC Shell	Duct sealing 30% leakage base	MF	All	RETRO	-	-	10.076	0.000	0.000	-	-	2.046	18	\$181.94	Duct sealing (30% leakage reduction) in homes with gas heating and no central AC	0.92			
5131	HVAC Shell	Window Film	MF	All	RETRO	-	-	-36.710	0.000	0.000	-	-	-8.685	10	\$194.50	Installing window film on inefficient existing windows in homes with gas heating and no central AC	-2.46			
5132	HVAC Shell	Window Replacement	MF	All	RETRO	-	-	23.313	0.000	0.000	-	-	5.725	25	\$542.00	Replacing inefficient windows at the end of useful life with efficient windows in homes with gas heating and no central AC	1.01			
5133	HVAC Shell	Original double hung window with low U storm	MF	All	RETRO	-	-	240.943	-0.011	-0.012	-	-	46.521	25	\$1,896.75	Retrofitting inefficient windows with efficient alternatives in homes with gas heating and no central AC	2.37			
5138	HVAC Shell	Window Film	MF	All	RETRO	-	-	-1098.453	0.399	0.419	-	-	0.000	10	\$194.50	Installing window film on inefficient existing windows in homes with electric heating and central AC	-1.36			
5141	HVAC Shell	Infiltration reduction - 30%	MF	All	NC	-	-	18.306	0.028	0.043	-	-	2.272	13	\$101.16	Air sealing (30% infiltration reduction) in homes with gas heating and central AC	1.91			
5142	HVAC Shell	Infiltration reduction - 50%	MF	All	NC	-	-	31.138	0.044	0.069	-	-	3.812	13	\$101.16	Air sealing (50% infiltration reduction) in homes with gas heating and central AC	3.18			
5143	HVAC Shell	Airtight Can Lights	MF	All	NC	-	-	13.859	0.021	0.033	-	-	1.756	15	\$459.90	Installing air can lights to reduce infiltration in homes with gas heating and central AC	0.36			
5144	HVAC Shell	Duct Insulation	MF	All	NC	-	-	51.471	0.074	0.081	-	-	2.140	20	\$202.32	Adding duct insulation in homes with gas heating and central AC	1.74			
5145	HVAC Shell	Duct location	MF	All	NC	-	-	83.190	0.127	0.152	-	-	3.581	30	\$632.25	Moving ductwork from unconditioned space to conditioned space in homes with gas heating and central AC	1.12			
5146	HVAC Shell	Duct sealing 15% leakage base	MF	All	NC	-	-	10.718	0.011	0.011	-	-	0.464	18	\$181.94	Duct sealing (15% leakage reduction) in homes with gas heating and central AC	0.35			
5147	HVAC Shell	Duct sealing 30% leakage base	MF	All	NC	-	-	29.127	0.031	0.033	-	-	1.244	18	\$181.94	Duct sealing (30% leakage reduction) in homes with gas heating and central AC	0.95			
5148	HVAC Shell	Door weatherstripping	MF	All	NC	-	-	5.380	0.003	0.003	-	-	0.244	5	\$43.00	Installing door weatherstripping - savings estimate weighted across heating/cooling combinations	0.25			

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5149	HVAC Shell	Basement Wall Insulation	MF	All	NC	-	-	-0.871	-0.011	-0.015	-	-	1.924	25	\$581.78	Installing basement wall insulation in homes with unconditioned basements and gas heating and central AC	0.26
5150	HVAC Shell	Wall Insulation	MF	All	NC	-	-	13.630	0.012	0.014	-	-	2.116	25	\$1,670.90	Installing wall insulation in homes with gas heating and central AC	0.14
5151	HVAC Shell	Roof Insulation	MF	All	NC	-	-	16.723	0.009	0.009	-	-	1.534	25	\$638.11	Installing roof insulation in homes with gas heating and central AC	0.28
5154	HVAC Shell	Window Replacement	MF	All	NC	-	-	33.113	0.030	0.030	-	-	0.790	25	\$2,878.72	Installing efficient windows in homes with gas heating and central AC	0.06
6004	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	SF	NLI	ROB	1216.000	-	536.032	0.000	0.000	87.3	-	21.805	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	1.38
6005	HVAC Equipment	High efficiency 98 AFUE furnace with ECM	SF	NLI	ROB	1216.000	-	536.032	0.000	0.000	87.3	-	29.062	15	\$1,608.58	Installation of 98 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	1.54
6006	HVAC Equipment	O&M Tune-up - furnace only	SF	NLI	RETRO	0.000	-	0.000	0.000	0.000	87.3	-	6.492	3	\$139.00	5% increase in furnace efficiency - in homes with gas furnaces	0.91
6007	HVAC Equipment	Boiler 95% plus AFUE	SF	NLI	ROB	0.000	-	-436.568	0.000	0.000	127.5	-	64.047	20	\$2,436.00	Installing 95 AFUE boilers to replace standard boilers - in homes with gas boilers	1.97
6008	HVAC Equipment	Boiler 92% plus AFUE	SF	NLI	ROB	0.000	-	-436.568	0.000	0.000	127.5	-	58.181	20	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	2.21
6009	HVAC Equipment	Boiler Tune-up	SF	NLI	RETRO	0.000	-	0.000	0.000	0.000	127.5	-	6.979	5	\$139.00	Increasing boiler efficiency by 5% - in homes with gas boilers	1.52
6012	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	SF	LI	DI	1216.000	-	536.032	0.000	0.000	87.3	-	21.805	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	0.69
6013	HVAC Equipment	O&M Tune-up - furnace only	SF	LI	DI	0.000	-	0.000	0.000	0.000	87.3	-	6.492	3	\$139.00	5% increase in furnace efficiency - in homes with gas furnaces	0.46
6014	HVAC Equipment	Boiler 92% plus AFUE	SF	LI	DI	0.000	-	-436.568	0.000	0.000	127.5	-	58.181	20	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	1.10
6015	HVAC Equipment	Boiler Tune-up	SF	LI	DI	0.000	-	0.000	0.000	0.000	127.5	-	6.979	5	\$139.00	Increasing boiler efficiency by 5% - in homes with gas boilers	0.76
6021	HVAC Equipment	DFHP - SEER 18 with 95 AFUE furnace - SEER 14 base	SF	All	ROB	6591.974	-	1460.671	0.544	0.544	87.3	-	2.874	15	\$1,189.14	Installation of SEER 18/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.88
6022	HVAC Equipment	DFHP - SEER 21 with 95 AFUE furnace - SEER 14 base	SF	All	ROB	6591.974	-	2191.006	0.816	0.816	87.3	-	4.311	15	\$2,125.65	Installation of SEER 21/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.57
6023	HVAC Equipment	Programmable Thermostats Tier 1	SF	All	RETRO	0.000	-	62.811	0.000	0.000	0.0	-	7.516	10	\$42.72	Installation of Tier 1 programmable thermostat in homes with gas heating and central AC	10.16
6024	HVAC Equipment	Programmable Thermostats Tier 2	SF	All	RETRO	0.000	-	206.458	0.000	0.000	0.0	-	24.706	10	\$161.72	Installation of Tier 2 programmable thermostat in homes with gas heating and central AC	8.83
6025	HVAC Equipment	Programmable Thermostats Tier 3	SF	All	RETRO	1239.623	0.090	111.566	0.000	0.000	87.3	-	7.522	10	\$237.99	Installation of Tier 3 programmable thermostat in homes with gas heating and central AC	1.95
6026	HVAC Equipment	Programmable Thermostats Tier 1	SF	All	RETRO	0.000	-	0.000	0.000	0.000	0.0	-	6.857	10	\$42.72	Installation of Tier 1 programmable thermostat in homes with gas heating and no AC	8.44
6027	HVAC Equipment	Programmable Thermostats Tier 2	SF	All	RETRO	0.000	-	0.000	0.000	0.000	0.0	-	22.539	10	\$161.72	Installation of Tier 2 programmable thermostat in homes with gas heating and no AC	7.33
6028	HVAC Equipment	Programmable Thermostats Tier 3	SF	All	RETRO	0.000	#DIV/0!	0.000	0.000	0.000	87.3	-	7.653	10	\$237.99	Installation of Tier 3 programmable thermostat in homes with gas heating and no AC	1.69
6032	HVAC Equipment	Smartphone Behavior Application	SF	All	RETRO	3166.555	0.011	33.249	0.000	0.000	83.0	1%	0.872	1	\$5.00	Use of smartphone application to deliver behavioral savings	1.83
6033	HVAC Equipment	Smartphone Behavior Application	SF	All	RETRO			0.000	0.000	0.000	0.0	0%	0.000	1	\$5.00	Use of smartphone application to deliver behavioral savings	0.00
6034	HVAC Equipment	Smartphone Behavior Application	SF	All	RETRO			0.000	0.000	0.000	0.0	0%	0.000	1	\$5.00	Use of smartphone application to deliver behavioral savings	0.00
6037	HVAC Equipment	Hot water temperature reset	SF	All	RETRO	0.000	-	-3.653	0.000	0.000	127.5	-	7.596	15	\$600.00	Retrofitting of existing boiler with temperature reset controls	0.87
6042	HVAC Equipment	DFHP - SEER 18 with 95 AFUE furnace - SEER 14 base	SF	All	NC	4877.719	-	1076.973	0.383	0.383	87.3	-	1.586	15	\$1,189.14	Installation of SEER 18/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.33

DTE (Michigan)		Measure Assumption Tab																	
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Per Unit Winter NCP kW	Base Fuel Use	% Fuel Savings	Per unit Fuel Savings	Useful Life	Measure Cost	Measure Description	UCT Ratio		
6043	HVAC Equipment	DFHP - SEER 21 with 95 AFUE furnace - SEER 14 base	SF	All	NC	4877.719	-	1615.460	0.575	0.575	87.3	-	2.378	15	\$2,125.65	Installation of SEER 21/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.12		
6047	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	SF	All	NC	1216.000	-	499.049	0.000	0.000	87.3	-	12.931	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	0.93		
6048	HVAC Equipment	High efficiency 98 AFUE furnace with ECM	SF	All	NC	1216.000	-	499.049	0.000	0.000	87.3	-	17.235	15	\$1,608.58	Installation of 98 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	1.01		
6050	HVAC Equipment	Boiler 92% plus AFUE	SF	All	NC	0.000	-	-260.007	0.000	0.000	127.5	-	36.181	15	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	1.17		
6051	HVAC Equipment	Boiler 95% plus AFUE	SF	All	NC	0.000	-	-260.007	0.000	0.000	127.5	-	39.613	15	\$2,436.00	Installing 95 AFUE boilers to replace standard boilers - in homes with gas boilers	1.04		
6055	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	MF	NLI	ROB	1216.000	-	344.238	0.139	0.139	56.7	-	13.534	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	1.00		
6056	HVAC Equipment	High efficiency 98 AFUE furnace with ECM	MF	NLI	ROB	1216.000	-	344.238	0.139	0.139	56.7	-	18.038	15	\$1,608.58	Installation of 98 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	1.08		
6057	HVAC Equipment	O&M Tune-up - furnace only	MF	NLI	RETRO	0.000	-	0.000	0.000	0.000	56.7	-	4.133	3	\$139.00	5% increase in furnace efficiency - in homes with gas furnaces	0.58		
6058	HVAC Equipment	Boiler 92% plus AFUE	MF	NLI	ROB	0.000	-	-672.477	0.000	0.000	82.9	-	39.496	20	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	1.31		
6059	HVAC Equipment	Boiler 95% plus AFUE	MF	NLI	ROB	0.000	-	-672.477	0.000	0.000	82.9	-	46.343	20	\$2,436.00	Installing 95 AFUE boilers to replace standard boilers - in homes with gas boilers	1.28		
6060	HVAC Equipment	Boiler Tune-up	MF	NLI	RETRO	0.000	-	0.000	0.000	0.000	82.9	-	8.556	5	\$139.00	Increasing boiler efficiency by 5% - in homes with gas boilers	1.86		
6063	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	MF	LI	DI	1216.000	-	344.238	0.139	0.139	56.7	-	13.534	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	0.50		
6064	HVAC Equipment	O&M Tune-up - furnace only	MF	LI	DI	0.000	-	0.000	0.000	0.000	56.7	-	4.133	3	\$139.00	5% increase in furnace efficiency - in homes with gas furnaces	0.29		
6065	HVAC Equipment	Boiler 92% plus AFUE	MF	LI	DI	0.000	-	-672.477	0.000	0.000	82.9	-	39.496	20	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	0.65		
6066	HVAC Equipment	Boiler Tune-up	MF	LI	DI	0.000	-	0.000	0.000	0.000	82.9	-	8.556	5	\$139.00	Increasing boiler efficiency by 5% - in homes with gas boilers	0.93		
6072	HVAC Equipment	DFHP - SEER 18 with 95 AFUE furnace - SEER 14 base	MF	All	ROB	6466.164	-	1318.174	0.531	0.531	56.7	-	2.252	15	\$1,189.14	Installation of SEER 18/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.72		
6073	HVAC Equipment	DFHP - SEER 21 with 95 AFUE furnace - SEER 14 base	MF	All	ROB	6466.164	-	1977.260	0.796	0.796	56.7	-	3.378	15	\$2,125.65	Installation of SEER 21/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.44		
6074	HVAC Equipment	Programmable Thermostats Tier 1	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$50.00	Installation of Tier 1 programmable thermostat in homes with gas heating and central AC	0.00		
6075	HVAC Equipment	Programmable Thermostats Tier 2	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$100.00	Installation of Tier 2 programmable thermostat in homes with gas heating and central AC	0.00		
6076	HVAC Equipment	Programmable Thermostats Tier 3	MF	All	RETRO	471.631	0.067	31.599	0.000	0.000	56.7	-	2.130	10	\$126.66	Installation of Tier 3 programmable thermostat in homes with gas heating and central AC	1.04		
6077	HVAC Equipment	Programmable Thermostats Tier 1	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$50.00	Installation of Tier 1 programmable thermostat in homes with gas heating and no AC	0.00		
6078	HVAC Equipment	Programmable Thermostats Tier 2	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$100.00	Installation of Tier 2 programmable thermostat in homes with gas heating and no AC	0.00		
6079	HVAC Equipment	Programmable Thermostats Tier 3	MF	All	RETRO	0.000	-	0.000	0.000	0.000	56.7	-	2.168	10	\$126.66	Installation of Tier 3 programmable thermostat in homes with gas heating and no AC	0.90		
6080	HVAC Equipment	Programmable Thermostats Tier 1	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$50.00	Installation of Tier 1 programmable thermostat in homes with electric heating and central AC	0.00		
6081	HVAC Equipment	Programmable Thermostats Tier 2	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	10	\$100.00	Installation of Tier 2 programmable thermostat in homes with electric heating and central AC	0.00		
6083	HVAC Equipment	Smartphone Behavior Application	MF	All	RETRO	1583.278	0.011	16.624	0.000	0.000	41.5	1%	0.436	1	\$5.00	Use of smartphone application to deliver behavioral savings	0.92		
6084	HVAC Equipment	Smartphone Behavior Application	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	1	\$5.00	Use of smartphone application to deliver behavioral savings	0.00		
6085	HVAC Equipment	Smartphone Behavior Application	MF	All	RETRO	0.000	0.000	0.000	0.000	0.000	0.0	0%	0.000	1	\$5.00	Use of smartphone application to deliver behavioral savings	0.00		
6091	HVAC Equipment	O2 Trim Control	MF	All	RETRO	0.000	-	0.000	0.000	0.000	82.9	-	2.185	15	\$255.00	1.1% improvement in boiler efficiency resulting from the addition of oxygen trim controls - apartment buildings with boilers	0.59		
6092	HVAC Equipment	Boiler 85% Ec	MF	All	RETRO	0.000	-	0.000	0.000	0.000	82.9	-	11.311	20	\$7,232.27	5% increase in boiler efficiency - in apartments with gas boilers and no central AC	0.13		
6093	HVAC Equipment	Boiler turndown control	MF	All	RETRO	0.000	-	-129.352	0.000	0.000	82.9	-	13.229	15	\$195.00	Installing boiler turndown controls - in apartment buildings with boilers	4.12		
6098	HVAC Equipment	DFHP - SEER 18 with 95 AFUE furnace - SEER 14 base	MF	All	NC	7236.621	-	1410.408	0.584	0.584	56.7	-	3.577	15	\$1,189.14	Installation of SEER 18/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.93		
6099	HVAC Equipment	DFHP - SEER 21 with 95 AFUE furnace - SEER 14 base	MF	All	NC	7236.621	-	2115.613	0.875	0.875	56.7	-	5.365	15	\$2,125.65	Installation of SEER 21/95 AFUE dual fuel heat pump in homes with electric heating/cooling - baseline is 14 SEER/80 AFUE DFHP	1.62		
6106	HVAC Equipment	High efficiency 94 AFUE furnace with ECM	MF	All	NC	1216.000	-	248.338	0.144	0.144	56.7	-	11.432	15	\$1,427.65	Installation of 94 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	0.85		
6107	HVAC Equipment	High efficiency 98 AFUE furnace with ECM	MF	All	NC	1216.000	-	253.983	0.144	0.144	56.7	-	14.898	15	\$1,608.58	Installation of 98 AFUE furnace with electronically commutated motor - baseline is 80 AFUE furnace	0.90		
6109	HVAC Equipment	Boiler 92% plus AFUE	MF	All	NC	0.000	-	-560.533	0.000	0.000	82.9	-	32.978	20	\$1,954.00	Installing 92 AFUE boilers to replace standard boilers - in homes with gas boilers	1.09		
6110	HVAC Equipment	Boiler 95% plus AFUE	MF	All	NC	0.000	-	-560.560	0.000	0.000	82.9	-	38.545	20	\$2,436.00	Installing 95 AFUE boilers to replace standard boilers - in homes with gas boilers	1.06		
6111	HVAC Equipment	O2 Trim Control	MF	All	NC	0.000	-	0.000	0.000	0.000	82.9	-	1.629	15	\$255.00	1.1% improvement in boiler efficiency resulting from the addition of oxygen trim controls - apartment buildings with boilers	0.44		
6112	HVAC Equipment	Boiler 85% Ec	MF	All	NC	0.000	-	0.000	0.000	0.000	82.9	-	8.407	20	\$7,232.27	5% increase in boiler efficiency - in apartments with gas boilers and no central AC	0.10		
6113	HVAC Equipment	Boiler turndown control	MF	All	NC	0.000	-	-102.555	0.000	0.000	82.9	-	10.004	15	\$195.00	Installing boiler turndown controls - in apartment buildings with boilers	3.09		
8001	Cross-Cutting	Behavior Modification: Home Energy Reports	SF	All	RETRO	8226.000	0.020	164.520	0.019	0.019	107.5	1%	1.075	1	\$6.77	Delivery of home energy reports	3.27		
8002	Cross-Cutting	Behavior Modification: Home Energy Reports	SF	All	NC	8226.000	0.020	164.520	0.019	0.019	107.5	1%	1.075	1	\$6.77	Delivery of home energy reports	3.27		
8003	Cross-Cutting	Behavior Modification: Home Energy Reports	MF	All	RETRO	4113.000	0.020	82.260	0.009	0.009	53.7	1%	0.537	1	\$6.77	Delivery of home energy reports	1.64		
8004	Cross-Cutting	Behavior Modification: Home Energy Reports	MF	All	NC	4113.000	0.020	82.260	0.009	0.009	53.7	1%	0.537	1	\$6.77	Delivery of home energy reports	1.64		

The list of sources provided below indicates where key assumptions, algorithms, parameters, etc. were obtained to calculate measure level estimates of energy and demand savings, useful lives, measure cost, and baseline/efficient saturations. The key data sources are provided by residential end-use. Data sources are recorded by measure and can be produced if needed. A list of

End Use	Energy Savings	Demand Savings	EUL	Measure Cost	Base Saturation	EE Saturation
<b>Appliances</b>	<b>MEMD</b> Illinois TRM ENERGY STAR calculators GDS calculations	<b>MEMD</b> Illinois TRM ENERGY STAR calculators GDS calculations	<b>MEMD</b> Illinois TRM ENERGY STAR calculators	<b>MEMD</b> Illinois TRM ENERGY STAR calculators	<b>2013 RBS</b> <b>2013 RCASS</b> 2014 PA Baseline	<b>2013 RBS</b> 2014 PA Baseline GDS
<b>Water Heating</b>	<b>MEMD</b> GDS calculations	<b>MEMD</b> Vermont TRM	<b>MEMD</b> Illinois TRM	<b>MEMD</b> Illinois TRM	<b>2013 RBS</b> 2014 PA Baseline	<b>2013 RBS</b> 2014 PA Baseline GDS
<b>HVAC Equipment</b>	<b>MEMD</b>	<b>MEMD</b>	<b>MEMD</b>	<b>MEMD</b>	<b>2015 RCAS</b> <b>2013 RBS</b> <b>2013 RCASS</b> GDS	<b>2015 RCAS</b> <b>2013 RBS</b> <b>2013 RCASS</b> GDS
<b>HVAC Shell</b>	<b>MEMD</b>	<b>MEMD</b>	<b>MEMD</b>	<b>MEMD</b>	<b>2015 RCAS</b> <b>2013 RBS</b> <b>2013 RCASS</b> GDS	<b>2015 RCAS</b> <b>2013 RBS</b> <b>2013 RCASS</b> GDS
<b>Cross-Cutting</b>	<b>MEMD</b> GDS calculations	<b>MEMD</b> GDS calculations	<b>MEMD</b>	<b>MEMD</b>	<b>GDS</b>	<b>GDS</b>

List of Abbreviations
2013 RBS: DTE Energy Residential Baseline Study: First Quarter 2013
2013 RCASS: DTE Energy 2013 Residential Customer Appliance Saturation Survey
2014 PA Baseline: 2014 Pennsylvania Statewide Act 129 Residential Baseline Study
2015 RCAS: DTE Energy 2015 Residential Customer Appliance Survey



## APPENDIX B | COMMERCIAL MEASURE DETAIL

Michigan Commercial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life

DTE (Michigan)	Measure Assumption					
Measure Name	Annual MMBtu Savings	Cost Type: 1=Full 2=Inc.	Cost/Unit Descriptor	Cost/Unit	Effective Measure Life	Direct Utility Test
<b>Water Heating</b>						
Small High Efficiency Gas Water Heater	8.37	2	per heater	\$393.33	13	1.3
Large High Efficiency Gas Water Heater	30.83	2	per heater	\$1,135.00	13	1.7
Instant Gas Water Heater	60.20	2	per heater	\$285.00	20	17.3
Indirect Gas Water Heater	0.18	2	per MBH input capacity	\$14.09	15	0.9
Domestic Water Heater Tune-up	0.06	2	per MBH input capacity	\$2.50	2	0.3
Low Flow Showerhead	2.20	1	per unit	\$25.00	10	4.6
Low Flow Faucet Aerator	3.77	1	per unit	\$2.50	10	79.3
Pipe wrap - DHW	0.21	1	per linear foot	\$6.00	20	2.9
Pipe wrap - Boiler	0.80	1	per linear foot	\$6.62	20	9.9
High Efficiency Pool Heater	0.24	1	per MBtu input capacity	\$3.82	15	4.4
Pool Covers	0.09	1	per SF surface area	\$7.30	10	0.6
Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	4.43	2	per heater	\$400.70	7	0.4
Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	2.15	2	per MBH input capacity	\$97.97	7	0.9
Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	2.27	2	per MBH input capacity	\$102.03	7	0.9
ES Dishwasher, High Temp, Gas Heat, Elec Booster	29.83	2	per unit	\$241.62	16	9.0
ES Dishwasher, High Temp, Gas Heat, Gas Booster	46.88	2	per unit	\$622.89	16	5.5
ES Dishwasher, Low Temp, Gas Heat	52.80	2	per linear foot	\$171.39	16	22.4
Tank Insulation (gas)	1.91	1	per linear foot	\$2.22	15	59.5
Pre Rinse Sprayers (gas)	6.00	2	per MBtu input capacity	\$35.00	5	5.2
Solar Water Heating w/gas auxiliary tank (SEF=1.5)	67.68	1	per SF surface area	\$26,400.00	20	0.2
Refrigeration Waste Heat Recovery - DWH	9.47	1	Per Unit	\$180.00	15	3.6
Wastewater, Filtration/Reclamation	1396.00	1	Per Unit	\$150,000.00	20	0.8
O-zone Generator for Laundry	4.21	2	Per Unit	\$75.73	10	2.9
Solar pool heater	94.69	2	Per Unit	\$5,500.00	20	1.4
HVAC Condenser Heater Recovery Water Heating	14.05	2	Per Unit	\$254.00	15	3.8
Process Cooling Condenser Heater Recovery Water Heating	22.65	2	per SF	\$254.00	15	6.2
Energy Efficient Windows	11.41	2	100SF	\$954.08	25	1.1
Ceiling Insulation	15.32	1	1000 sq ft roof area	\$505.68	30	3.0
Wall Insulation	120.78	1	1000 sq ft wall area	\$90.86	30	130.4
Roof Insulation	3.56	1	1000 sq ft	\$348.95	30	1.0
Integrated Building Design	840.00	2	Per Building	\$15,065.37	30	5.5
Building Operator Certification	156.40	2	per participant of 194,500 SF	\$407.46	5	11.6
Duct Insulation	2.04	2	Per SF	\$3.10	25	60.0
Window Improvements	3.16	1	100 sq ft glazing	\$259.16	15	0.9
EMS install	1.39	1	1000 sq ft cond floor area	\$1.19	15	81.1
EMS Optimization	3.38	1	1000 sq ft cond floor area	\$12.77	20	21.7
HVAC Occupancy Sensors	5.33	2	1000 sq ft cond floor area	\$284.83	15	1.3
Retrocommissioning	0.05	1	per sq ft	\$0.30	7	6.0
Commissioning	0.04	1	per sq ft	\$1.16	7	1.4
Programmable Thermostats	1.80	1	1000 sq ft cond floor area	\$115.77	9	0.8
EMS Pump Scheduling Controls	15.03	2	per hp	\$3.54	15	294.0
Web enabled EMS	45.71	2	1000 sq ft cond floor area	\$136.56	15	23.2
Gas Furnace 92 AFUE	0.24	2	per kBtuh	\$9.58	15	1.7
Gas Furnace 95 AFUE	0.30	2	per kBtuh	\$9.58	15	2.2
Improved Duct Sealing - Heating	2.32	2	per ton	\$107.91	18	1.7
Gas Unit Heater - Condensing (AFUE =93%)	64.94	2	per 200 kBtuh	\$2,640.00	19	2.0
Infrared Heater	0.36	2	per kBtuh	\$2.20	15	24.9
Boiler Tune-Up	0.03	2	per kBtuh	\$0.83	2	0.5
Boiler Reset Controls	0.06	2	per kBtuh	\$2.78	15	229.9
Boiler O2 Trim Controls	0.02	2	per kBtuh	\$0.85	15	1.4
Repair/Replace malfunctioning steam traps	29.80	2	per unit	\$168.00	5	5.4
Destratification Fans (HVLS)	8.35	2	1000 sq ft cond floor area	\$362.25	15	1.6
Exhaust Hood Makeup Air	345.86	2	0.000	\$5,900.00	20	6.3
Demand Controlled Ventilation	14.87	2	0.000	\$75.00	15	13.7

Michigan Commercial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life

DTE (Michigan)		Measure Assumption				
Measure Name	Annual MMBtu Savings	Cost Type: 1=Full 2=Inc.	Cost/Unit Descriptor	Cost/Unit	Effective Measure Life	Direct Utility Test
CKV Hood with Demand Control	0.04	2	cfm	\$0.21	20	21.4
Engineered CKV hood	19.01	2	100 cfm red	\$191.38	15	6.9
Guest Room Energy Management, Gas Heating	6.10	2	control	\$250.00	8	1.9
Boiler Efficiency Improvement 80% to 88%	0.08	2	per kBtuh	\$12.31	20	0.5
Condensing Boiler 90% Ec	0.13	2	per kBtuh	\$24.62	20	0.5
Boiler turndown control	0.10	2	per kBtuh	\$0.65	15	9.6
Boiler Economizer	0.04	2	per kBtuh	\$4.50	15	0.6
Sensible ERV (Flat plate HX)	0.05	2	cfm	\$2.86	15	0.7
Total ERV (Enthalpy Wheel)	0.06	2	cfm	\$3.16	15	0.6
Boiler sequencing	0.05	2	per kBtuh	\$21.67	15	0.2
Furnace Tune-Up	0.03	2	per kBtuh	\$17.87	3	0.0
Linkageless and O2 Trim Controls	0.05	2	per kBtuh	\$2.35	5	0.7
VAV System Conversion	26.88	1	1000 sq ft cond floor area	\$604.24	20	3.6
High Efficiency Gas Griddle	14.90	2	per unit	\$4,575.00	12	0.2
High Efficiency Gas Combination Oven	40.30	2	per unit	\$21,797.00	12	0.1
High Efficiency Gas Convection Oven	30.60	2	per unit	\$326.00	12	5.6
High Efficiency Gas Conveyer Oven	80.85	2	per unit	\$3,241.00	12	1.5
High Efficiency Gas Rack Oven	157.35	2	per unit	\$8,433.50	12	1.1
Power Burner Range	40.80	2	per unit	\$1,400.00	7	1.2
High Efficiency Fryer	50.50	2	per unit	\$1,477.00	12	2.0
High Efficiency Gas Steamer	205.90	2	per unit	\$6,221.00	12	2.0
Large Vat Fryer	57.70	2	per unit	\$3,122.00	12	1.1
Flexible Batch Broiler	129.95	2	per unit	\$8,517.50	12	0.9





















## Michigan Commercial Measure Database - Natural Gas

### Natural Gas Measure Sources

Source Number	Source
1	Michigan Master Database of Deemed Savings - 2013 - Non-Weather Sensitive Commercial
2	Michigan Master Database of Deemed Savings - 2013 - Weather Sensitive Commercial
3	MEMD Workpaper
3	ENERGY STAR Qualified Office Equipment Calculator
4	Efficiency Vermont TRM User Manual No. 2014-87
5	Drain Water Heat Recovery Characterization and Modeling - Final Report, C. Zaloum, M. Lafrance, J Gusdorf, 2007
6	California Energy Commission Codes and Standards Enhancement (CASE) Initiative: Analysis of Standards Options for Residential Swimming Pool & Portable Spa Equipment, July 2013
7	Mid-Atlantic TRM Version 4.0 June 2014
8	DC DDOE Natural Gas Efficiency Potential, Dec 2012 Completed by GDS Associates, Inc.
9	Previous GDS Studies
10	Building Commissioning - A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions. Lawrence Berkeley National Laboratory. Report Prepared for: California Energy Commission Public Interest Energy Research (PIER) - July 21, 2009
11	DTE Energy 2013 Commercial Baseline Study - < 1% Saturation of process heat recovery
12	DTE Energy 2013 Commercial Baseline Study - 45% of respondents have HW Temp Reset Controls
13	DTE Energy 2013 Commercial Baseline Study - 62% of respondent combination customers are always on
14	DTE Energy 2013 Commercial Baseline Study - Table 3-12, installations multiplied by 1.2 to account for Some instead of All and gas having higher breakout in customer type
15	DTE Energy 2013 Commercial Baseline Study -11% of respondent combination customers have external tank insulation
16	DTE Energy 2013 Commercial Baseline Study -19% uninsulated boiler pipes overall with a noted 41% opportunity in lodging
17	DTE Energy 2013 Commercial Baseline Study -25% of respondent combination customers have insulated pipes weighted by input capacity
18	DTE Energy 2013 Commercial Baseline Study 39% of windows single pane
19	DTE Energy 2013 Commercial Baseline Study average roof values in comparison to baseline MEMD WX
20	DTE Energy 2013 Commercial Baseline Study Table 3-18, 1/3 of fryers are high efficiency
21	DTE Energy 2013 Commercial Baseline Study Table 3-40, EMS
22	DTE Energy 2013 Commercial Baseline Study Table 3-40, Manual thermostat or Manual ON/OFF
23	DTE Energy 2013 Commercial Baseline Study Table 3-40, Manual thermostat or Manual ON/OFF for Lodging
24	DTE Energy 2013 Commercial Baseline Study Table 3-40, Without EMS
25	DTE Energy 2013 Commercial Baseline Study, 1/3 of fryers are high efficiency
26	DTE Energy 2013 Commercial Baseline Study, 56% uninsulated ducts; Measure applicability from MEMD WX
27	DTE Energy 2013 Commercial Baseline Study, 8% of boilers are condensing
28	DTE Energy 2013 Commercial Baseline Study, Hot Water Boilers < than .88 weighted
29	DTE Energy 2013 Commercial Baseline Study, HVAC systems with economizers from respondents with larger weighted 67% and smaller weighted at 33%
30	DTE Energy 2013 Commercial Baseline Study, Table 3-2 26% have performed maintenace in last year
31	DTE Energy 2013 Commercial Baseline Study, Table 3-2 9 of 9% have performed maintenance in last year
32	DTE Energy 2013 Commercial Baseline Study, Water Heater Age > 10 years 38%
33	EIA, 2003 CBECS, New England, Non Mall saturation, square footage
34	GDS Associates Estimate/Calculation
35	GDS SURVEY
36	GDS Survey; Measure applicability from MEMD WX
37	Independent Assessment of Conservation and Energy Efficiency Potential for Connecticut and the Southwest Connecticut Region, GDS Associates, June 2004
38	Michigan Baseline 2011: Commercial Baseline Report
39	NYSERDA Natural Gas Potential Study
40	GDS Estimate including Water Heating, DHW Generation and Storage Equipment



## Michigan Commercial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life, Savings Factor, Remaining Factor Sources

Reference numbers designate source for information from Natural Gas Measure Source List

Measure Name	Annual kWh Savings	Cost/ Unit	Effective Measure Life	Savings Factor	Remaining Factor
<b>Water Heating</b>					
Small High Efficiency Gas Water Heater	1	1	1	3	32
Large High Efficiency Gas Water Heater	1	1	1	3	38
Instant Gas Water Heater	1	1	1	3	38
Indirect Gas Water Heater	1	1	1	3	34
Domestic Water Heater Tune-up	1	1	1	3	31
Low Flow Showerhead	1	1	1	3	14
Low Flow Faucet Aerator	1	1	1	3	14
Pipe wrap - DHW	1	1	1	3	17
Pipe wrap - Boiler	1	1	1	3	16
High Efficiency Pool Heater	1	1	1	3	34
Pool Covers	1	1	1	3	34
Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	1	1	1	3	38
Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	1	1	1	3	38
Clothes Washer ENERGY STAR, Electric Water heater, Gas Dryer	1	1	1	3	38
ES Dishwasher, High Temp, Gas Heat, Elec Booster	1	1	1	3	38
ES Dishwasher, High Temp, Gas Heat, Gas Booster	1	1	1	3	38
ES Dishwasher, Low Temp, Gas Heat	1	1	1	3	38
Tank Insulation (gas)	1	1	1	1	15
Pre Rinse Sprayers (gas)	1	1	1	1	35
Solar Water Heating w/gas auxiliary tank (SEF=1.5)	8	8	8	8	40
Refrigeration Waste Heat Recovery - DWH	1	1	1	1	11
Wastewater, Filtration/Reclamation	8	8	8	8	34
O-zone Generator for Laundry	1	1	1	1	38
Solar pool heater	9	9	9	9	34
HVAC Condenser Heater Recovery Water Heating	1	1	1	1	11
Process Cooling Condenser Heater Recovery Water Heating	1	1	1	1	11
<b>Energy Efficient Windows</b>					
Energy Efficient Windows	2	2	2	2	18
Ceiling Insulation	2	2	2	2	38
Wall Insulation	2	2	2	2	38
Roof Insulation	2	2	2	2	19
Integrated Building Design	9	9	9	9	38
Building Operator Certification	1	1	1	1	34
Duct Insulation	1	1	1	1	26
Window Improvements	2	2	2	2	18
EMS install	2	2	2	2	24

## Michigan Commercial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life, Savings Factor, Remaining Factor Sources

Reference numbers designate source for information from Natural Gas Measure Source List

Measure Name	Annual kWh Savings	Cost/ Unit	Effective Measure Life	Savings Factor	Remaining Factor
EMS Optimization	2	2	2	2	21
HVAC Occupancy Sensors	2	2	2	2	24
Retrocommissioning	9	10	9	9	35
Commissioning	9	10	9	9	33
Programmable Thermostats	2	2	2	2	22
EMS Pump Scheduling Controls	2	2	2	2	13
Web enabled EMS	2	2	2	2	24
Gas Furnace 92 AFUE	2	2	2	2	35
Gas Furnace 95 AFUE	2	2	2	2	34
Improved Duct Sealing - Heating	2	2	2	2	36
Gas Unit Heater - Condensing (AFUE =93%)	9	9	9	9	37
Infrared Heater	2	2	2	2	34
Boiler Tune-Up	2	2	2	2	30
Boiler Reset Controls	2	2	2	2	12
Boiler O2 Trim Controls	2	2	2	2	34
Repair/Replace malfunctioning steam traps	1	1	1	1	34
Destratification Fans (HVLS)	2	2	2	2	34
Exhaust Hood Makeup Air	9	9	9	9	38
Demand Controlled Ventilation	9	9	9	2	38
CKV Hood with Demand Control	2	2	2	2	34
Engineered CKV hood	2	2	2	2	34
Guest Room Energy Management, Gas Heating	2	2	2	2	23
Boiler Efficiency Improvement 80% to 88%	2	2	2	2	28
Condensing Boiler 90% Ec	2	2	2	2	27
Boiler turndown control	2	2	2	2	38
Boiler Economizer	2	2	2	2	29
Sensible ERV (Flat plate HX)	2	2	2	2	38
Total ERV (Enthalpy Wheel)	2	2	2	2	34
Boiler sequencing	2	2	2	2	38
Furnace Tune-Up	2	2	2	2	34
Linkageless and O2 Trim Controls	2	2	2	2	39
VAV System Conversion	2	2	2	2	34
High Efficiency Gas Griddle	1	1	1	1	38
High Efficiency Gas Combination Oven	1	1	1	1	34
High Efficiency Gas Convection Oven	1	1	1	1	38
High Efficiency Gas Conveyer Oven	1	1	1	1	38
High Efficiency Gas Rack Oven	1	1	1	1	34
Power Burner Range	9	9	9	9	38
High Efficiency Fryer	1	1	1	1	20
High Efficiency Gas Steamer	1	1	1	1	38
Large Vat Fryer	1	1	1	1	25
Flexible Batch Broiler	1	1	1	1	34

## APPENDIX C | INDUSTRIAL MEASURE DETAIL

Michigan Industrial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life

DTE (Michigan)		Measure Assumption					
Measure Name		Annual MMBTU Savings	Cost Type: 1=Full 2=Inc.	Cost/Unit Descriptor	Cost/Unit	Effective Measure Life	UCT
<b>Conventional Boiler Use</b>							
High Efficiency Hot Water Boiler		0.15	2	per heater	\$11.00	20	1.1
Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)		1.00	2	\$/unit	\$55.59	18	1.4
High Efficiency Steam Boiler		0.10	2	\$/kBtu	\$12.90	20	0.6
High Efficiency Hot Water Boiler (>300,000 Btu/h) Eff. =85%-90%)	(Th.	1.00	2	per PC	\$21.20	25	4.3
Condensing Boiler (>300,000 Btu/h) (EF>90%) >=90%)	(Th. Eff.	1.00	2	\$/unit	\$24.91	18	3.1
High Efficiency Steam Boiler (>300,000 Btu/h) (Th. Eff. >=80%)		1.00	2	per mmBtu	\$46.99	25	1.9
Boiler Tune-Up		303.90	1	per 100 hp	\$850.00	5	10.8
Boiler Pipe Insulation		1.00	1	per mmBtu	\$24.25	15	2.9
Boiler Reset Controls		1.00	1	per unit	\$47.63	20	1.7
O2 Burner Controls		0.07	1	\$/kBtu	\$0.85	15	5.7
Linkageless Controls for Boilers		0.07	1	\$/kBtu	\$1.80	15	2.7
Automatic Boiler Blowdown		0.00	1	\$/gal avoided	\$0.02	15	6.9
Repair Malfunctioning Steam Traps		1.00	1	per mmBtu	\$5.86	5	5.2
Insulate Steam Lines / Condensate Tank		1.00	1	per mmBtu	\$14.43	15	4.8
<b>Process Heating</b>							
High Efficiency Hot Water Boiler		0.15	2	per heater	\$11.13	20	1.1
Condensing Boiler (>300,000 Btu/h) (EF>90%) >=90%)	(Th. Eff.	1.00	2	\$/Unit	\$24.90	18	3.1
High Efficiency Steam Boiler		0.10	2	\$/kBtu	\$13.00	20	0.6
Repair Malfunctioning Steam Traps		1.00	1	per mmBtu	\$5.86	5	5.2
Direct Contact Water Heater		1.00	1	\$/unit	\$24.90	20	3.3
Process Boiler Tune-Up		303.90	1	per 100 hp	\$850.00	5	10.8
Boiler Pipe Insulation		1.00	1	per unit	\$14.05	15	4.9
Boiler Reset Controls		1.00	1	per unit	\$47.63	20	1.7
O2 Burner Control for Process		0.07	1	\$/kBtu	\$0.85	15	5.7
Linkageless Controls for Process Boilers		0.07	1	\$/kBtu	\$1.80	15	2.7
Waste-Heat Recovery		1.00	1	per unit	\$25.00	10	13.0
Regenerative Thermal Oxidizer vs. STO		1.00	1	\$/unit	\$4.06	10	2.1
Regenerative Thermal Oxidizer vs. CTO		1.00	1	per unit	\$34.38	10	1.5
Improved Sensors & Process Controls		1.00	1	per unit	\$34.29	5	1.5
Refrigeration Heat Recovery		1.00	1	linear ft	\$20.40	15	3.4
Process Boiler Sequencing		39.60	1	\$/kBtu	\$650.00	15	4.2
Process Boiler Stack Economizer		1.05	1	\$/kBtu	\$5.00	15	15.2
Automatic Boiler Blowdown		0.00	1	\$/gal avoided	\$0.02	15	6.9
Modulated Boiler Controls for Process		0.11	1	\$/kBtu	\$0.65	15	11.2
Air Compressor Exhaust Heat Recovery		4.20	1	\$/hp	\$75.00	15	3.9
Process Dryer Exhaust Rate Control		0.70	1	\$/hp	\$2.00	15	24.2
<b>Facility HVAC</b>							
High Efficiency Furnace (<=300,000 Btu/h) (AFUE >=92%)		1.00	2	\$/MMBtu	\$19.31	18	4.0
Gas Unit Heater - Condensing		1.00	2	\$/MMBtu	\$65.27	22	1.3
Infrared Heater (low intensity - two stage)		1.00	2	\$/MMBtu	\$18.83	17	4.0
Insulate and Seal Ducts (New Aerosol Duct Sealing)		1.00	1	\$/MMBtu	\$501.67	20	0.2
Stack Heat Exchanger (Standard Economizer)		1.00	1	\$/MMBtu	\$16.54	20	4.9
Stack Heat Exchanger (Condensing Economizer)		1.00	1	\$/MMBtu	\$11.16	20	7.3
Heat Recovery: Air to Air		1.00	1	\$/MMBtu	\$163.93	20	0.5
Direct Fired Make-up Air System		1.00	1	\$/MMBtu	\$59.01	20	1.4

**Michigan Industrial Measure Database - Natural Gas**

Measure Savings, Cost and Useful Life

DTE (Michigan)	Measure Assumption					
Measure Name	Annual MMBTU Savings	Cost Type: 1=Full 2=Inc.	Cost/Unit Descriptor	Cost/Unit	Effective Measure Life	UCT
<b>Building Envelope</b>						
Integrated Building Design	840.00	2	\$/unit	\$166,226.40	30	0.5
Energy Efficient Windows	11.40	2	100SF	\$954.08	20	1.0
Ceiling Insulation R-11 to R-42	15.32	1	000 sq ft roof area	\$505.68	20	2.5
Wall Insulation R-7.5 to R13	123.42	1	000 sq ft wall area	\$100.00	20	100.9
Roof Insulation R-11 to R-24	3.57	1	000 sq ft roof area	\$348.95	20	0.8
Truck Loading Dock Seals	40.20	1	per door	\$2,857.00	20	1.2
<b>Ventilation</b>						
Demand-Controlled Ventilation	37.16	2	1) sq ft cond floor	\$75.00	15	34.3
Improved Duct Sealing	2.32	2	ton	\$107.91	18	1.7
De-stratification Fan	8.35	1	1) sq ft cond floor	\$375.00	15	1.5
<b>HVAC Controls</b>						
Programmable Thermostats	20.75	1	1) sq ft cond floor	\$49.71	9	20.3
EMS install	1.37	1	1) sq ft cond floor	\$1.19	15	80.0
EMS Optimization	3.38	1	1000 sq ft	\$12.77	17	19.6
Retrocommissioning	0.05	2	1) sq ft cond floor	\$0.30	15	13.0
<b>Agriculture</b>						
Greenhouse Under-Floor/Under-Bench Hydronic Heating	0.34	1	\$/sq ft	\$12.00	20	2.3
Heat Curtains for Greenhouses	0.13	1	\$/sq ft	\$2.50	5	1.6
Other Industrial -Grain Dryer	0.35	1	\$/100 Bushels	\$18.00	15	1.3
IR Film for Greenhouses	0.01	1	\$/sq ft	\$0.11	5	8.8



















Natural Gas Measure Sources

Source Number	Source
1	Michigan Master Database of Deemed Savings - 2013 - Non-Weather Sensitive Commercial
2	Michigan Master Database of Deemed Savings - 2013 - Weather Sensitive
3	Federal Energy Management Program (FEMP), Energy Cost Calculator for Electric and Gas Water Heaters
4	GDS Associates estimate based upon review of various customer and vendor surveys, baseline studies and potential studies conducted by GDS in other states
5	Therma-Stor Return On Investment Calculation Form, <a href="http://www.thermastor.com/Heat-Recovery-water-Heaters/Heat-Recovery-ROI-Form.pdf">http://www.thermastor.com/Heat-Recovery-water-Heaters/Heat-Recovery-ROI-Form.pdf</a>
6	Natural Gas Energy Efficiency Resource Development Potential in New York, Final Report for NYSERDA, by Optimal Energy, ACEEE, VEIC, Resource Insight and Energy & Environmental Analysis, October 2006, Appendix C
7	US DOE- Federal Energy Management Program (FEMP): Heat Recovery from Wastewater Using a Gravity-Film Heat Exchanger
8	Food Service Technology Center, Pre-Rinse Spray Valve/Water Cost Calculator
9	Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants, An Emerging Technology Field Monitoring Study, FSTC Report 5011.07.04, Food Service Technology Center, April 2007
10	US DOE - Energy Efficiency And Renewable Energy - Estimating a Solar Water Heater System's Cost
11	Gene Dedick - East Coast VP Sales - AquaRecycle - ph: 210-325-9258: 1,248,000 lbs/yr = 30 gpm washer-extractor system with lint shaker.
12	<a href="http://www.aquarecycle.com/laundry-water-energy-savings.php">http://www.aquarecycle.com/laundry-water-energy-savings.php</a>
13	Commercial Laundry Conservation Technologies, Bill Hoffman, James Riesenberger
14	Trevor Brown Southeastern Laundry/Commercial Laundry Conservation Technologies - Bill Hoffman, James Riesenberger
15	US DOE - Energy Efficiency And Renewable Energy - Determining Gas Swimming Pool Heating Efficiency - <a href="http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13170">http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13170</a>
16	NYSERDA Deemed Savings Database, Rev 09-082006.
17	Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008)
18	Gas Solutions for the Foodservice Industry, <a href="http://www.gfen.info/pdf/cookinggas0107.pdf">http://www.gfen.info/pdf/cookinggas0107.pdf</a>
19	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003; Questar 2006 DSM Market Characterization Report, Nexant, Appendix D (sq ft) & E (cost/sq ft).
20	Cost of the most common type of steam trap (Inverted bucket trap) according to Grainger catalog ranges from \$125 - \$147, plus one hour of labor @ \$100/hr. <a href="http://www.grainger.com/Grainger/ecatalog/N-bkg/No-16/Ntt-inverted+bucket+trap?Ns=List+Price%7CO">http://www.grainger.com/Grainger/ecatalog/N-bkg/No-16/Ntt-inverted+bucket+trap?Ns=List+Price%7CO</a>
21	Greenheck sales representative cost and measure life information on 5,000 CFM model. (\$4,500 materials, \$1,000 labor, and \$400 crane rental (to lift onto roof))
22	<a href="http://www.cleanboiler.org/Eff_Improve/Efficiency/Boiler_Reset_Control.asp">http://www.cleanboiler.org/Eff_Improve/Efficiency/Boiler_Reset_Control.asp</a>
23	Measure information from Nexant's "Gas Energy Efficiency Measure Analysis to Support NYSERDA's Con Edison Gas Efficiency Program" reported in August 2005. Savings unit is MMBtu/unit. Baseline efficiency from DOE
24	Natural Gas Boiler/Burner Consortium - <a href="http://www.energysolutionscenter.org/boilerburner/Eff_Improve/Efficiency/Oxygen_Control.asp">http://www.energysolutionscenter.org/boilerburner/Eff_Improve/Efficiency/Oxygen_Control.asp</a>
25	Found a wide range (4% - 16%) of savings estimates based on literature review Used a mid-range savings estimate factor of 10%
26	5% - 10% improvement in energy associated with losses (Optimizing Steam Systems: Saving Energy and Money in Mexican Hotels, by David Jaber, Alliance to Save Energy) GDS estimates that poor insulation represents 15%- 20% of total gas input.
27	Review of various internet sites including Zoo Fans (25%), Big Ass Fan Company (30%) and Energy Wales (20%)
28	Natural Gas Energy Efficiency Resource Development Potential in New York, Final Report for NYSERDA, by Optimal Energy, ACEEE, VEIC, Resource Insight and Energy & Environmental Analysis, October 2006 - Appendix C - MD ENERGY SAVINGS FRACTIONS
29	Flex Your Power, Demand Ventilation Control Reduces Kitchen Fan Energy Consumption by 50% to 70% and makeup air heating energy by 25%: <a href="http://www.fypower.org/news/?p=682">http://www.fypower.org/news/?p=682</a>
30	Natural Gas Energy Efficiency Resource Development Potential in New York, Final Report for NYSERDA, by Optimal Energy, ACEEE, VEIC, Resource Insight and Energy & Environmental Analysis, October 2006 Appendix C - RET ENERGY SAVINGS FRACTIONS. (Average across all building types - varies significantly based on occupancy and ventilation requirements )
31	ACEE, Emerging Energy Saving Technologies & Practices for the Buildings Sector, 2004 (6 zones at \$575 per zone) p 102. Assessment of Energy and Capacity Savings Potential in Iowa', Prepared for The Iowa Utility Association February 15, 2008. In Collaboration with Summit Blue Consulting, Nexant, Inc., A-TEC Energy Corporation, and Britt/Makela Group; Natural Gas Energy Efficiency Resource Development Potential in New York, Final Report for NYSERDA, by Optimal Energy, ACEEE, VEIC, Resource Insight and Energy & Environmental Analysis, October 2006 Appendix B p 40-44
32	Actual average project cost provided by NGRID for NY projects
33	ACEE, Emerging Energy Saving Technologies & Practices for the Buildings Sector, 2004
34	Energy Efficiency and Renewable Energy Resource Development Potential in New York State - Final Report, Volume 5 Energy Efficiency Technical Appendices
35	<a href="http://www.toolbase.org/Technology-Inventory/HVAC/hvac-smart-zoning-controls">http://www.toolbase.org/Technology-Inventory/HVAC/hvac-smart-zoning-controls</a>
36	Energy Star Cost Calculator, Energy Star Website, <a href="http://www.energystar.gov">www.energystar.gov</a> .
37	GasNetworks Aug08update - "Validating the Impacts of Programmable Thermostats." GasNetworks, January 2007
38	EIA, 2003 CBECs, New England, Non Mall saturation, square footage
39	For Combo Heating / Water Heating Units costs and savings add up similar separate equipment from water heating tab and space heating tab. Literature claims combined system equipment costs are higher, installation costs lower compared to separate systems.
40	Gas Fired water Heater Screening Tool <a href="http://bea.ugi.esource.com/BEA1/PA/PA_WaterHeating/PA-41_calc">http://bea.ugi.esource.com/BEA1/PA/PA_WaterHeating/PA-41_calc</a>
41	Building Commissioning - A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions. Lawrence Berkeley National Laboratory. Report Prepared for:
42	California Energy Commission Public Interest Energy Research (PIER) - July 21, 2009
43	GDS Natural Gas Energy Efficiency Potential in Massachusetts - April 2009
44	MEMD Support Documentation - 2014 - Workbooks and Algorithms
45	Michigan Baseline 2011: Commercial Baseline Report
46	Codes and Standards Enhancement Initiative for PY2004: Title 20 Standards Development, Analysis of Standards Options for Portable Electric Spas, Davis Energy Group Energy Solutions, May 12, 2004



Michigan Industrial Measure Database - Natural Gas

Natural Gas Measure Sources

Source Number	Source
47	Massachusetts Farm Energy Guides by Farm Sector: Best Management Practices for Greenhouses, 2010
48	Public Service New Mexico Electric Energy Efficiency Potential Study; Itron, Inc., September 2006
49	DTE Energy Commercial Baseline Study; Opinion Dynamics Corporation, October 2010
50	GDS Maine Potential Study (GDS Engineering Estimates)
51	U.S. Energy Information Administration, Model Documentation Report: Industrial Demand Module of the National Energy Modeling System, May 2013.
52	GDS Maryland Gas Potential Study, 2011.
53	Advancing Energy Efficiency In Arkansas, ACEEE, March 2011, p. 173

## Michigan Industrial Measure Database - Natural Gas

Measure Savings, Cost and Useful Life, Savings Factor, Remaining Factor Sources

Reference numbers designate source for information from Natural Gas Source List

Measure Name	Annual MMBTU Savings	Cost/Unit	Effective Measure Life	Savings Factor	Remaining Factor
<b>Building Envelope</b>					
Integrated Building Design	2	2	3	4	45
Energy Efficient Windows	2	2	3	2	45
Ceiling Insulation R-11 to R-42	4	4	3	4	45
Wall Insulation R-7.5 to R13	2	2	3	4	45
Roof Insulation R-11 to R-24	2	2	3	4	45
Truck Loading Dock Seals	2	2	3	4	45
<b>HVAC Controls</b>					
Programmable Thermostats	38	37	3	43	45
EMS install	2	2	3	48	45
EMS Optimization	4	35	3	35	4
Retrocommissioning	4	36	3	48	4
<b>Conventional Boiler Use</b>					
High Efficiency Hot Water Boiler	52	52	52	52	51
Condensing Boiler (<=300,000 Btu/h) (AFUE>90%)	52	52	52	52	51
High Efficiency Steam Boiler	52	52	52	52	51
High Efficiency Hot Water Boiler (>300,000 Btu/h) (Th. Eff. =85%-90%)	52	52	52	52	51
Condensing Boiler (>300,000 Btu/h) (EF>90%) (Th. Eff. >=90%)	52	52	52	52	51
High Efficiency Steam Boiler (>300,000 Btu/h) (Th. Eff. >=80%)	52	52	52	52	51
Boiler Tune-Up	52	52	52	52	51
Boiler Pipe Insulation	52	52	52	52	51
Boiler Reset Controls	52	52	52	52	51
O2 Burner Controls	52	52	52	52	51
Linkageless Controls for Boilers	52	52	52	52	51
Automatic Boiler Blowdown	52	52	52	52	51
Repair Malfunctioning Steam Traps	52	52	52	52	51
Insulate Steam Lines / Condensate Tank	52	52	52	52	51
<b>Process Heating</b>					
High Efficiency Hot Water Boiler	44	44	44	44	3
Condensing Boiler (>300,000 Btu/h) (EF>90%) (Th. Eff. >=90%)	52	52	52	52	51
High Efficiency Steam Boiler	44	44	44	44	3
Repair Malfunctioning Steam Traps	52	52	52	52	51
Direct Contact Water Heater	52	52	52	52	51
Process Boiler Tune-Up	52	52	52	52	51
Boiler Pipe Insulation	52	52	52	52	51
Boiler Reset Controls	52	52	52	52	51
O2 Burner Control for Process	44	44	44	44	3
Linkageless Controls for Process Boilers	44	44	44	44	3
Waste-Heat Recovery	53	53	53	53	51
Regenerative Thermal Oxidizer vs. STO	53	53	53	53	51
Regenerative Thermal Oxidizer vs. CTO	53	53	53	53	51

**Michigan Industrial Measure Database - Natural Gas**

Measure Savings, Cost and Useful Life, Savings Factor, Remaining Factor Sources

Reference numbers designate source for information from Natural Gas Source List

Measure Name	Annual MMBTU Savings	Cost/Unit	Effective Measure Life	Savings Factor	Remaining Factor
Improved Sensors & Process Controls	53	53	53	53	51
Refrigeration Heat Recovery	53	53	53	53	51
Process Boiler Sequencing	44	44	44	44	3
Process Boiler Stack Economizer	44	44	44	44	3
Automatic Boiler Blowdown	44	44	44	44	3
Modulated Boiler Controls for Process	44	44	44	44	3
Air Compressor Exhaust Heat Recovery	44	44	44	44	3
Process Dryer Exhaust Rate Control	44	44	44	44	3
<b>Facility HVAC</b>					
High Efficiency Furnace (<=300,000 Btu/h) (AFUE >=92%)	52	52	52	52	51
Gas Unit Heater - Condensing	52	52	52	52	51
Infrared Heater (low intensity - two stage)	52	52	52	52	51
Insulate and Seal Ducts (New Aerosl Duct Sealing)	52	52	52	52	51
Stack Heat Exchanger (Standard Economizer)	52	52	52	52	51
Stack Heat Exchanger (Condensing Economizer)	52	52	52	52	51
Heat Recovery: Air to Air	52	52	52	52	51
Direct Fired Make-up Air System	52	52	52	52	51
<b>Agriculture</b>					
Greenhouse Under-Floor/Under-Bench Hydronic Heating	44	44	44	44	3
Heat Curtains for Greenhouses	44	44	44	44	3
Other Industrial -Grain Dryer	44	44	44	44	3
IR Film for Greenhouses	44	44	44	44	3

## APPENDIX D | GLOBAL ASSUMPTIONS



## APPENDIX E | INCREMENTAL ANNUAL SAVINGS BY SECTOR

**Incremental Annual Residential Electric Energy Savings in the Achievable UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Appliances	Water Heating	HVAC Shell	HVAC Equipment	Cross-Cutting	Total	% of Annual Sales
2016	7,353	115,117	523,753	316,997	283,004	1,246,224	1.1%
2017	8,776	127,301	579,107	350,073	299,868	1,365,125	1.2%
2018	10,530	144,477	637,291	392,069	317,060	1,501,427	1.3%
2019	12,048	158,067	692,668	427,658	333,818	1,624,258	1.5%
2020	13,565	171,658	747,576	463,248	350,170	1,746,218	1.6%
2021	15,080	185,205	801,952	498,761	366,008	1,867,006	1.7%
2022	16,594	198,744	855,782	534,259	381,272	1,986,652	1.8%
2023	18,108	212,276	909,029	569,743	395,907	2,105,062	1.9%
2024	19,621	225,799	961,656	605,212	409,855	2,222,142	1.9%
2025	21,133	239,314	1,013,626	640,667	423,061	2,337,801	2.0%
2026	21,393	245,362	607,788	635,891	421,396	1,931,830	1.7%
2027	22,765	241,044	597,451	634,938	420,040	1,916,238	1.7%
2028	22,718	245,054	547,265	633,986	418,963	1,867,986	1.6%
2029	23,181	242,567	601,880	633,033	418,573	1,919,235	1.6%
2030	23,177	240,082	563,547	632,081	418,486	1,877,373	1.6%
2031	23,172	237,547	531,131	675,218	419,425	1,886,494	1.6%
2032	23,164	235,013	495,097	671,409	420,767	1,845,449	1.6%
2033	23,156	232,479	459,279	684,449	422,478	1,821,840	1.5%
2034	23,148	229,945	437,784	684,345	424,592	1,799,814	1.5%
2035	23,139	227,411	404,253	684,243	427,114	1,766,160	1.5%

**Incremental Annual Electric Residential Energy Savings in the Constrained UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Appliances	Water Heating	HVAC Shell	HVAC Equipment	Cross-Cutting	Total	% of Annual Sales
2016	3,089	48,350	219,982	133,142	118,865	523,429	0.5%
2017	3,476	50,417	229,354	138,646	118,762	540,654	0.5%
2018	3,945	54,127	238,756	146,885	118,784	562,497	0.5%
2019	4,474	58,698	257,220	158,809	123,962	603,162	0.5%
2020	5,037	63,733	277,559	171,995	130,011	648,335	0.6%
2021	5,536	67,988	294,394	183,093	134,360	685,371	0.6%
2022	5,970	71,505	307,897	192,218	137,176	714,767	0.6%
2023	6,413	75,182	321,952	201,787	140,219	745,553	0.7%
2024	6,845	78,772	335,483	211,134	142,982	775,216	0.7%
2025	7,321	82,906	351,151	221,947	146,561	809,885	0.7%
2026	9,473	108,641	269,115	281,558	186,584	855,371	0.7%
2027	10,459	110,746	274,496	291,720	192,986	880,407	0.8%
2028	10,987	118,515	264,672	306,612	202,622	903,407	0.8%



Year / End Use	Appliances	Water Heating	HVAC Shell	HVAC Equipment	Cross-Cutting	Total	% of Annual Sales
2029	11,496	120,294	298,483	313,933	207,578	951,784	0.8%
2030	12,165	126,018	295,803	331,776	219,661	985,424	0.8%
2031	12,589	129,053	288,548	366,827	227,862	1,024,879	0.9%
2032	13,555	137,523	289,718	392,891	246,222	1,079,909	0.9%
2033	14,404	144,616	285,699	425,769	262,807	1,133,294	1.0%
2034	15,253	151,524	288,481	450,953	279,788	1,185,999	1.0%
2035	16,364	160,821	285,880	483,883	302,046	1,248,993	1.0%

**Incremental Annual Commercial Natural Gas Energy Savings (MMBtu) in the Achievable UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Building Envelope	Cooking	HVAC Controls	Space Heating	Water Heating	Total	% of Annual Sales
2016	14,775	21,488	338,205	166,059	67,314	607,841	1.6%
2017	14,775	21,488	338,205	166,059	67,314	607,841	1.6%
2018	14,775	21,488	338,205	166,059	67,314	607,841	1.6%
2019	14,775	21,488	338,205	166,059	67,314	607,841	1.6%
2020	14,775	21,488	338,205	166,059	67,314	607,841	1.6%
2021	17,194	21,488	338,205	166,627	67,365	610,878	1.7%
2022	17,194	21,488	338,205	166,627	67,365	610,878	1.7%
2023	17,194	23,198	497,872	166,627	67,365	772,256	2.1%
2024	17,194	23,198	497,872	168,427	67,365	774,056	2.1%
2025	17,194	23,198	497,872	168,427	67,365	774,056	2.1%
2026	12,154	23,198	204,066	156,410	52,931	448,760	1.2%
2027	12,154	23,198	204,066	156,410	52,931	448,760	1.2%
2028	12,154	42,975	204,066	156,410	52,931	468,536	1.3%
2029	12,154	42,975	204,066	156,410	63,190	478,795	1.3%
2030	12,154	44,686	363,732	156,410	63,190	640,173	1.7%
2031	14,572	44,686	542,260	289,054	80,348	970,920	2.5%
2032	14,572	44,686	542,260	290,853	82,885	975,257	2.6%
2033	14,572	44,686	382,594	290,853	83,973	816,678	2.1%
2034	14,572	44,686	382,594	293,446	83,973	819,270	2.1%
2035	14,572	44,686	382,594	295,081	83,973	820,906	2.1%

**Incremental Annual Commercial Natural Gas Energy Savings (MMBtu) in the Constrained UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Building Envelope	Cooking	HVAC Controls	Space Heating	Water Heating	Total	% of Annual Sales
2016	6,423	9,341	147,025	72,189	29,263	264,241	0.7%
2017	6,441	9,367	147,435	72,390	29,344	264,978	0.7%
2018	6,535	9,504	149,593	73,450	29,774	268,857	0.7%
2019	6,981	10,152	159,787	78,455	31,803	287,178	0.8%
2020	7,478	10,876	171,181	84,050	34,071	307,656	0.8%
2021	9,064	11,328	178,300	87,845	35,515	322,052	0.9%
2022	9,363	11,702	184,182	90,743	36,686	332,676	0.9%
2023	8,289	11,184	240,027	80,332	32,477	372,309	1.0%
2024	8,530	11,509	247,010	83,562	33,422	384,034	1.0%
2025	8,875	11,975	256,997	86,940	34,773	399,560	1.1%
2026	8,966	17,114	150,542	115,386	39,048	331,057	0.9%
2027	9,193	17,548	154,358	118,311	40,038	339,447	0.9%
2028	8,902	31,475	149,458	114,555	38,767	343,156	0.9%
2029	8,923	31,549	149,812	114,826	46,390	351,500	0.9%
2030	7,732	28,428	231,394	99,503	40,200	407,256	1.1%
2031	6,301	19,321	234,457	124,978	34,740	419,796	1.1%
2032	6,566	20,136	244,347	131,061	37,349	439,459	1.1%
2033	7,662	23,495	201,163	152,927	44,152	429,399	1.1%
2034	7,991	24,506	209,813	160,925	46,050	449,285	1.2%
2035	8,384	25,709	220,116	169,768	48,312	472,288	1.2%

**Incremental Annual Industrial Natural Gas Energy Savings in the Achievable UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Process Heating	Facility HVAC	Total	% of Annual Sales
2016	13,567	9,105	22,672	1.7%
2017	13,567	9,105	22,672	1.7%
2018	13,567	9,105	22,672	1.8%
2019	13,567	9,105	22,672	1.8%
2020	13,567	9,105	22,672	1.8%
2021	17,425	9,302	26,726	2.1%
2022	17,425	9,302	26,726	2.1%
2023	17,425	9,302	26,726	2.1%
2024	17,425	9,302	26,726	2.1%
2025	17,425	9,677	27,102	2.1%
2026	10,724	3,889	14,613	1.2%
2027	10,724	3,889	14,613	1.2%
2028	10,724	3,889	14,613	1.2%
2029	10,724	3,889	14,613	1.2%
2030	10,724	3,889	14,613	1.2%
2031	15,977	10,022	25,999	2.0%
2032	15,977	10,022	25,999	2.0%
2033	15,977	10,367	26,345	2.1%
2034	15,993	11,130	27,124	2.1%
2035	15,993	10,755	26,748	2.1%

**Incremental Annual Industrial Natural Gas Energy Savings in the Constrained UCT Potential Scenario, by End Use for DTE Energy**

Year / End Use	Process Heating	Facility HVAC	Total	% of Annual Sales
2016	5,327	3,575	8,902	0.7%
2017	5,736	3,849	9,585	0.7%
2018	6,166	4,138	10,304	0.8%
2019	6,642	4,457	11,100	0.9%
2020	7,193	4,827	12,019	0.9%
2021	8,668	4,627	13,295	1.1%
2022	8,948	4,777	13,724	1.1%
2023	9,291	4,960	14,251	1.1%
2024	9,590	5,119	14,709	1.2%
2025	9,917	5,508	15,425	1.2%
2026	14,653	5,313	19,966	1.6%
2027	14,868	5,392	20,260	1.6%

Year / End Use	Process Heating	Facility HVAC	Total	% of Annual Sales
2028	14,960	5,425	20,385	1.6%
2029	15,235	5,525	20,760	1.6%
2030	15,525	5,630	21,155	1.7%
2031	12,564	7,881	20,444	1.6%
2032	13,167	8,259	21,426	1.7%
2033	13,611	8,832	22,443	1.8%
2034	13,813	9,613	23,426	1.8%
2035	14,561	9,792	24,353	1.9%