Synapse
Energy Economics, Inc.

Michigan Clean Power Plan Modeling: Baseline Input Assumptions

November 2, 2015

	Value	Source
1—Choice of Electric Sector Model	• System Optimizer: industry standard, capacity expansion	• ABB (formerly Ventyx)
2—Analysis Period	• 2016 to 2034	• MPSC staff
3—Model Region	• MI, IA, IL, IN, OH, MN, and WI	• MPSC staff
4—Weighted Average Cost of Capital	• 6.64%	• average in recent MPSC proceedings
5—Load Growth	• 1.2% per year	• MPSC staff
6—Energy Waste Reduction Savings	• Current average annual incremental savings (1.4%) • Falling (linear trend) to the 1% minimum in 2020 • Constant at 1% to 2034	• Utility filings • Synapse analysis of costs cap and change in costs over time
7—Energy Waste Reduction Costs *in 2014 inflation adjusted dollars per kWh*	• Current average levelized costs: $0.018 • Rising (linear trend) to $0.036 in 2020; constant to 2034	• Utility filings • Synapse analysis of MI historical trend, other states, federal lighting standard
8—Unit Retirements *in MW by 2034*	• Announced retirements: 900 coal; 800 nuclear; 400 other • Expected retirements: 2,100 additional coal	• EIA 2014; Power Engineering 10/12/2015 • MPSC staff
9—Additional Gas Capacity *in MW*	• Wolverine : Alpine Power Plant (432 in 2016) • Holland BPW: Holland Energy Park (114 in 2018) • Invenergy: Project J394 (280 in 2017)	• MPSC staff
10—Natural Gas Price *in 2014 inflation adjusted dollars per MMBtu*	• From $3.00 n 2016 • Rising to $4.13 in 2034	• 2016: Sept. 2015 NYMEX futures; 2017-2021: EIA Sept. 2015 Short-Term Energy Outlook; 2022-2034: EIA AEO 2015 "High Oil and Gas Resource Case"
11—Coal Price *in 2014 inflation adjusted dollars per MMBtu*	• From $0.83 to $2.87 in 2016 (by region of origin) • Rising to $1.26 to $4.00 in 2034	• EIA Sept. 2015 Coal Production and Minemouth Prices by Region, "High Oil and Gas Resource Case"
12—Fuel Oil Price *in 2014 inflation adjusted dollars per MMBtu*	• Distillate from $17.57 in 2016 to $25.40 in 2034 • Residual from $8.49 in 2016 to $13.22 in 2034	• EIA Aug. 2014 Monthly Energy Review, "High Oil and Gas Resource Case"
13—Renewable Installed Capacity *in MW in 2014*	• Wind: 1,350 onshore; 0 offshore • Solar: 3 residential; 10 commercial; 10 utility • Biomass: 220 • Combined heat and power (CHP): 3,453	• 2015 MI Renewable Resource Assessment (RRA) • 2015 MI RRA • 2015 MI RRA • U.S. DOE CHP Installation Database (August 2015)
14—Renewable Maximum Potential Capacity *in MW in 2034*	• Wind: 11,700 onshore 1,000 offshore • Solar: 2,900 residential; 8,700 commercial; 8,700 utility • Biomass: 1,600 • CHP: 7,900	• 2015 MI RRA • Offshore: Synapse analysis of projects in other states • 2015 MI RRA • 2015 MI RRA; • Pew 2015 Industrial Energy Efficiency in MI
15—Renewable Capacity Factors	• Wind: 35% onshore 40% offshore • Solar: 13% residential; 12% commercial; 13% utility • Biomass: 65% • CHP: 57%	• U.S. DOE 2014 Wind Technologies Market • U.S. DOE 2013 Offshore Wind Analysis • 2015 MI RRA • EIA 2012 Form 860 data • EIA Oct. 2012 Today in Energy
16—Renewable Capital Costs *in 2014 inflation adjusted dollars per kWh*	• Wind: $1,702 in 2016 up to $1,723 in 2034 onshore $6,456 throughout period offshore • Solar: $3,553 in 2016 down to $2,532 in 2034 residential $2,271 in 2016 down to $1,618 in 2034 commercial $1,606 in 2016 down to $1,144 in 2034 utility • Biomass: $3,170 in 2016 down to $2,904 in 2034 • CHP: $1,500 throughout period	• Baseline: DOE 2014 Wind Technologies Market; Growth trent: 2015 MI RRA • EIA 2013 Updated Capital Cost Estimates • 2015 MI RRA • 2015 MI RRA • 2015 MI RRA • 2015 MI RRA • 2015 MI RRA
17—Renewable Fixed O&M Costs *in 2014 inflation adjusted dollars per kW*	• Wind: $41 onshore; $77 offshore • Solar: $30 • Biomass: $86 • CHP: $7	• EIA 2013 Updated Capital Cost Estimates • 2015 MI RRA • 2015 MI RRA • Synapse analysis of EPA and EIA forecasts
18—Renewable Variable O&M Costs *in 2014 inflation adjusted dollars per MWh*	• Wind: $0 • Solar: $0 • Biomass: $4 • CHP: $10	• EIA 2013 Updated Capital Cost Estimates • 2015 MI RRA • 2015 MI RRA • Synapse analysis of EPA and EIA forecasts
19—Federal Environmental Policies	• Expected within analysis period: Cooling Water (316(b)); CCRs; ELGs; SO_2 NAAQS; O_3 NAAQS; MATS; Regional Haze; CSAPR	• EPA rulings; Synapse analysis of expected outcomes
20—Coal Retrofit Costs *in 2014 inflation adjusted dollars*	• $77 to $120 million in 2016 • Rising to $451 to $890 million in 2034	• Synapse Coal Asset Valuation Tool
21—Wholesale Electric Prices	• Generated endogenously within model	• System Optimizer
22—Macroeconomic and Employment Effects	• IMPLAN input-output model	• MIG, Inc.
23—Uncertainty	• Test modeling results for sensitivity to changes in natural gas price and electric sales	• MPSC staff