

Vulnerability of the Electricity Sector to Climate Change in the Midwest

Douglas J. Gotham
Director, State Utility Forecasting Group

Workshop on: Climate change impacts,
vulnerability and adaptation in the Midwest

Impacts in 3 Broad Areas

- Demand
 - Consumption of electricity
- Supply
 - Generation of electricity
- Delivery
 - Transmission and distribution of electricity

Electricity Demand

- Sensitive to ambient temperature
- In winter, as temperature \uparrow , demand \downarrow and vice versa
- In summer, as temperature \uparrow , demand \uparrow and vice versa
- Summer cooling impacts are more significant to the electricity industry
 - Overall system peak usually occurs in summer
 - Most winter space heating uses other fuels

Factors Affecting Peak Demand

- Ambient temperature
 - Including time of day and day of week
- Humidity
 - THI is better indicator than temperature
- Duration of heat wave
 - Customers are more willing to limit cooling needs in the first day or two than they are after a few days
 - Heat buildup in urban areas

High Summer Temperatures

- According to PJM Interconnection*, for their west region the difference between a 50/50 summer and a 90/10 summer is an increase in peak demand of more than 6% (or more than 4,500 MW in 2010)

* *PJM Load Forecast Report, January 2010*

Electricity Supply

- Many generators are affected by either ambient temperatures or water availability
- Combustion turbine efficiency decreases as air temperature increases
 - Summer capacity usually de-rated, often as much as 20%

Hydroelectric Facilities

- The Midwest does not generate much of its energy from hydroelectric facilities
 - 1.2% in East North Central region*
- Much of it is run-of-river (no dam) and cannot store water for later use



* Energy Information Administration

Steam Plants

- Availability and temperature of cooling water is significant
- The lower the temperature of the condensate, the greater the Carnot (maximum achievable) efficiency
- 21% of U.S. utility generating units are steam driven, but they represent 76% of generating capacity*

* Environmental Protection Agency

Cooling Water

- 30% of ECAR and 16 % of MAIN utility plants have cooling water intake structures*
- 13% nationally



* Environmental Protection Agency

Once Through Cooling

- 75% of plants using lakes, reservoirs, or freshwater rivers for cooling water intake are once through*
 - No cooling tower
- These facilities may have to reduce output during drought conditions



* Environmental Protection Agency

Electricity Delivery

- Ambient temperature affects transmission lines
 - Heat dissipation
 - Sag
- High temperatures can cause line de-rates



Storms

- Changes to the frequency, severity, or location of storms will affect the reliability of electricity delivery
 - Lightning
 - Winds & tornadoes
 - Ice
- If a broader region is affected, restoration time will increase

Mitigation

- Demand
 - Load management
 - Price response
 - Energy efficiency
- Supply
 - Additional generation / switch to generators that are less sensitive to water & temperature
 - Cooling towers
- Delivery
 - Additional infrastructure
 - Underground lines
 - Distributed generation