Water Demand Projections for Power Generation in Texas

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Scope of Study

- Discuss and review different types of cooling technologies
- Estimate statewide water use for the industry
- Develop projections for future water use on a state and regional level

Study Authors and Steering Committee

- **Bureau of Economic Geology**
  - **Dr. Carey King, Dr. Ian Duncan, and Dr. Michael Webber, Bureau of Economic Geology**
- **Steering Committee**
  - **Greg Carter and Kenneth Patton of American Electric Power**
  - **Chris Bisset (retired – American Electric Power)**
  - **Sandra Dannhard and Rick Gangluff of the South Texas Project nuclear facility**
  - **Ted Long of NRG Energy**
  - **Gale Henslee of Xcel Energy**
  - **Gary Spicer of Luminant Power**
  - **Dawn Loller, Wolf Hollow LP**
- **TWDB Project Manager, Stuart Norvell**

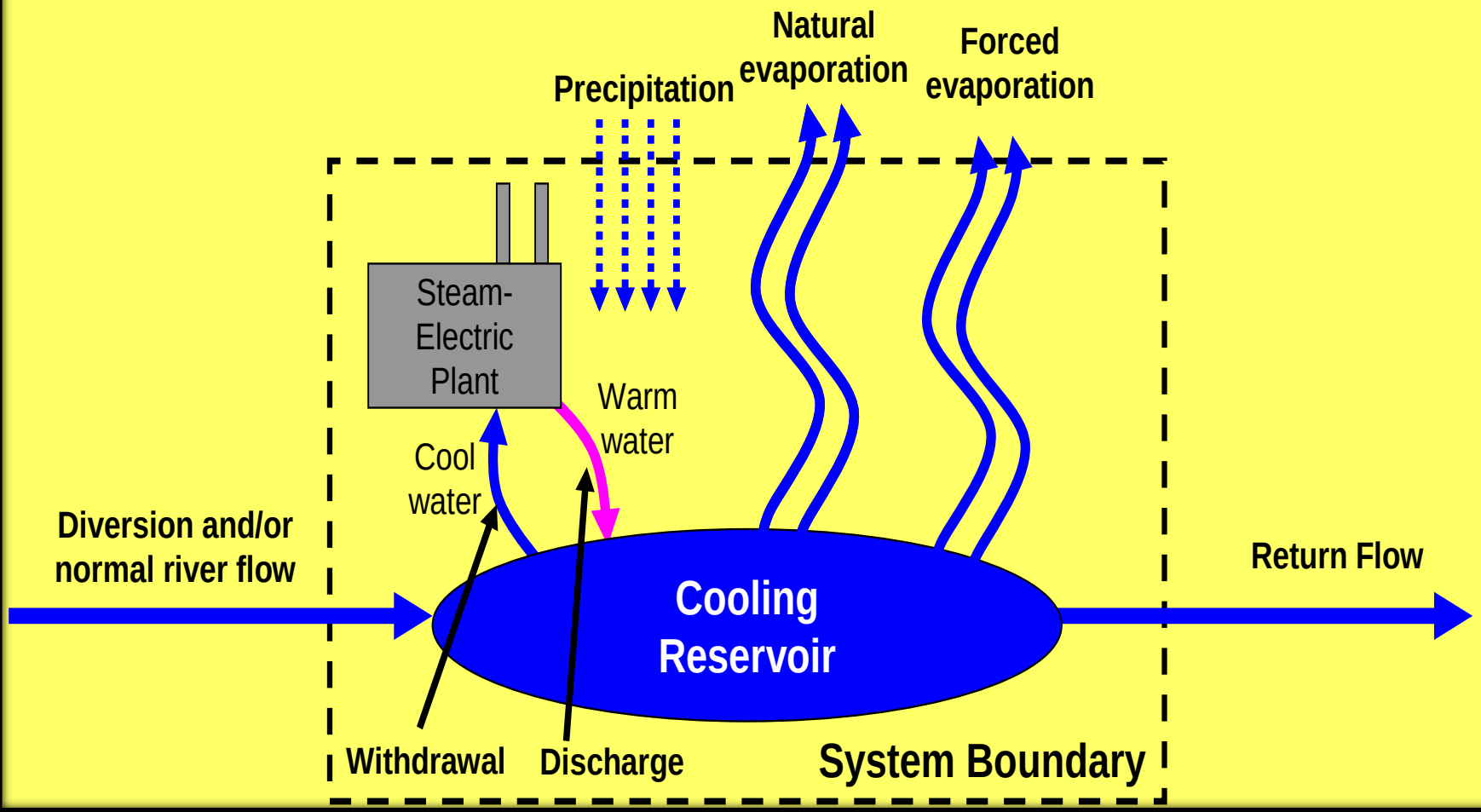
Water Use for Different Cooling Technologies

- 99% of water used for power generation in Texas comes from surface water sources

- Predominant types of cooling systems in Texas
  - Once through systems
  - Cooling towers
  - Some air-cooled units but limited (3% of generation)
  - A few hybrid air and water systems (<1% of generation)

Type A: Once-through with Reservoir

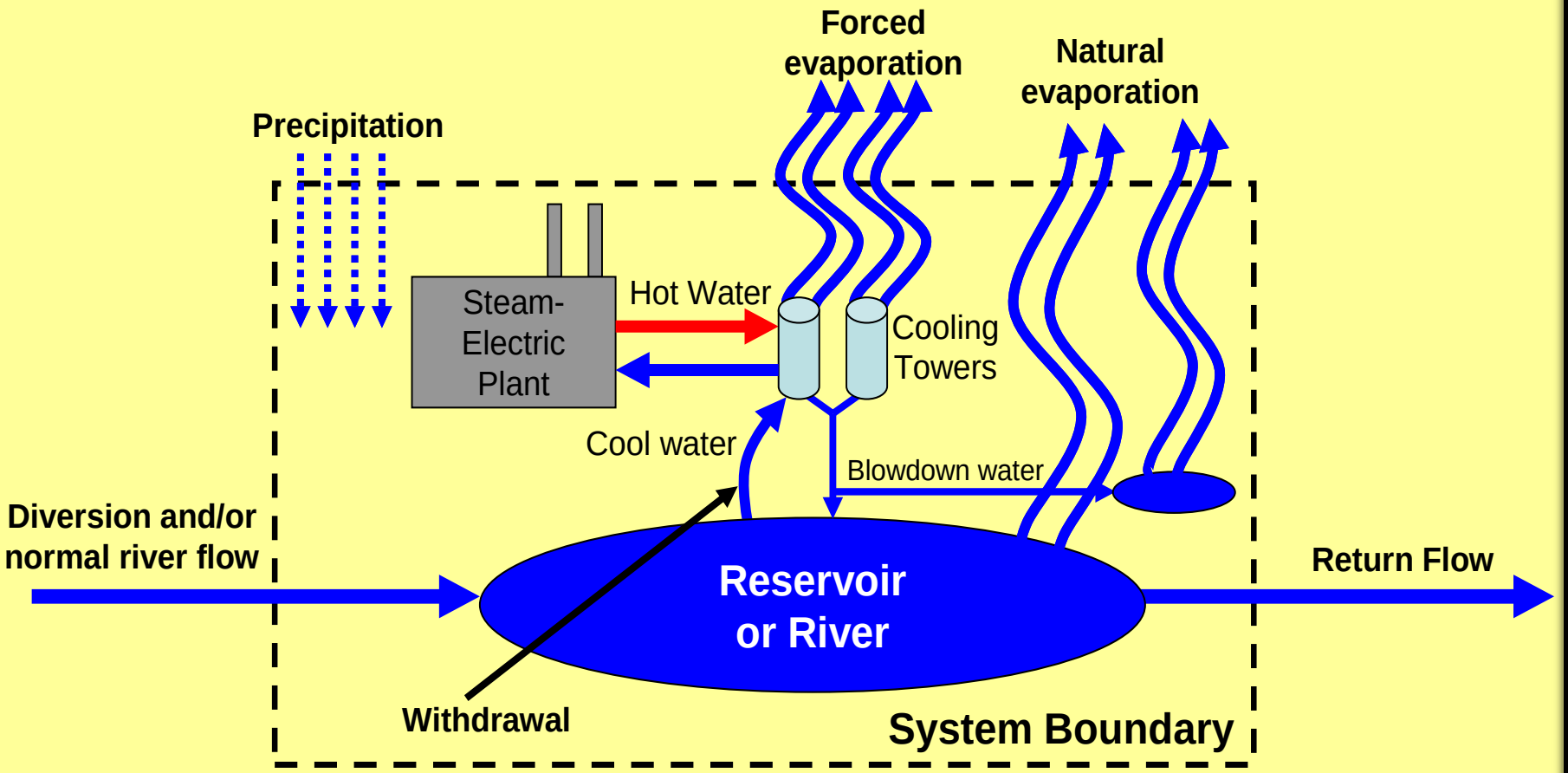
(Reservoir can serve many purposes: recreation, municipal supply, wildlife habitat, etc.)



South Texas Project

Type D: Cooling Tower with surface water

(Surface water can serve many purposes: recreation, municipal supply, wildlife habitat, etc.)

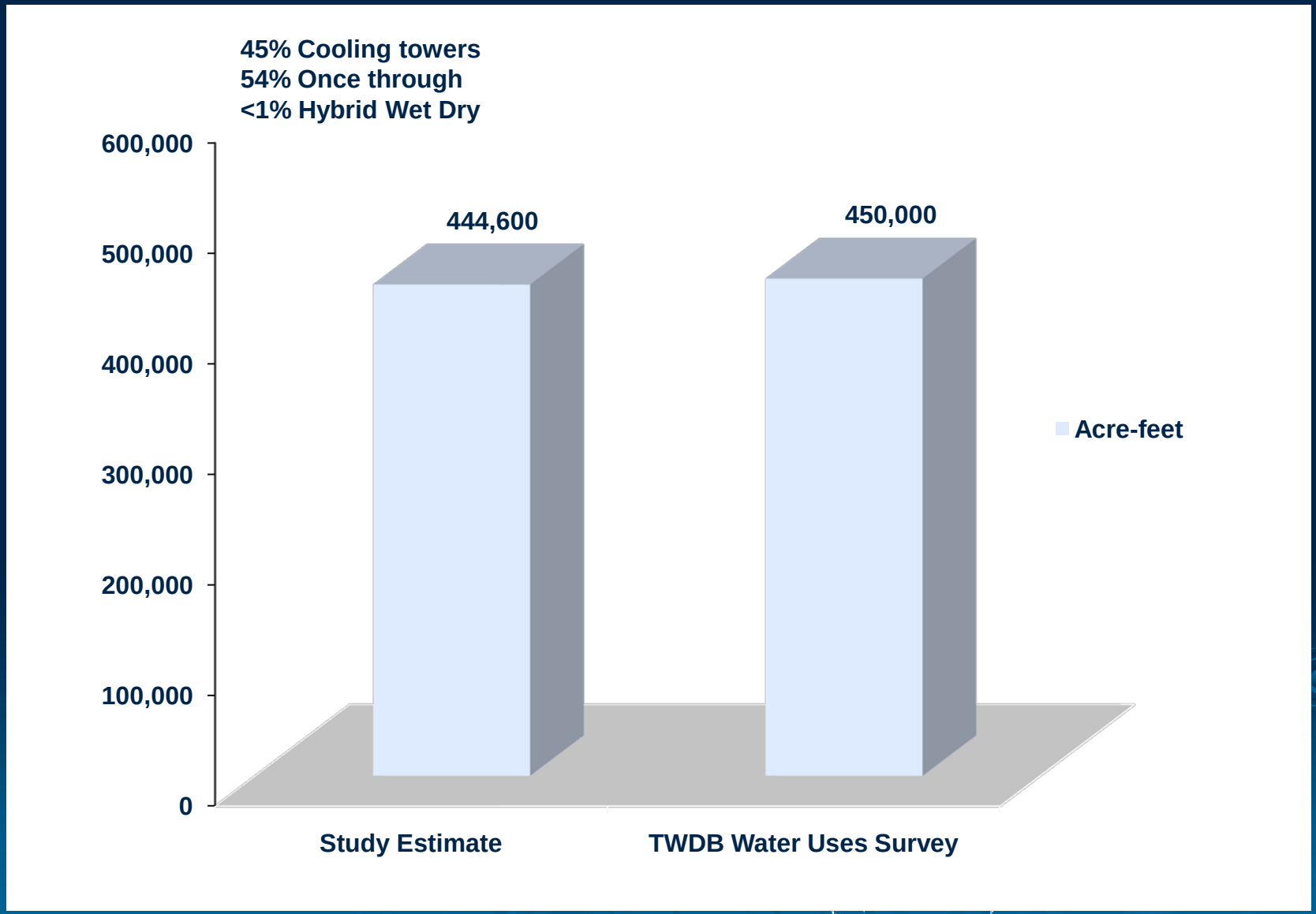


Consumption = forced evaporation
Withdrawal ~ Consumption

Estimated Consumption Rates Based on Cooling System and Fuel Type

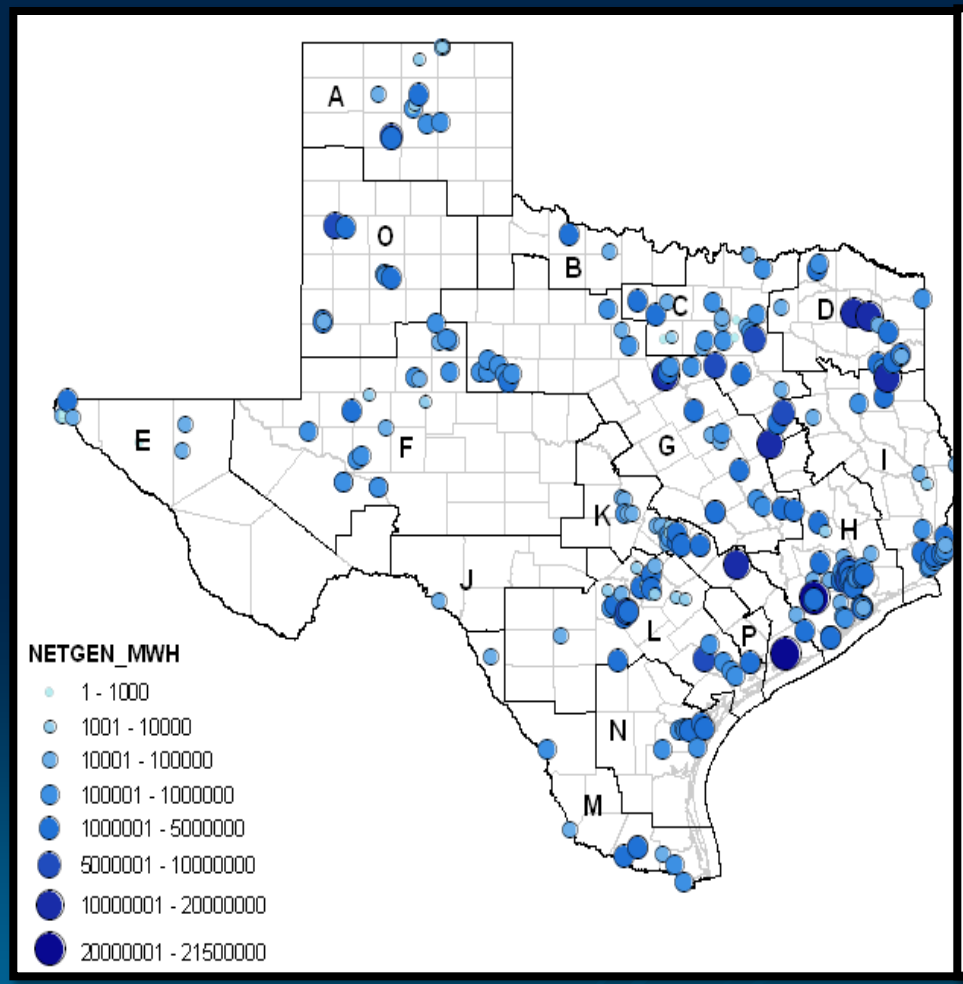
Fuel	Prime Mover	Cooling System	Water consumption rate (gallons per kilowatt hours)
Gas	Combined Cycle	Cooling tower	0.23
Gas	Gas Turbine	Cooling tower	0.05
Gas	Steam Turbine	Cooling tower	0.70
Gas	Combined Cycle	Once-through	0.23
Gas	Gas Turbine	Once-through	0.05
Gas	Steam turbine	Once-through	0.35
Coal	Steam turbine	Cooling tower	0.60
Coal	Steam turbine	Once-through	0.35
Nuclear	Steam turbine	Any	0.60

Statewide Water Consumption Estimate for Thermoelectric Generation (Projection Baseline)

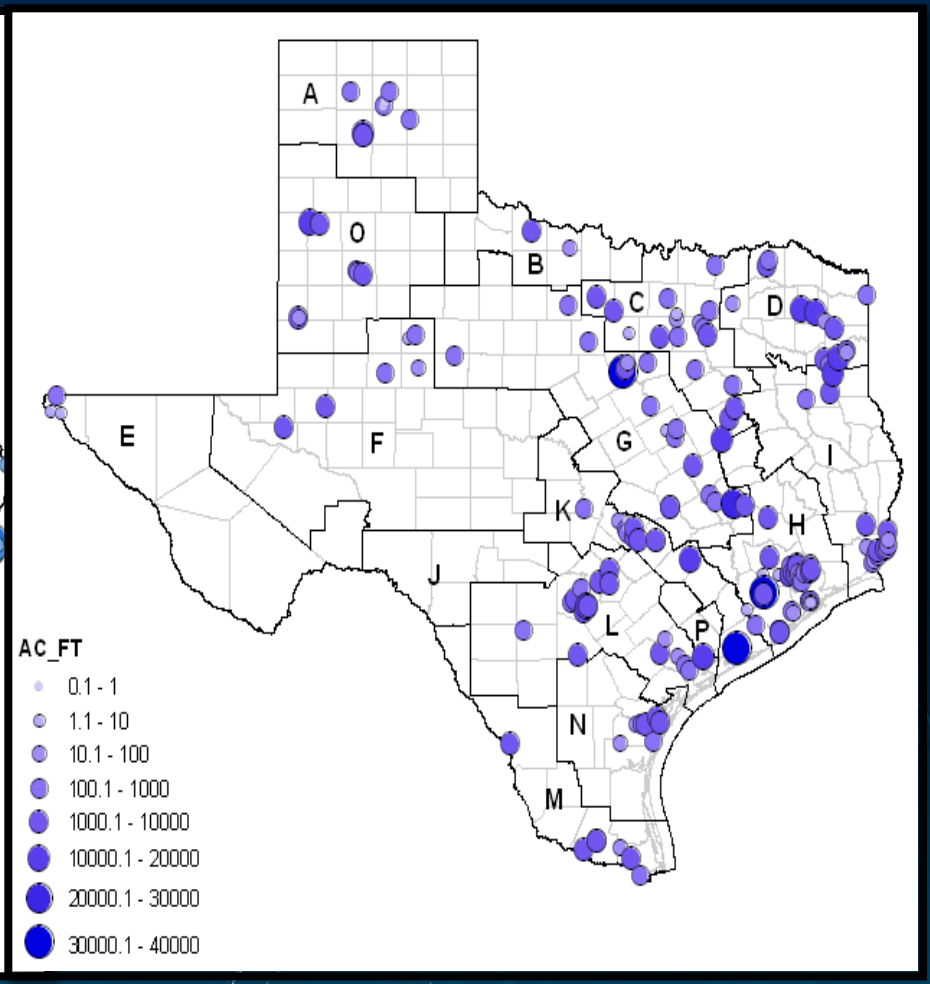


Regional Distribution of Generation and Water Consumption

Generation



Water Consumption



Projections for Future Thermoelectric Generation Water Use in Texas

- Long-term forecasts (2010-2060)
- Two components
  - Future electricity demand
  - Resultant forecasts of water requirements for the industry
- Key drivers
  - Economic and demographic growth
  - Trends in fuel costs
  - Future mixes of generating technology
  - Policy factors (particularly Federal)
  - Changes in energy efficiency (supply and demand)

Projections Methodology

- Created 8 scenarios to capture uncertainties in supply and demand
  - **Demands side uncertainty**
    - **"*Status quo*"**
      - **Electrical demand scenario based on ERCOT 2008 forecasts with an annual electricity growth rate of 1.8% and assumes no increases in demand side efficiency**
    - **"*Low energy*"**
      - **Electrical demand scenario based on American Council for an Energy-Efficient Economy report on Texas and assumes demands are offset by 50 million megawatts over the long-term planning horizon (2015 – 2060) through demand side management**

Projections methodology (cont.)

- **Scenarios capturing supply side uncertainty**

Volatility in natural gas prices

- **"*High natural gas prices*"**
  - Assumes gas prices are high enough to prevent natural gas combined cycle (NGCC) plants from dispatching as base load facilities
  - Assumes NGCC plants operate as peaking facilities generating approximately 20% electricity sales
- **"*Low natural gas prices*"**
  - Assumes NGCC plants form part of base load generation as they do today at 40% of electricity sales

Projections methodology (cont.)

- **Scenarios capturing supply side uncertainty**
  - Policy uncertainty
    - Will federal legislation mandate a carbon tax on the industry and will Texas power plants be economically driven by federal legislation to implement carbon capture and storage (CCS)?
    - Higher carbon prices imply a greater potential that CCS will be implemented by the industry
    - *"With Policy Incentives for Carbon Capture"* – Assumes future federal legislation places a "carbon price" and EGUs would implement carbon capture and storage
      - Carbon capture and storage increases water requirements
    - *"Without Policy Incentives for Carbon Capture"* No future legislation establishing a carbon price.

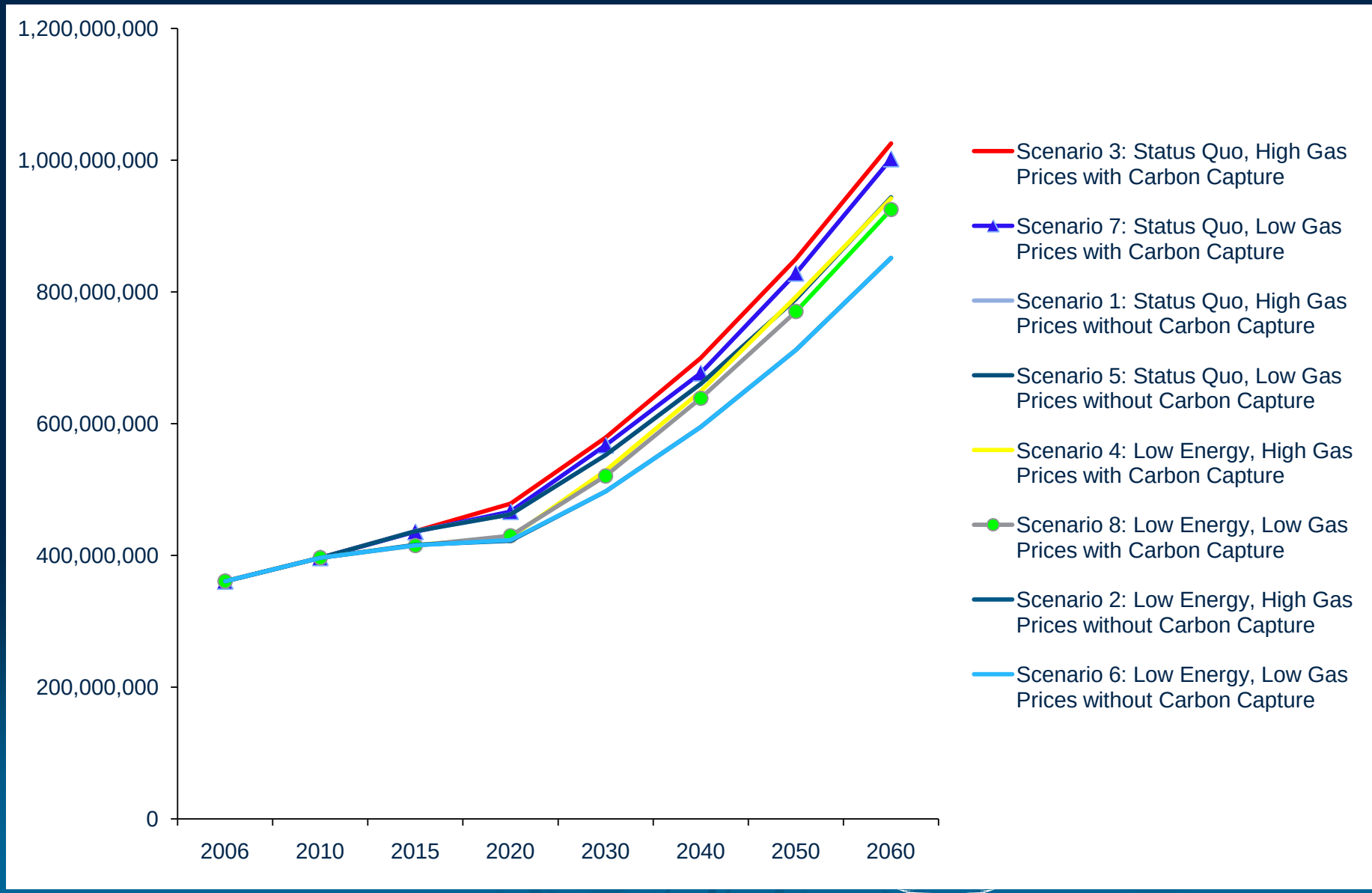
Projections methodology (cont.)

Energy efficiency	Natural Gas Prices	Federal Carbon Policy
Low Energy Demand	High	No
Status Quo	High	No
Low Energy Demand	High	Yes
Status Quo	High	Yes
Low Energy Demand	Low	No
Status Quo	Low	No
Low Energy Demand	Low	Yes
Status Quo	Low	Yes

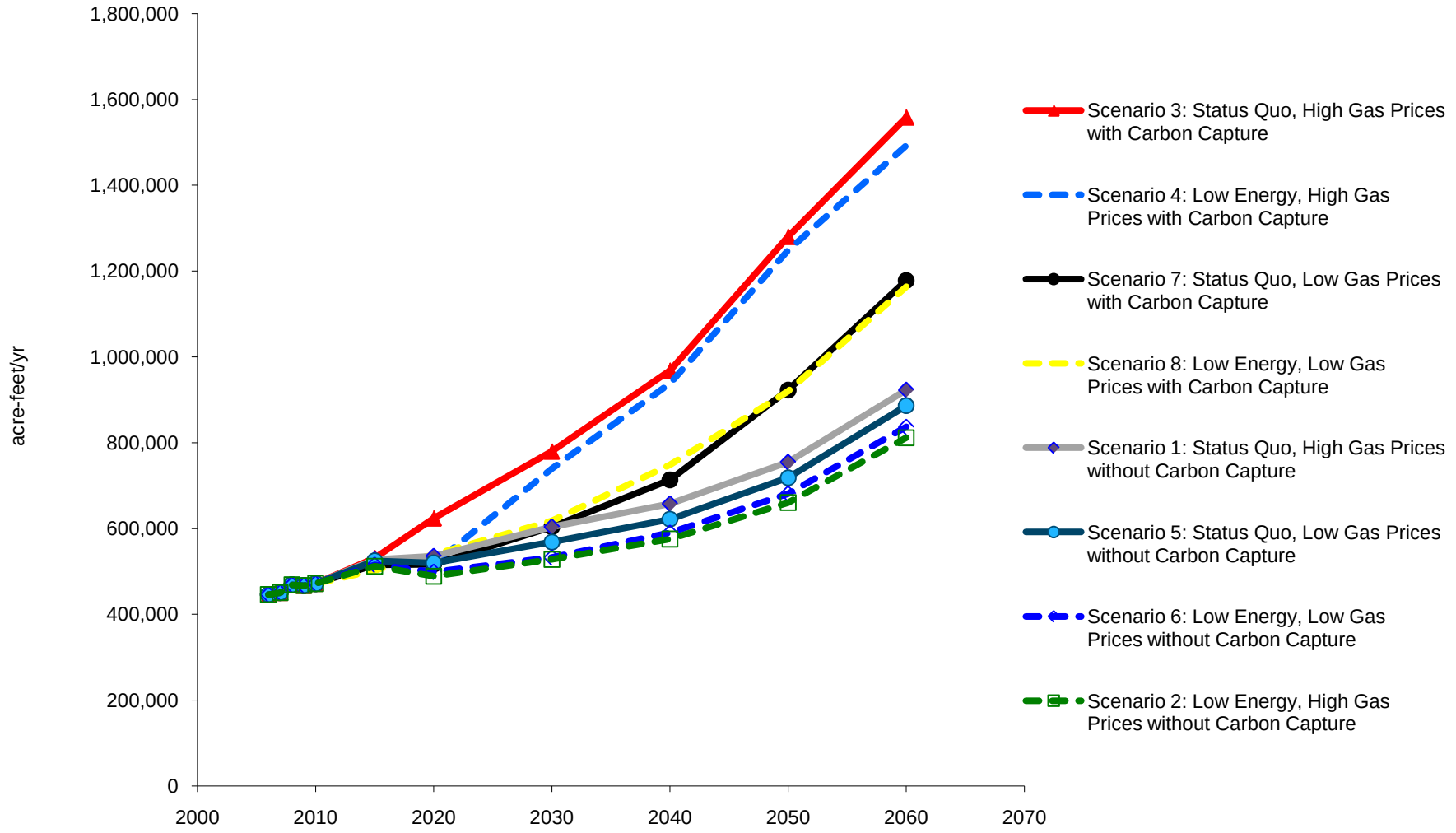
Projections methodology (cont.)

- Additional assumptions
  - Near-term estimates (2010-2015) include planned facilities and those under construction
  - Apportioned total Texas thermoelectric water demand according to ratios of each fuel types and generating technology in each county in 2015
  - For example, if 10% of natural gas generation in 2015 occurred in Harris County, then projections assume that 10% all future natural gas generation will occur in Harris County
  - Renewables will provide 30% of generation by 2060
    - 20% from wind and 10% from concentrated and photovoltaic solar power

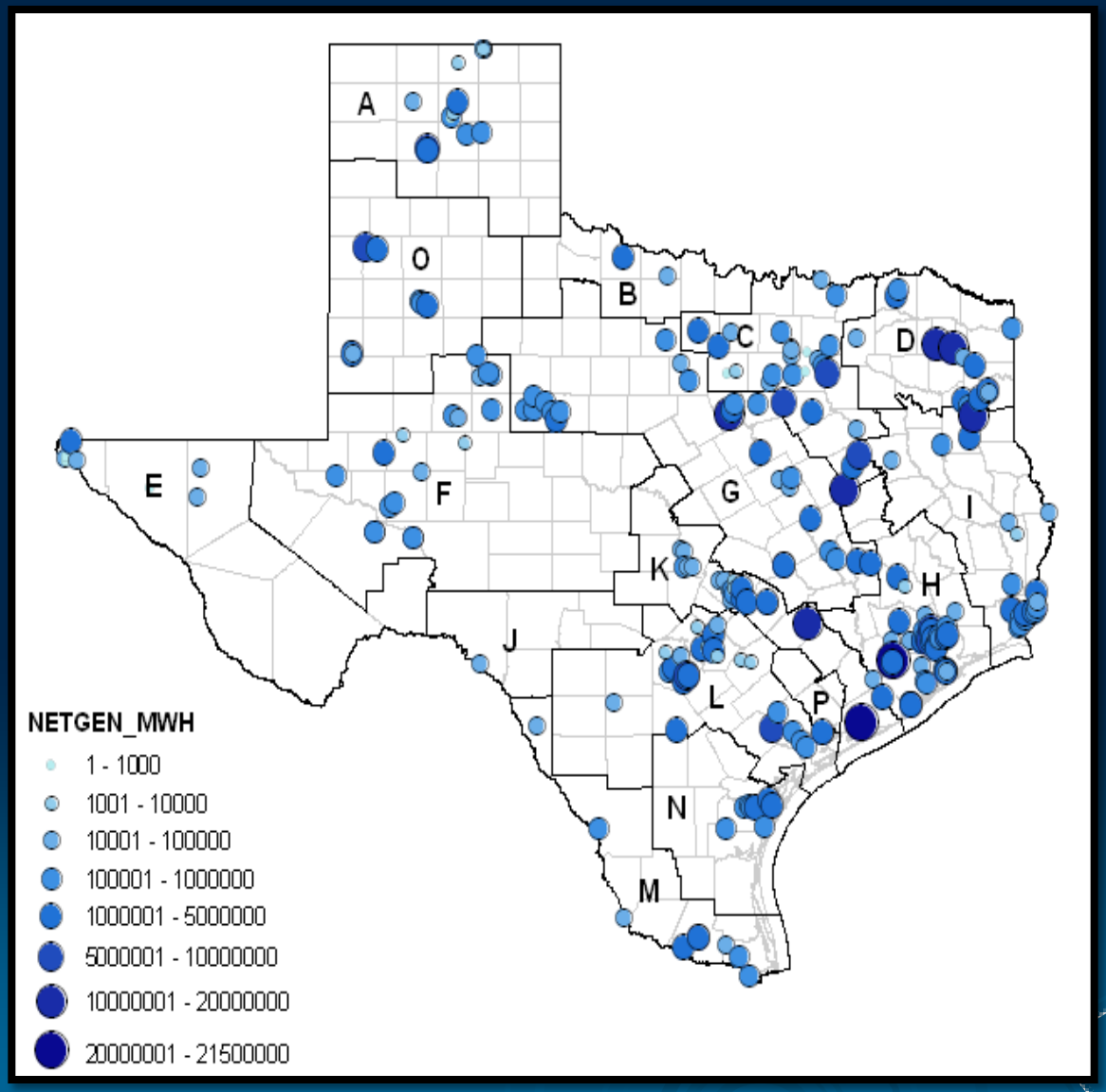
Projected Generation through 2060
(megawatt hours per year)



Projected Water Use through 2060 (acre-feet per year)

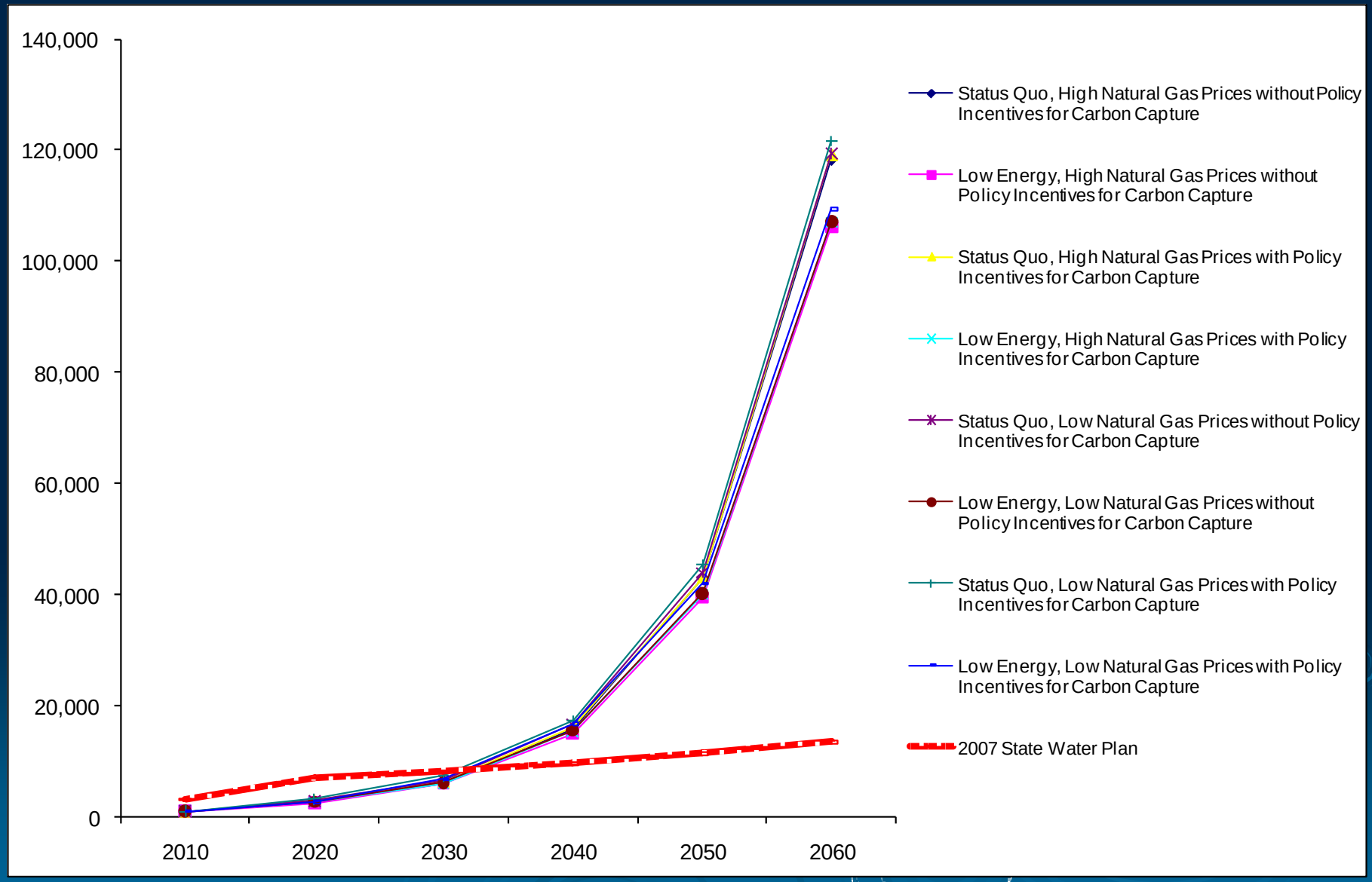


Regional Distribution of Projected Generation and Water Use

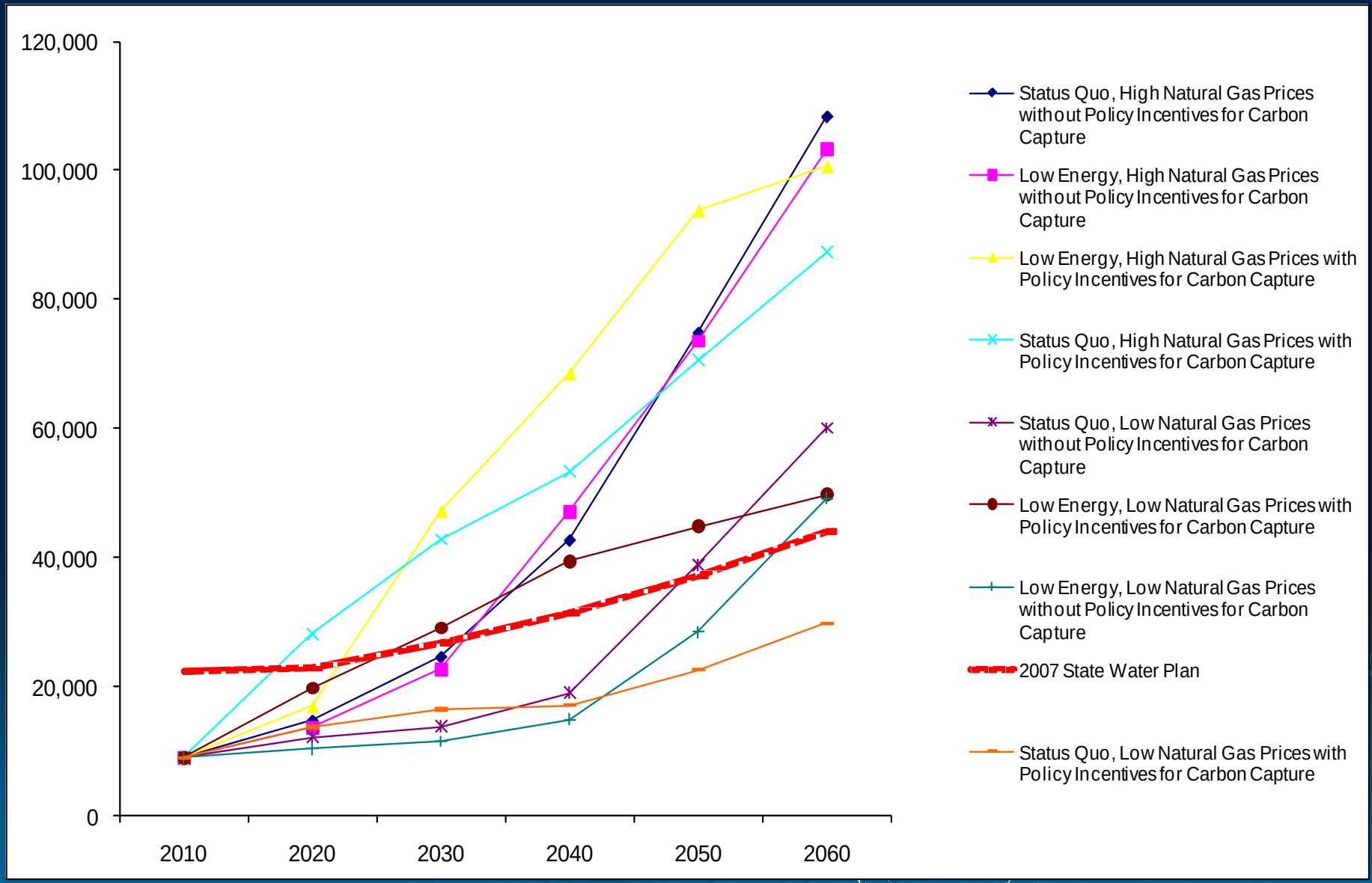


- Again, we assume that new generating capacity grows in relation to where it exists today and where there are planned facilities
- Wildcard = potential new technology incorporated in long-term projections
  - Wind
  - Solar

Projected water use for Regional Water Planning Area E (Far West Texas, El Paso and the Big Bend Area)



Projected water use in Regional Water Planning Area F (Central West Texas, Midland-Odessa and Surrounding Counties)



Conclusion

- State level projections are fairly straightforward
- Short-term regional level projections for supply are more difficult
- Long-term regional level projections similar to herding cats


Questions or Comments?