The Energy-Water Nexus: A Case Study of the Arkansas River Basin

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Project Introduction

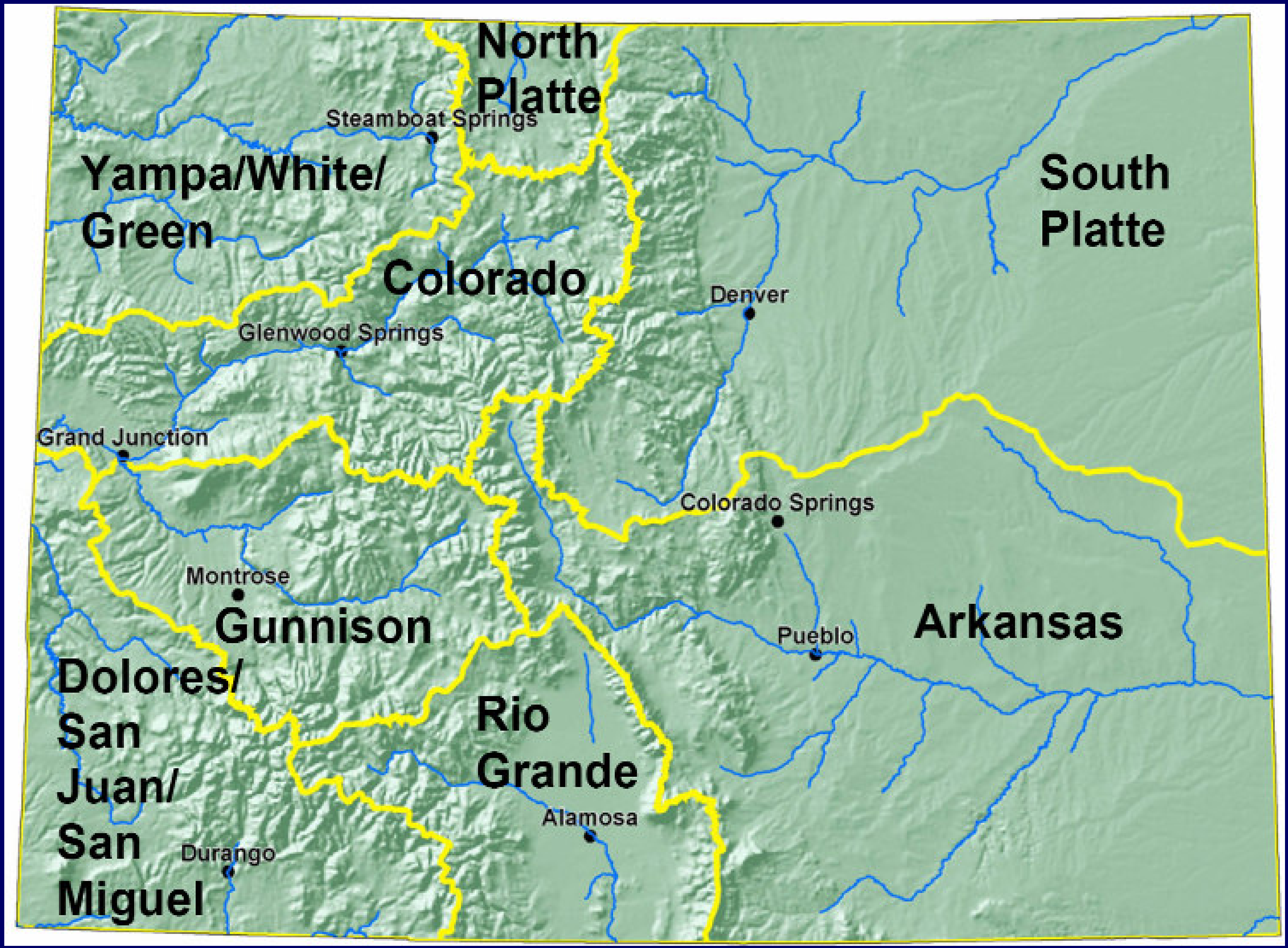
Goal 1: Assess water demands for municipal needs, electricity generation, and agriculture in the Arkansas River Basin in 2015 and 2030

Goal 2: Recommend alternatives to reduce water demands – municipal conservation, energy efficiency, and renewable sources of energy

Outline

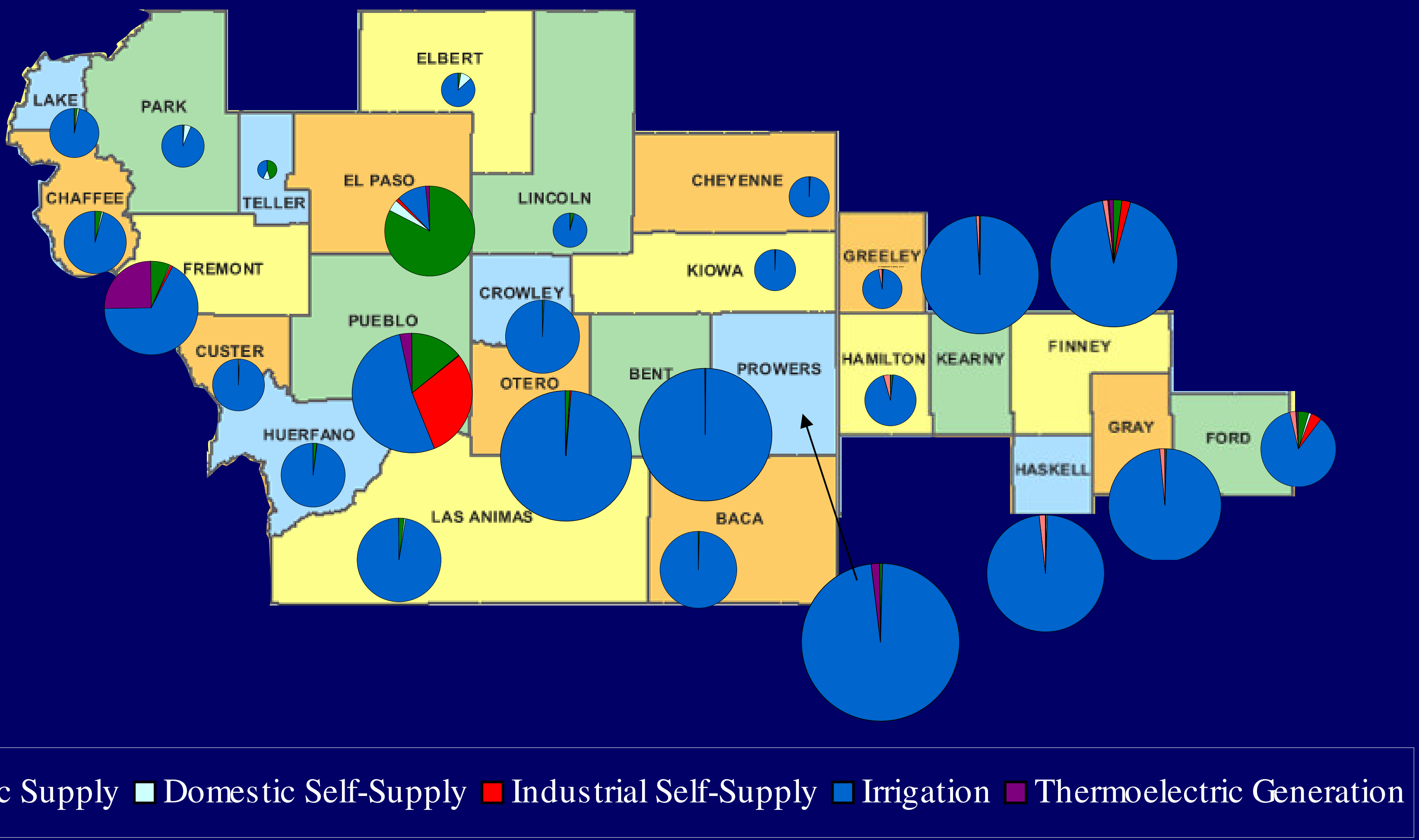
- Municipalities
- Electricity Generation
- Agriculture
- Climate Change
- Conclusions

Background: The Arkansas Basin



Source: CWCB, Statewide Water Supply Initiative

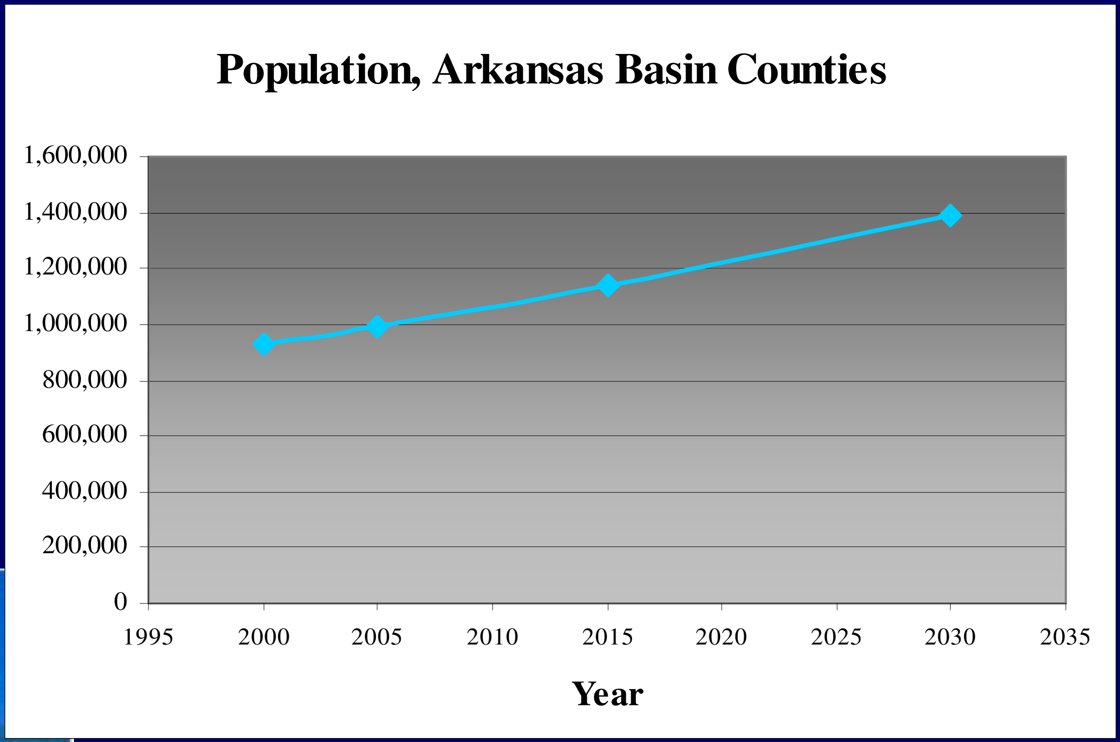
Background: Water Withdrawals in the Arkansas Basin



Municipalities

Municipalities

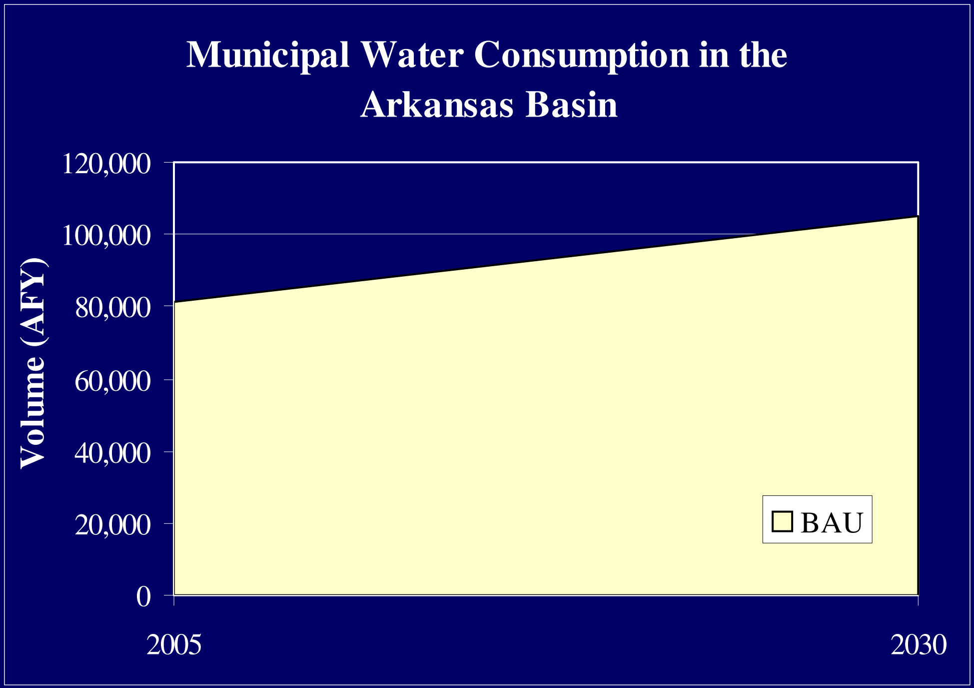
Population Growth → Increased Demand



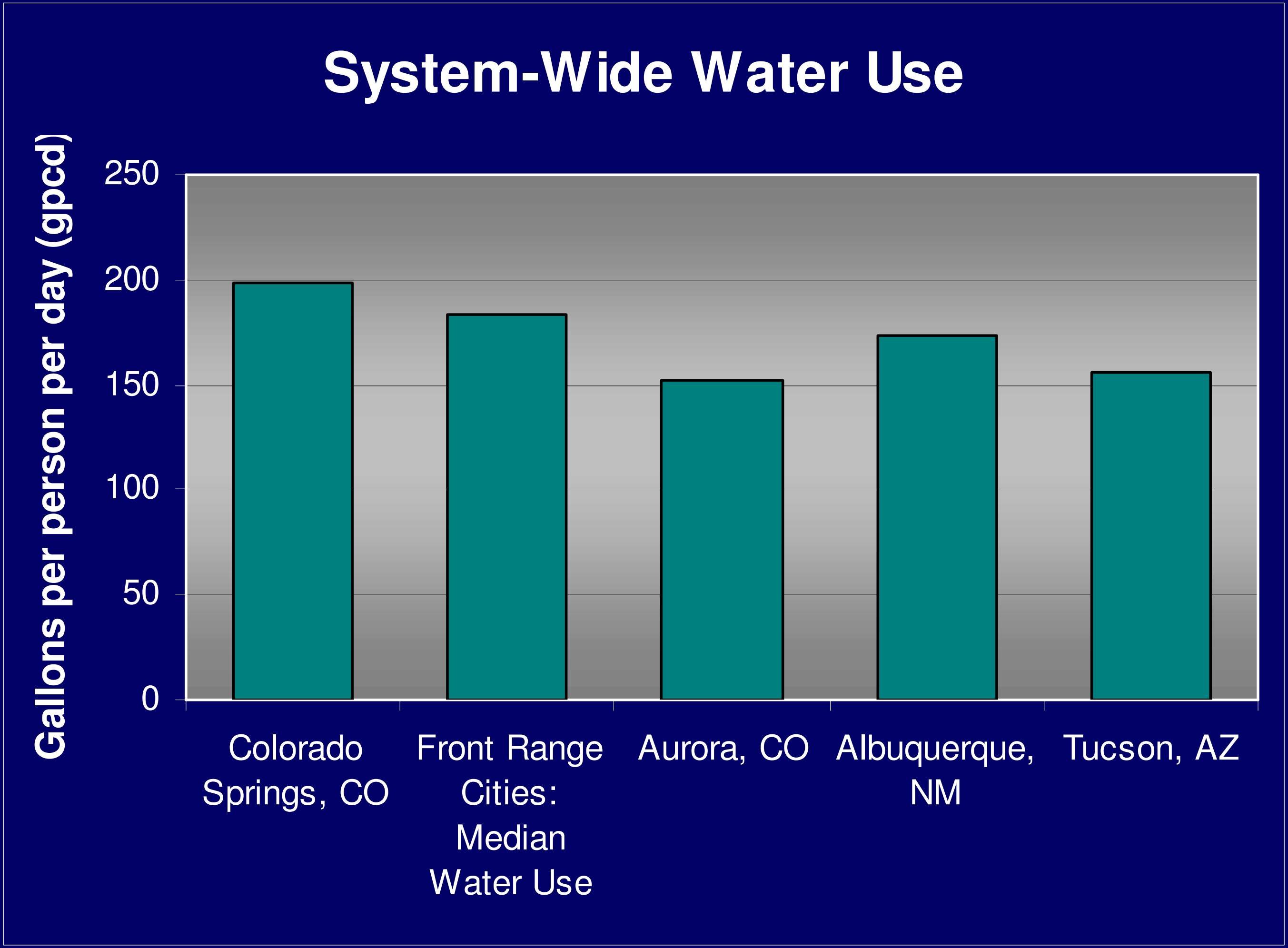
Municipalities

BAU Scenario

- Efficiency improvements based on plumbing standards and efficiency programs in place today



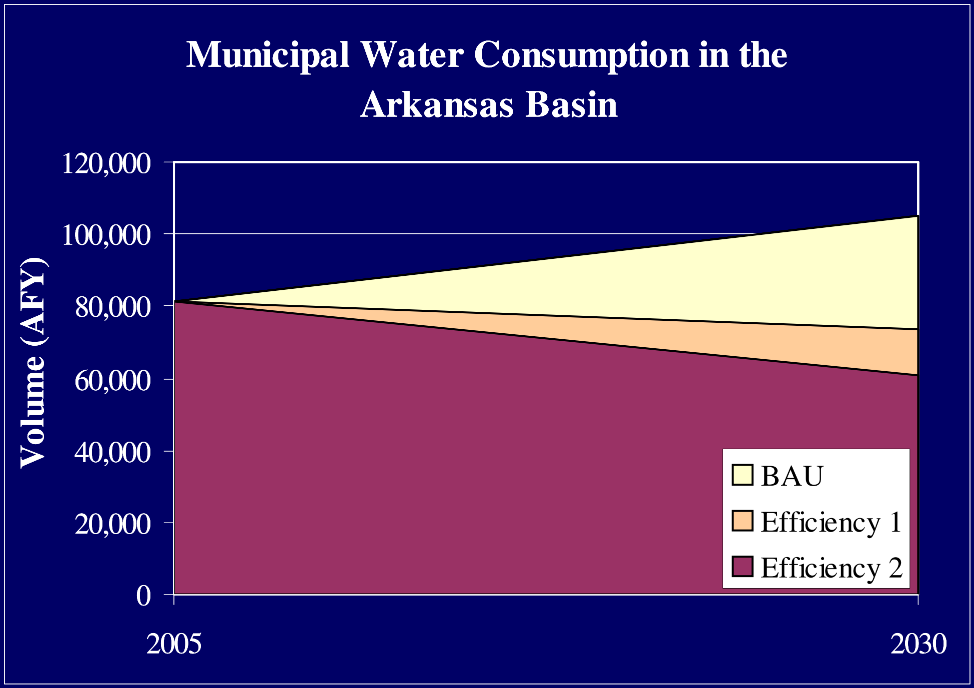
Municipalities: Potential for Improved Efficiency



Municipalities

Alternate Scenarios

- Efficiency 1:
  - SFR indoor water use efficiency
  - Efficient irrigation of turfgrass <u>or</u> 45% of customers install moderate xeriscaping
- Efficiency 2: Water use efficiency in all sectors

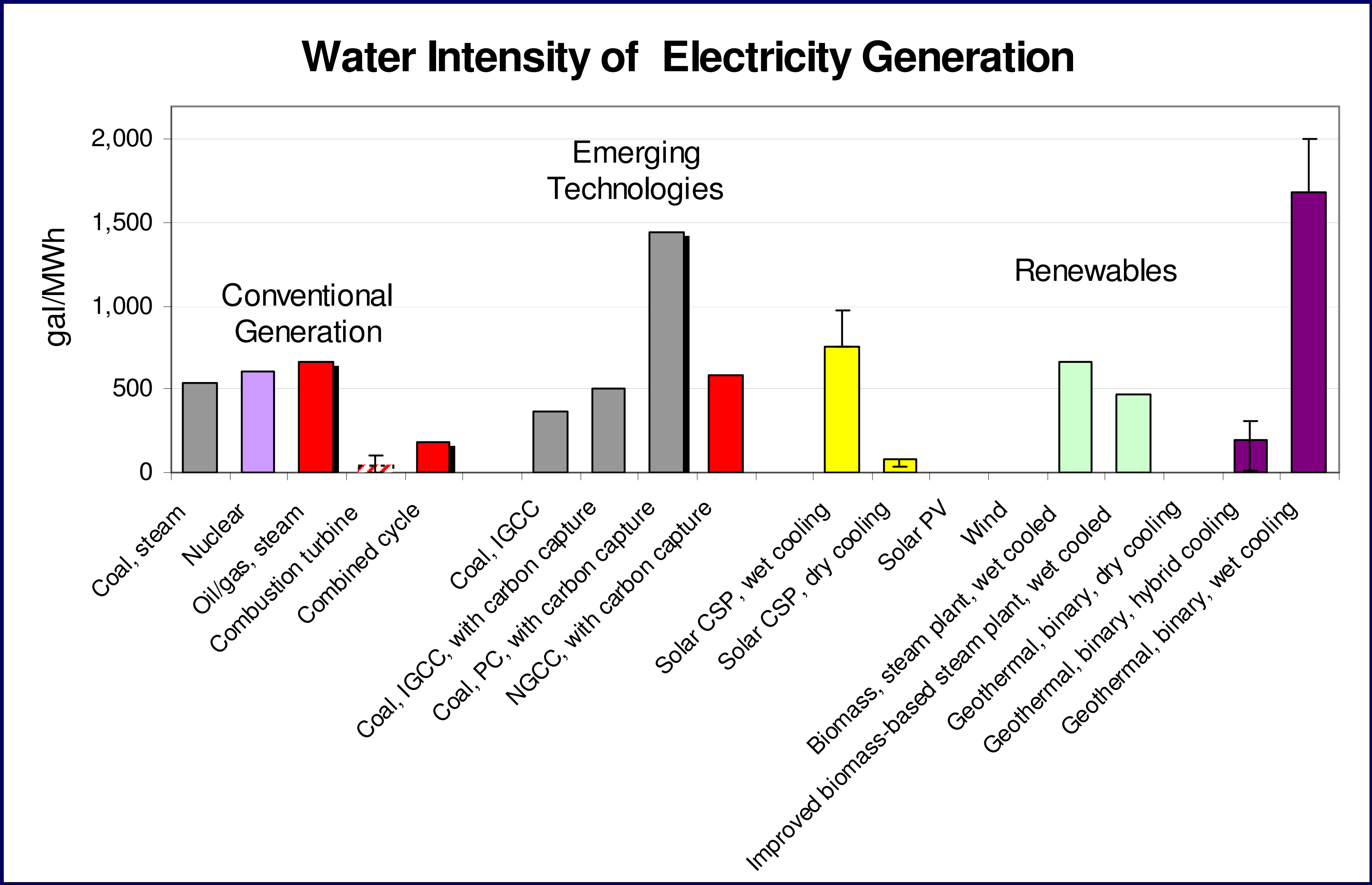


Electricity Generation

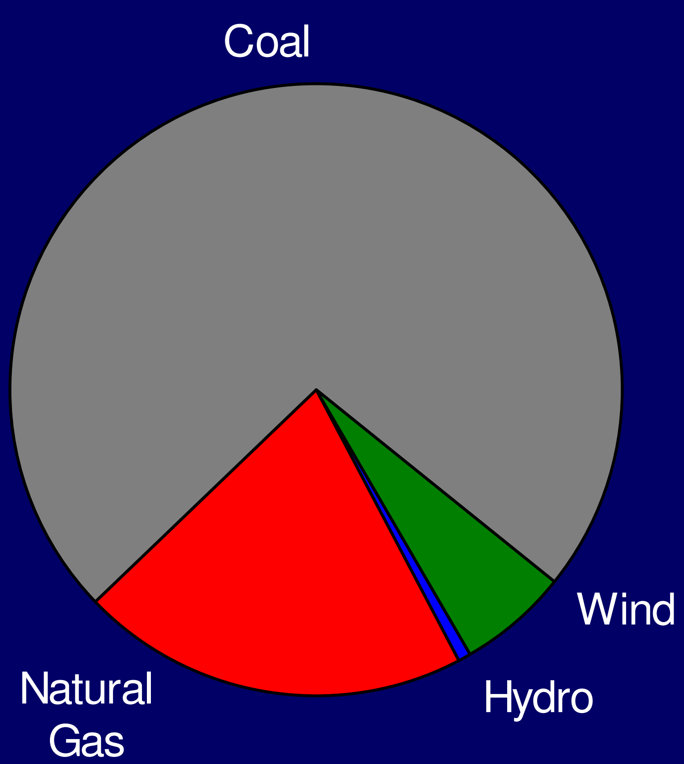
Electricity: Background

- **Water use for electricity generation**
  - Conventional generation
  - Alternatives

Electricity: Background



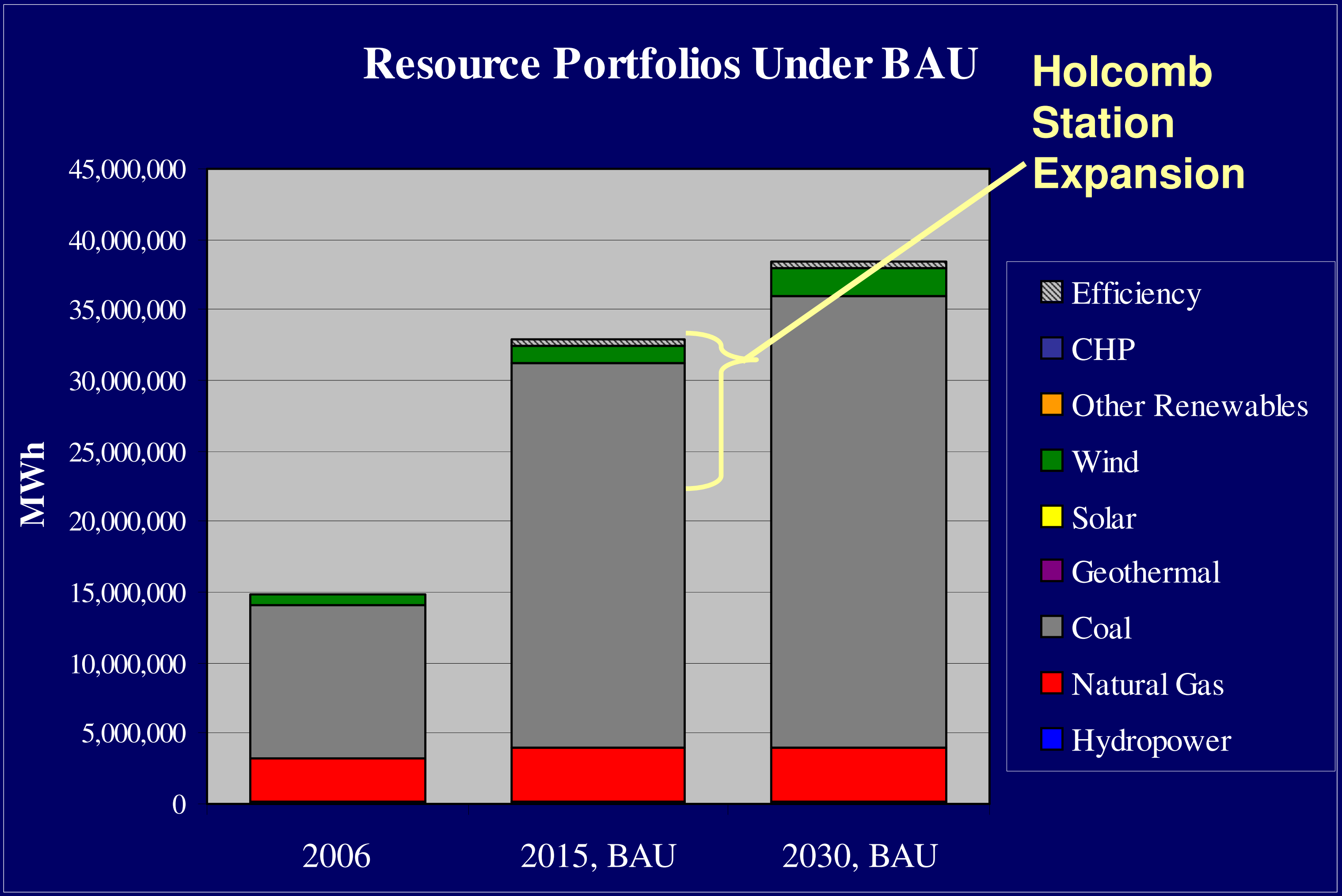
Background: Electricity Generation, 2006



15,000,000 MWh

→ **~21,000 AF of water**

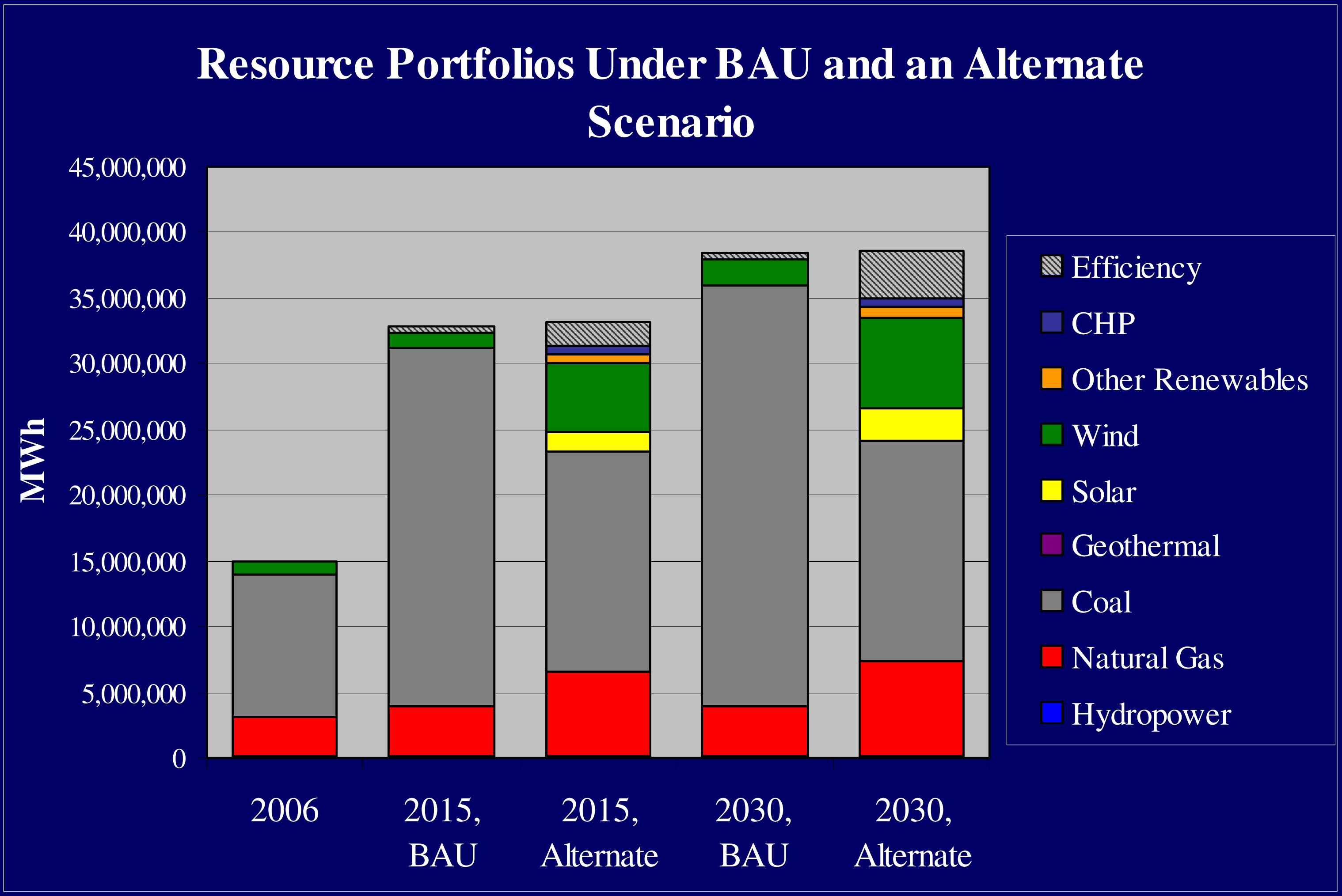
Electricity Generation: Business As Usual (BAU)



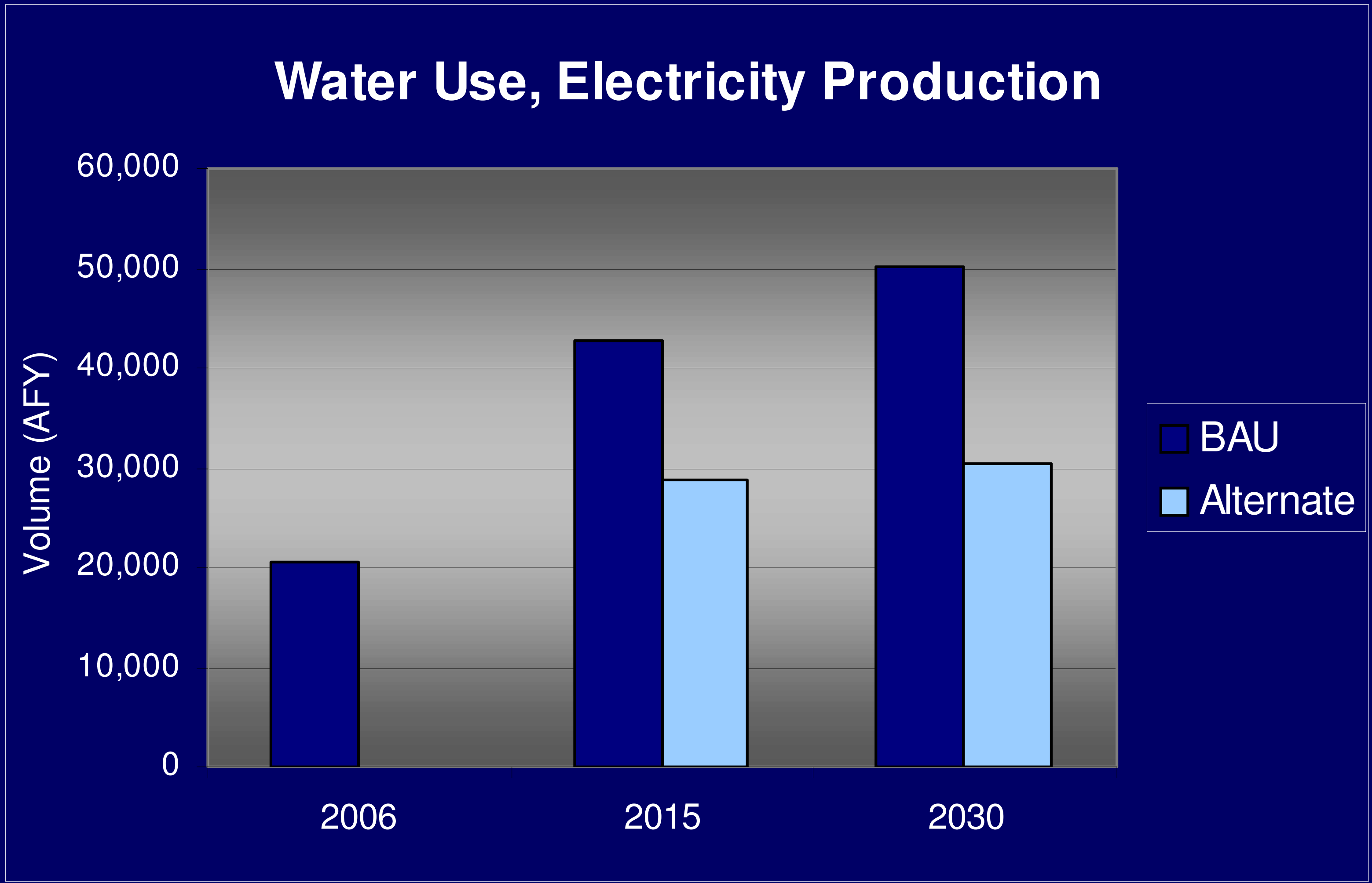
Electricity Generation: Alternate Scenarios

- Replace the proposed coal plants with energy efficiency, renewables, natural gas, and combined heat and power

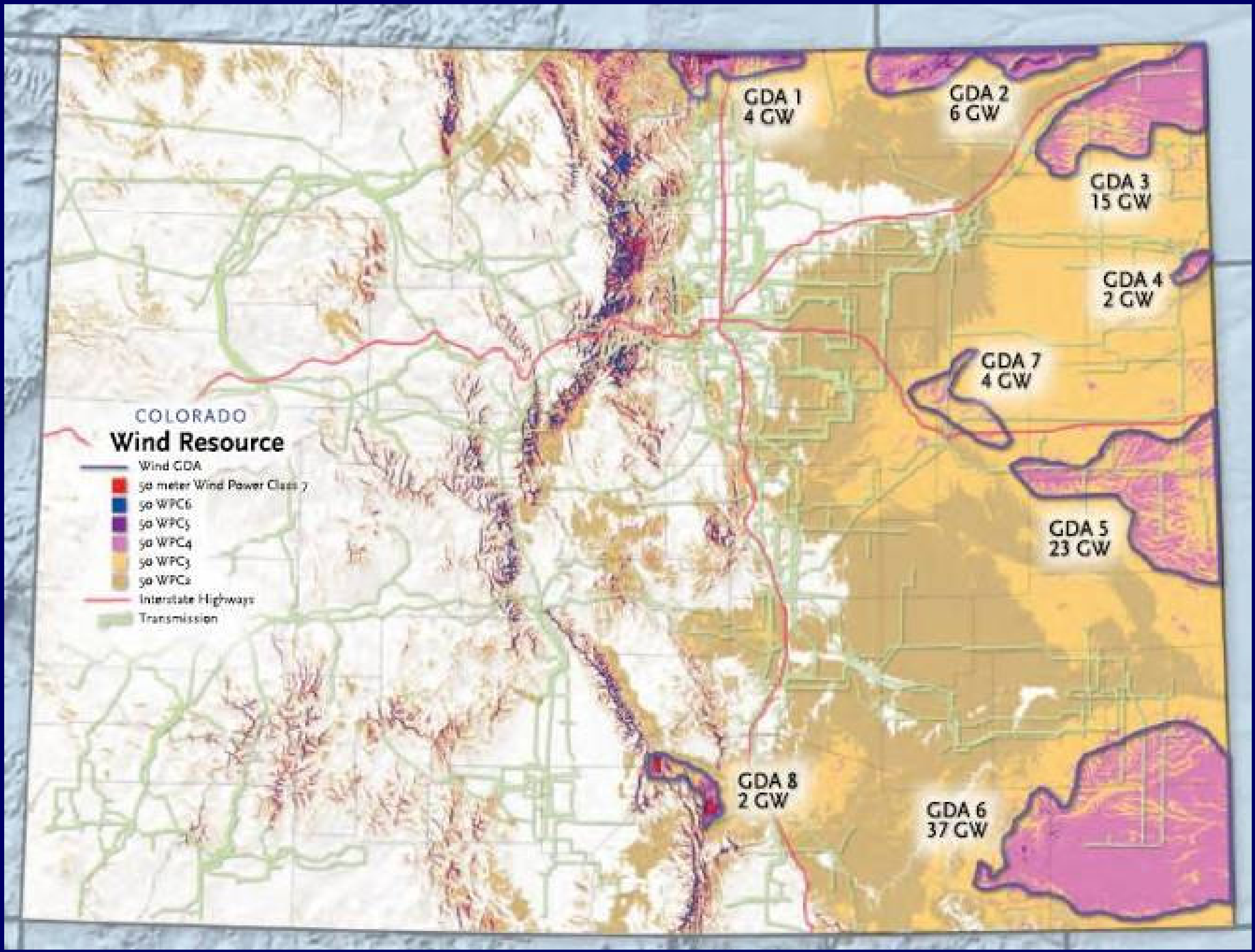
Electricity Generation: BAU and Alternate Scenario



Water Use

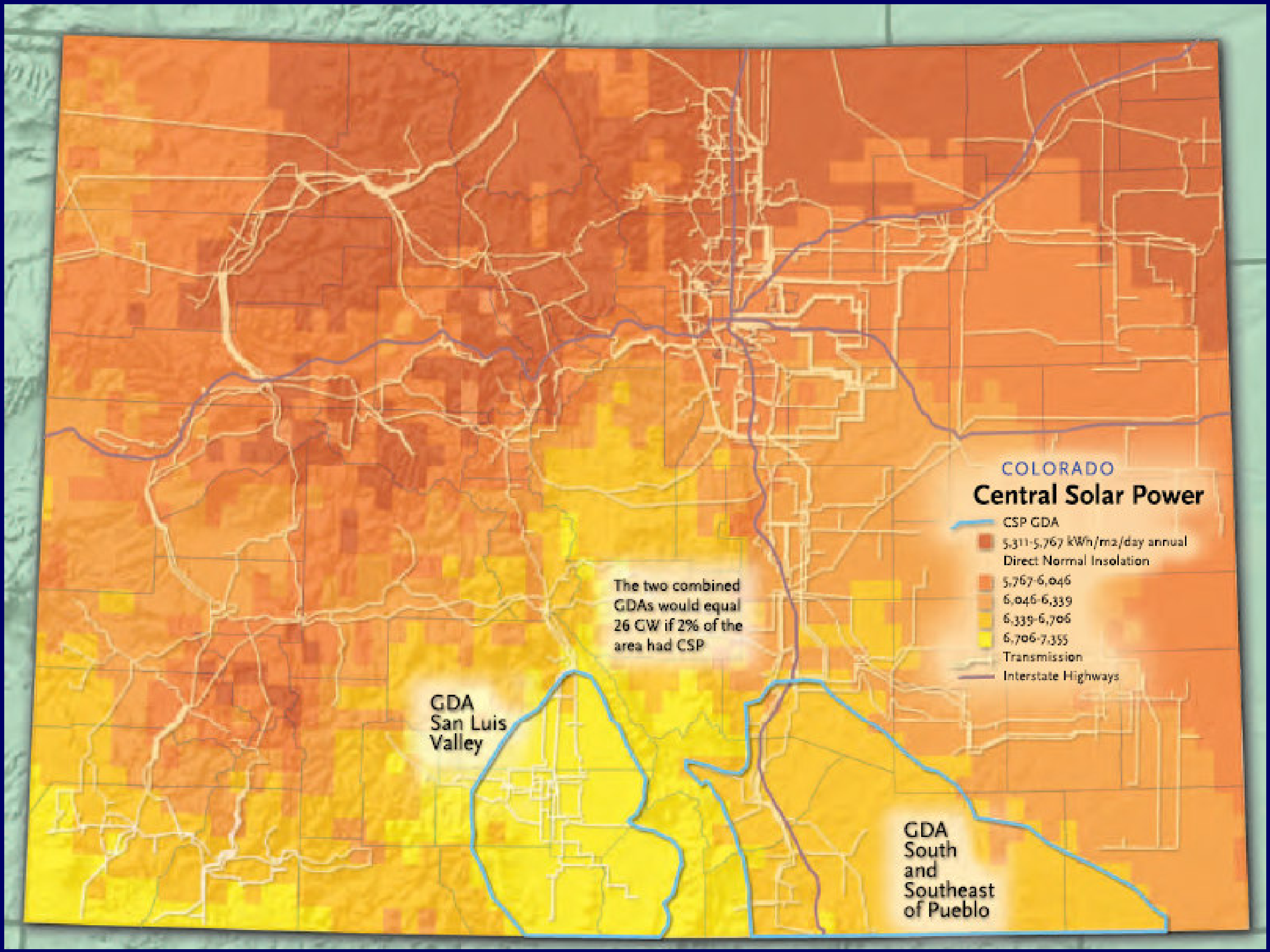

Water Use, Electricity Production
Volume (AFY)
60,000
50,000
40,000
30,000
20,000
10,000
0
2006
2015
2030
BAU
Alternate

Electricity: Renewable Potential



Total Capacity:
96 GW

Electricity: Renewable Potential



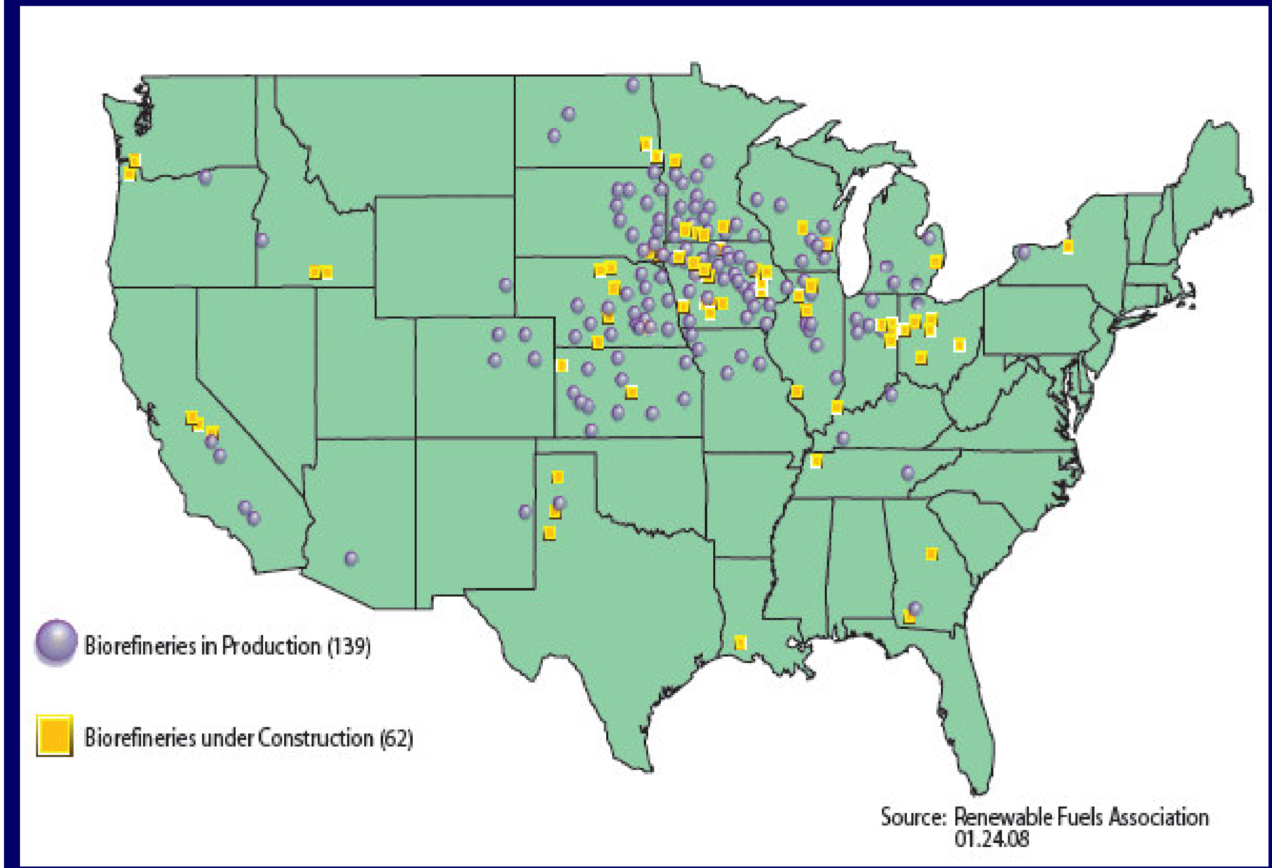
Total Capacity: 26 GW

Agriculture

Agriculture

- Recent trends: declining agricultural land use; water conversions
- Ethanol boom/high crop prices → increased pressure to use marginal crop lands for farming
- The Arkansas River Compact = no *new* water available for new farmland in the basin in Colorado
- Conservation Reserve Program lands with groundwater rights (Kansas) could potentially be put back into production

Ethanol: Biorefinery Locations



Location	Production Capacity
Arkansas Basin	72 Mgal/yr
Kansas (excluding Ark. Basin)	403 Mgal/yr
Colorado	125 Mgal/yr

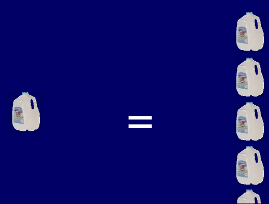
Water Use: Ethanol

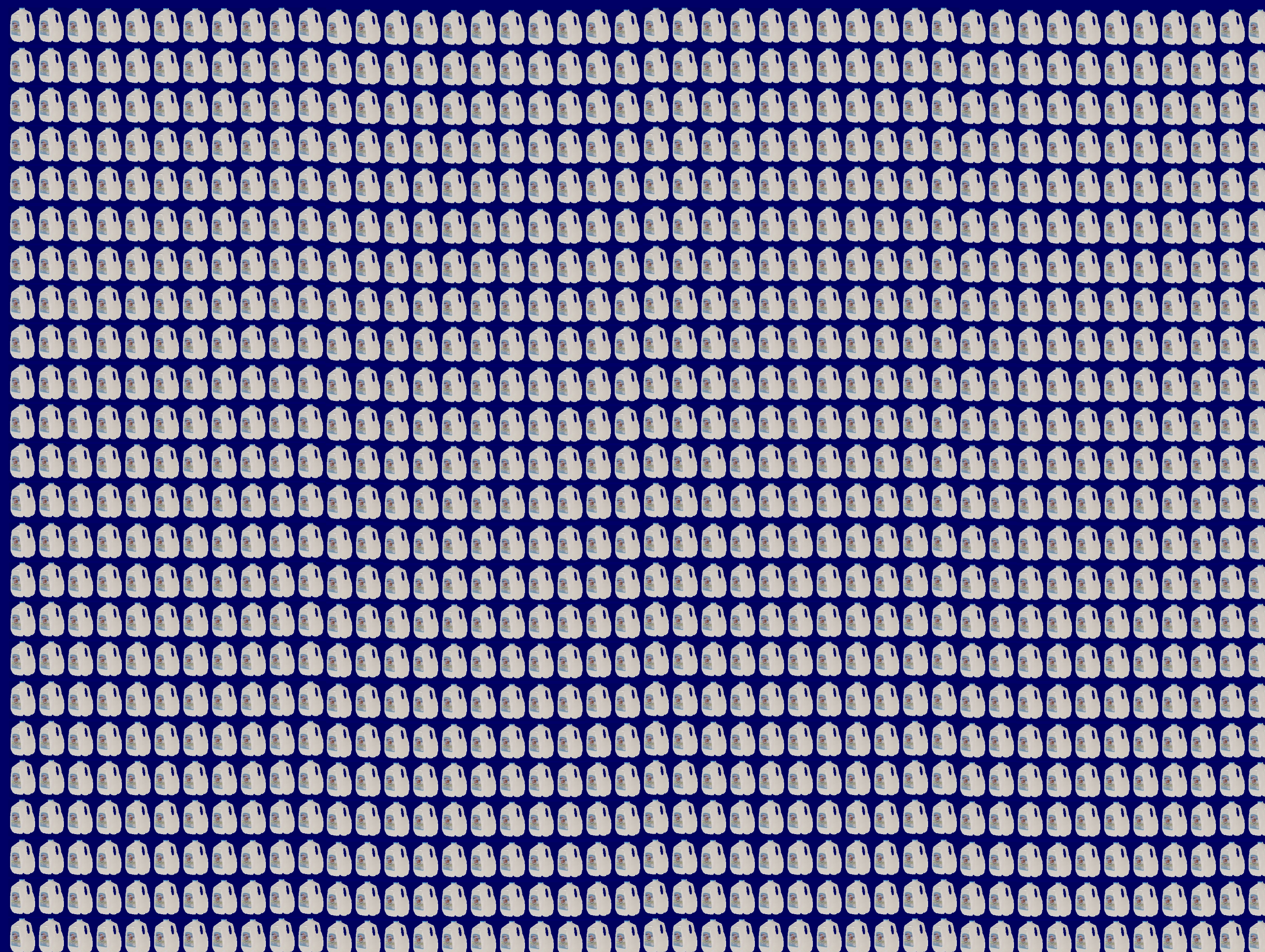
Irrigation: 1000 - 1200 Gallons of Water

Processing:

4.2 Gallons of Water

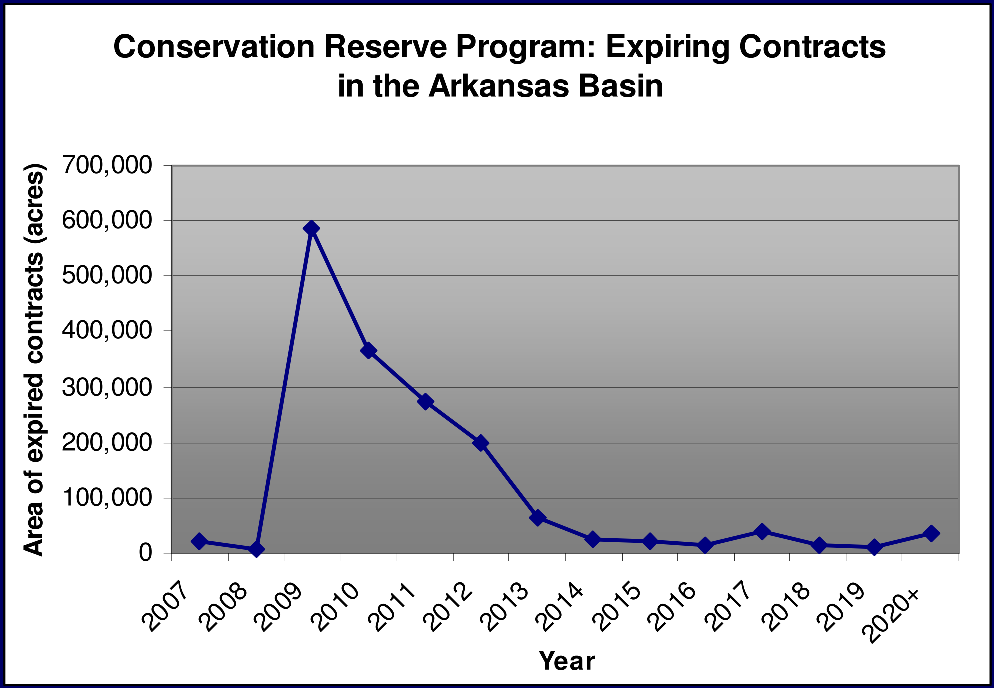
1 Gallon of Ethanol



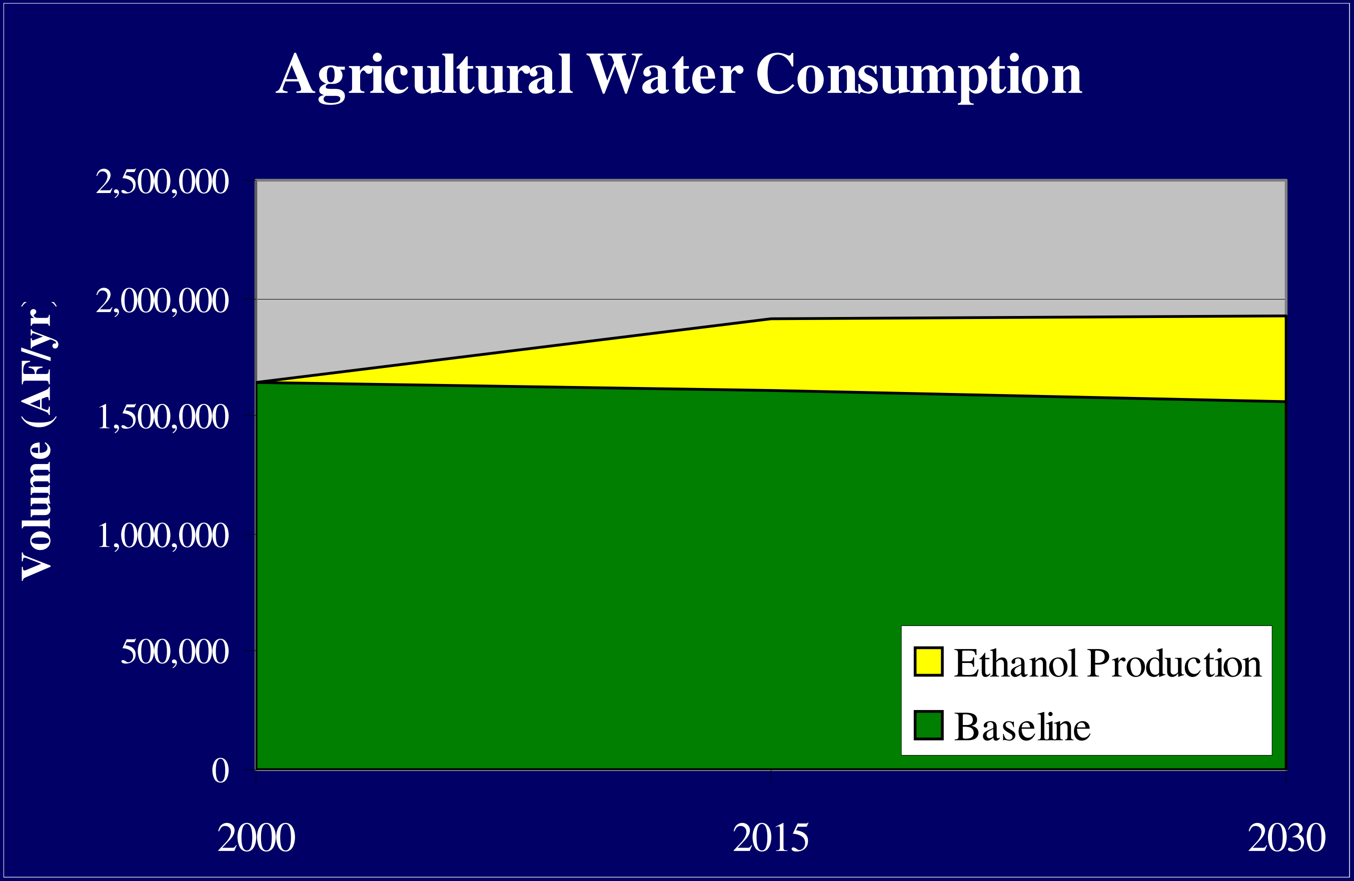


Agriculture

- Conservation Reserve Program
  - Pays rents to farmers on marginal croplands
  - Contracts expire every 10 – 15 years
- What will happen to this land?
- Depends on:
  - Farm Bill
  - Crop prices
- But… *Most* land is going back into production, if the farmer has resources available.



Agriculture

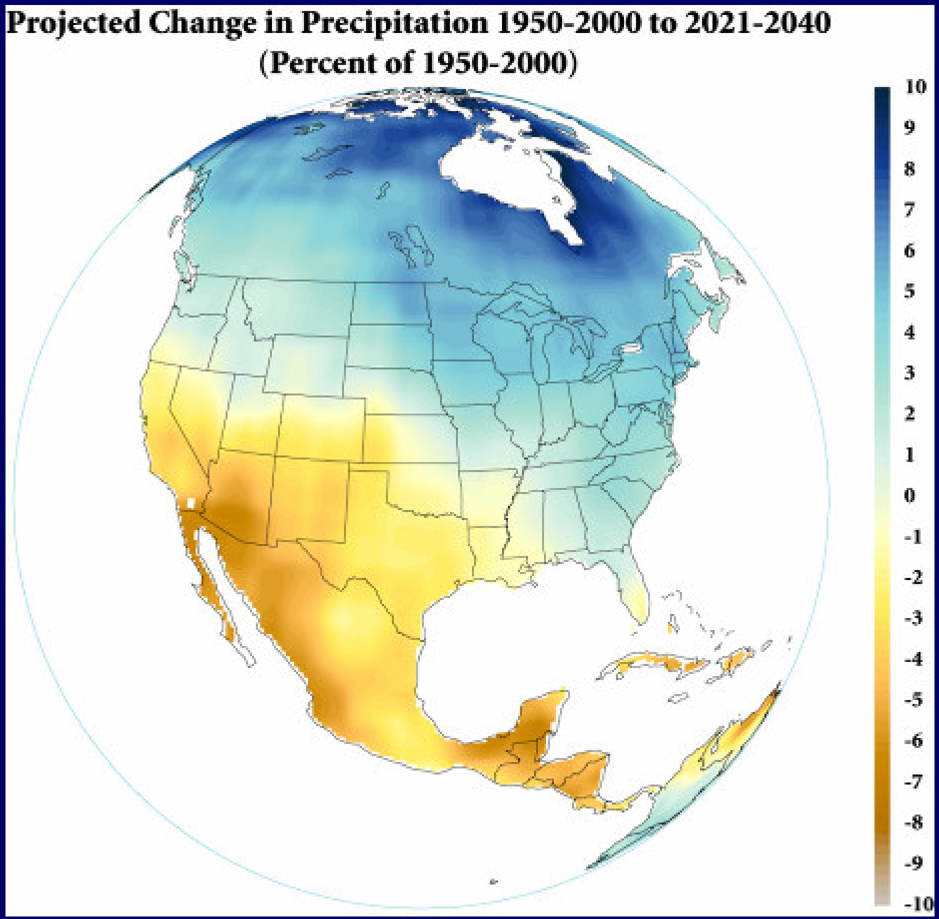


- Water consumption if 50% of CRP land in the Kansas portion of the basin goes back into production

Climate Change

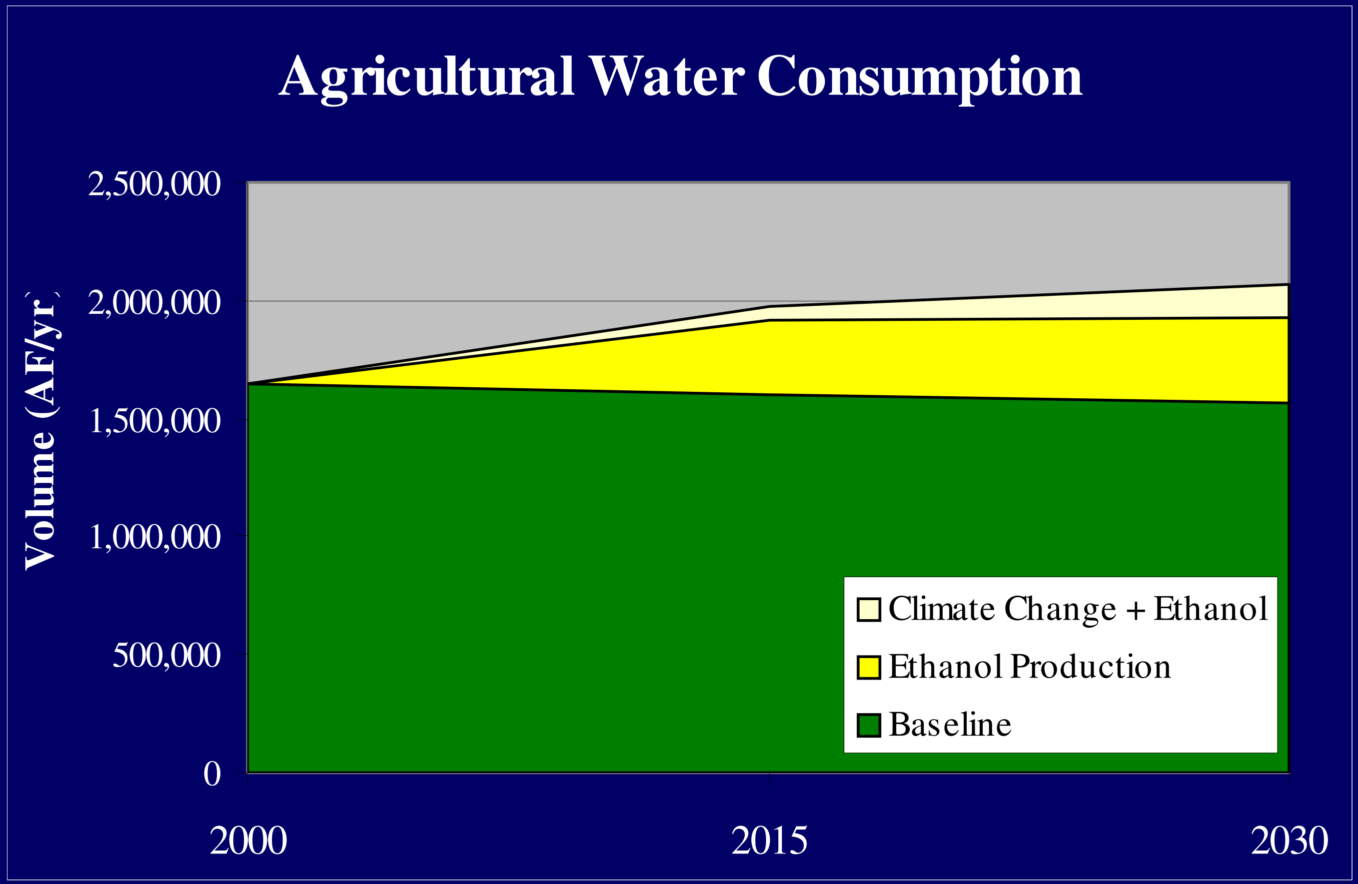
- Recent study looked at 49 GCM simulations

- Projects a more arid Southwest, with the droughts of the past becoming the norm. La Niña/dustbowl type events are *on top* of higher average temperatures and rates of evapotranspiration.



Source: Seager et al., 2007

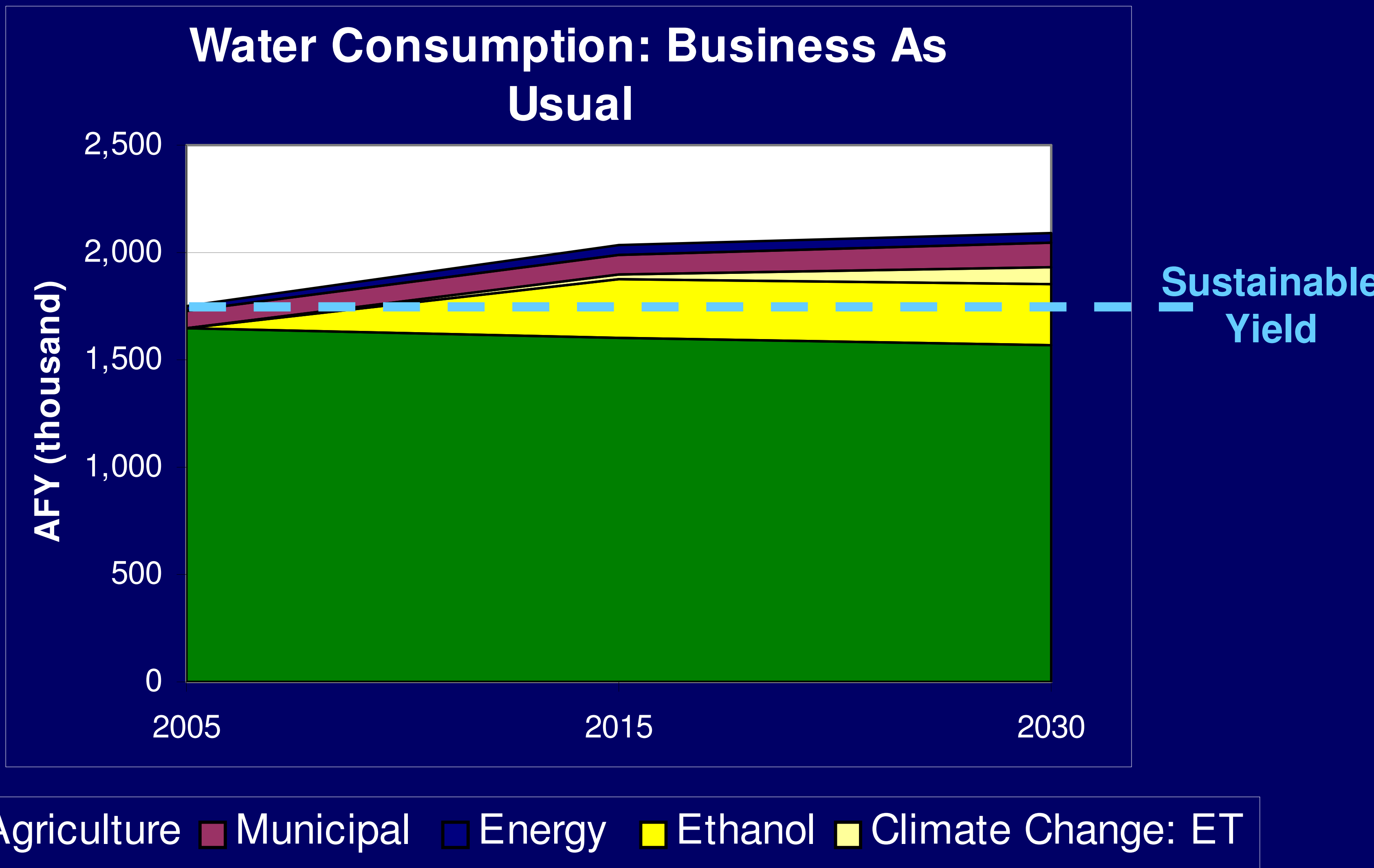
Climate Change



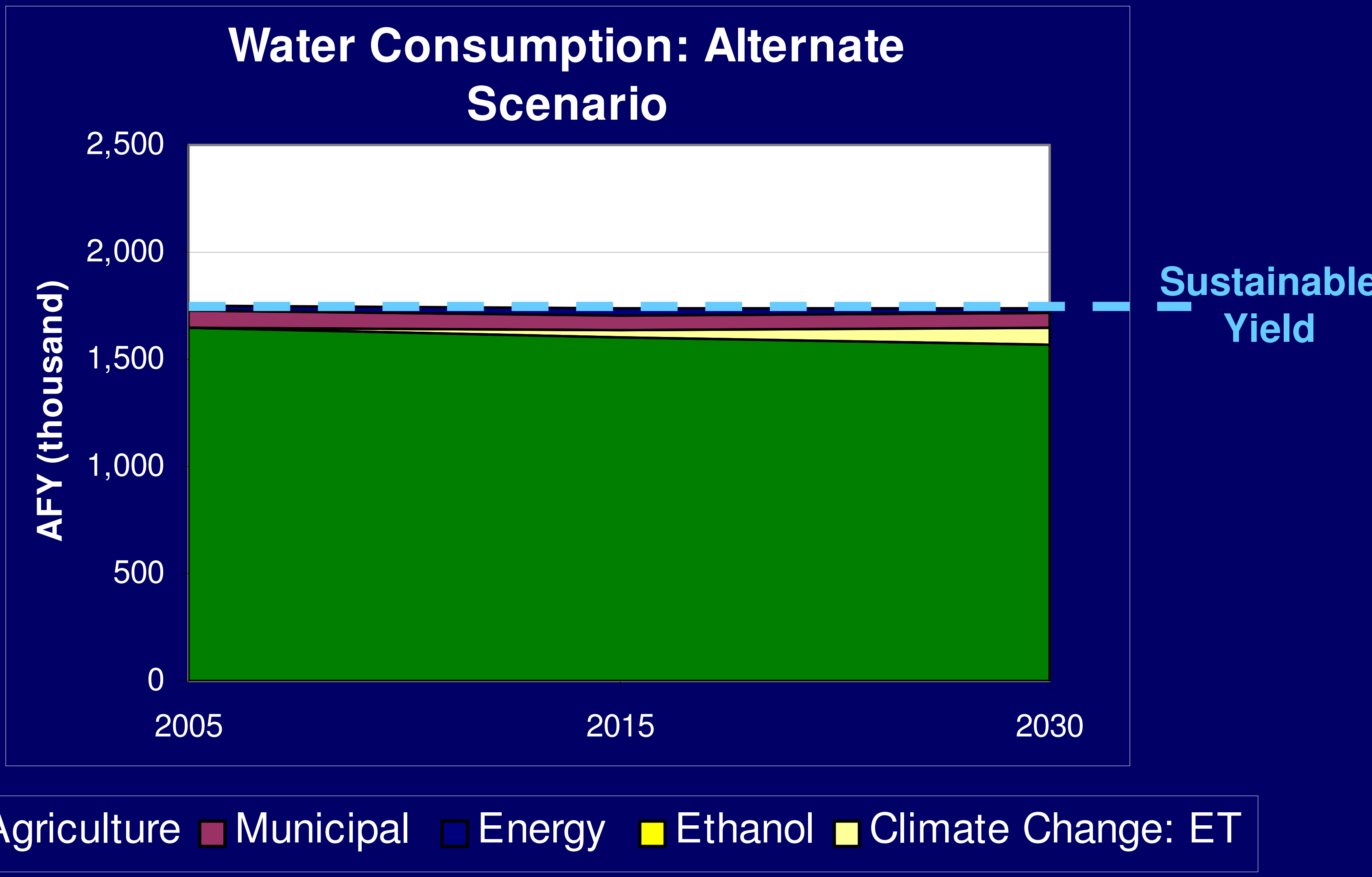
- Water consumption if 50% of CRP land in the Kansas portion of the basin goes back into production and climate change increases water losses from irrigated land.

Summary

Context: Competing Demands



Context: Competing Demands



Other Factors/Uncertainties

- Municipalities
  - Growth rates
  - Economic trends
- Electricity
  - Capital cost of renewables
  - Operating cost
    - Fuel prices
  - Risk of GHG regulation
  - Transmission Needs
- Agriculture
  - Farm policies
  - Crop prices

Policy Recommendations

1. Integrated planning
2. Accelerate water and energy conservation
3. Accurately value energy and water in utility planning processes
4. Decentralized solutions
   - Rainwater harvesting
   - CHP, solar PV
5. “Water Smart” fuel and renewable portfolio standards

Policy Recommendations

6. Be creative!
    - How can new water systems reduce their GHG emissions?
    - Where do the synergies exist?
    - What are our “lost opportunities” today?

Conclusions

- Competition for limited water resources in the Arkansas Basin will increase
- Long range planning in the municipal and energy sectors can reduce water demands – through investments in municipal water use efficiency, energy efficiency, and renewable sources of energy
- These measures will be increasingly important, considering the impacts of climate change
- A comprehensive policy on agriculture and ethanol development – one that addresses water resources – will be most important

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