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Solutions for Today

| Options for Tomorrow

The 2018 Water Brief

Crosscutting Annual Review Meeting

April 10th, 2019

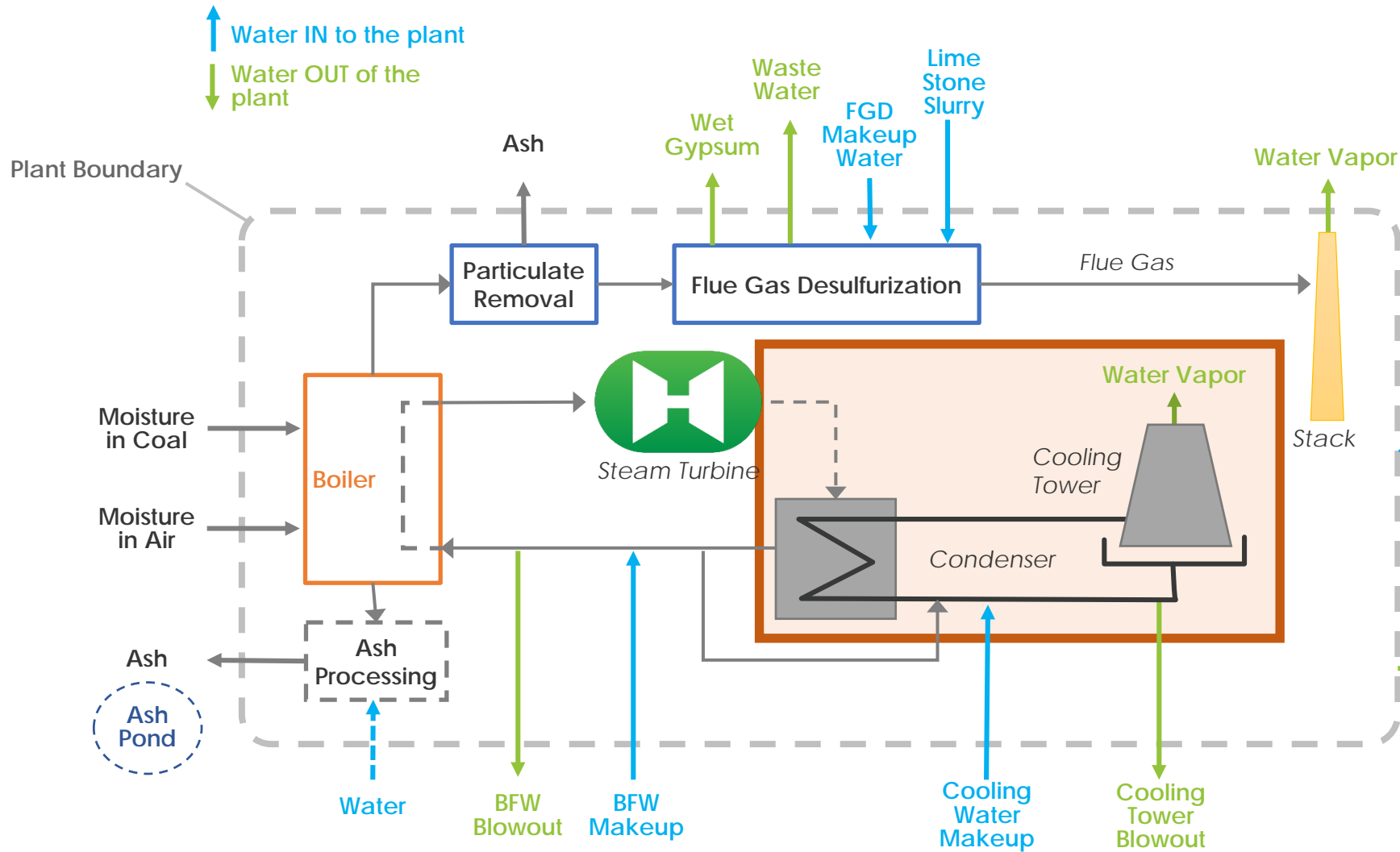


Jocelyn Kate Mackay

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National Energy Technology Laboratory
KeyLogic Systems



Water Use in Power Plants



Integrated System Studies
 Plant Level and Existing Fleet
 Water Availability
 (e.g. surface water, ground water, brackish water)
 Water Demand
 (e.g. power, agriculture, municipal, industry)



Water Source
 (river, lake, municipal system)



Water Reuse

Recent Energy-Water Legislation

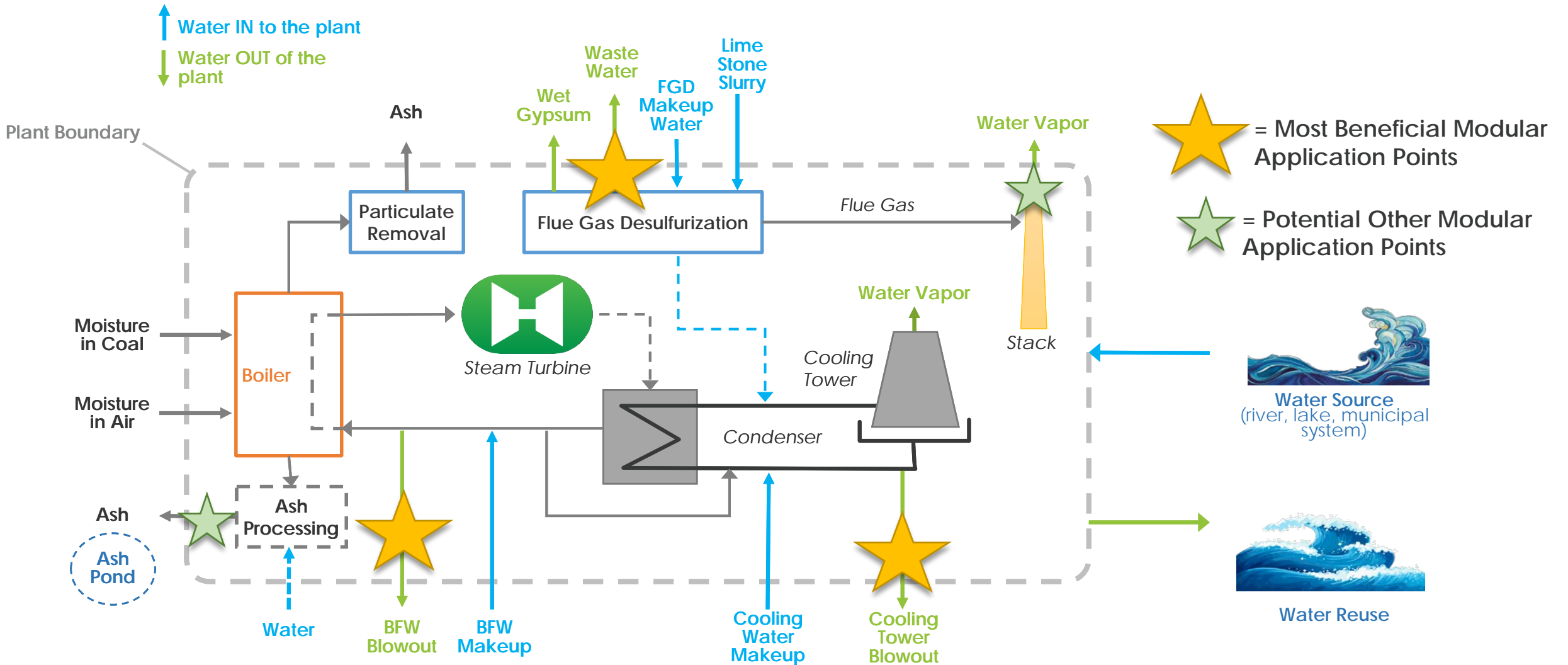
Energy and Water Research Integration Act of 2019

H.R. Bill 34, tasks DOE with creating strategic plan that integrates water considerations by —

- Advancing technologies that:
 - 1) Minimize freshwater withdrawal and consumption
 - 2) Increase water use efficiency
 - 3) Utilize nontraditional water sources



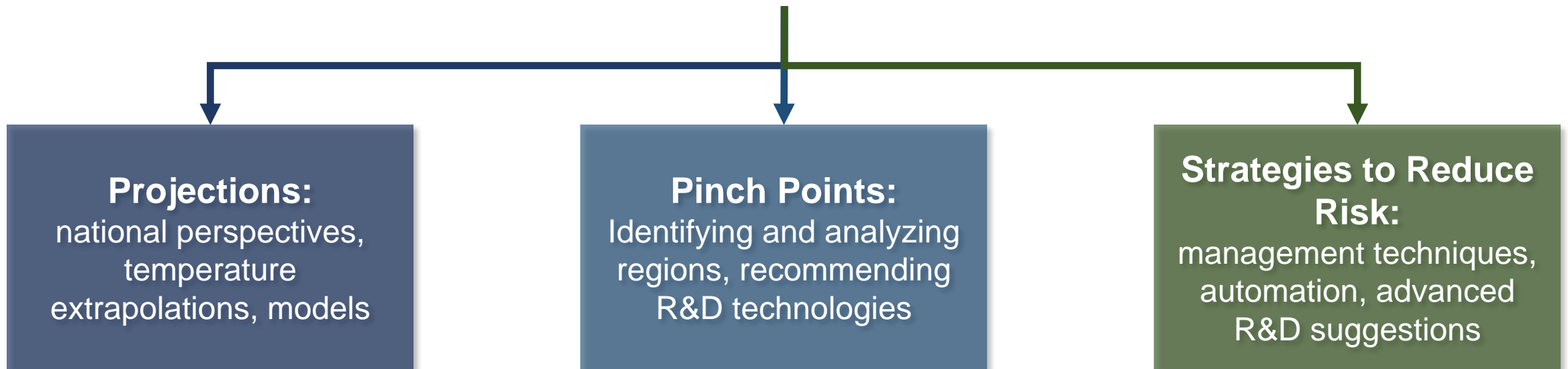
Modular Treatment Systems Applications



Crosscutting Water Management Goal

Mission: Provide **leadership**, raise **awareness**, and offer **cost-effective technical solutions** regarding potential national **issues** in **water quality and availability**.

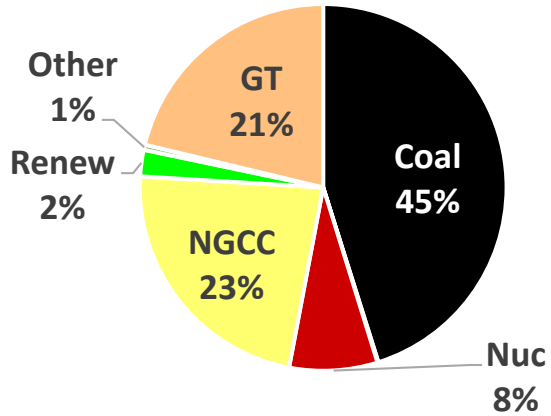
How?



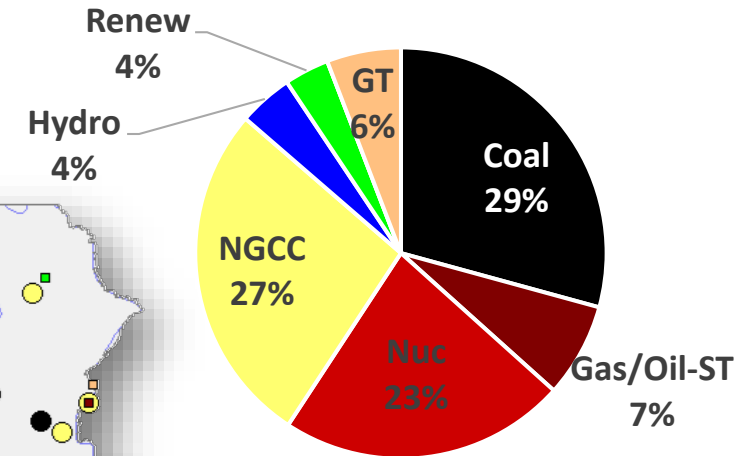
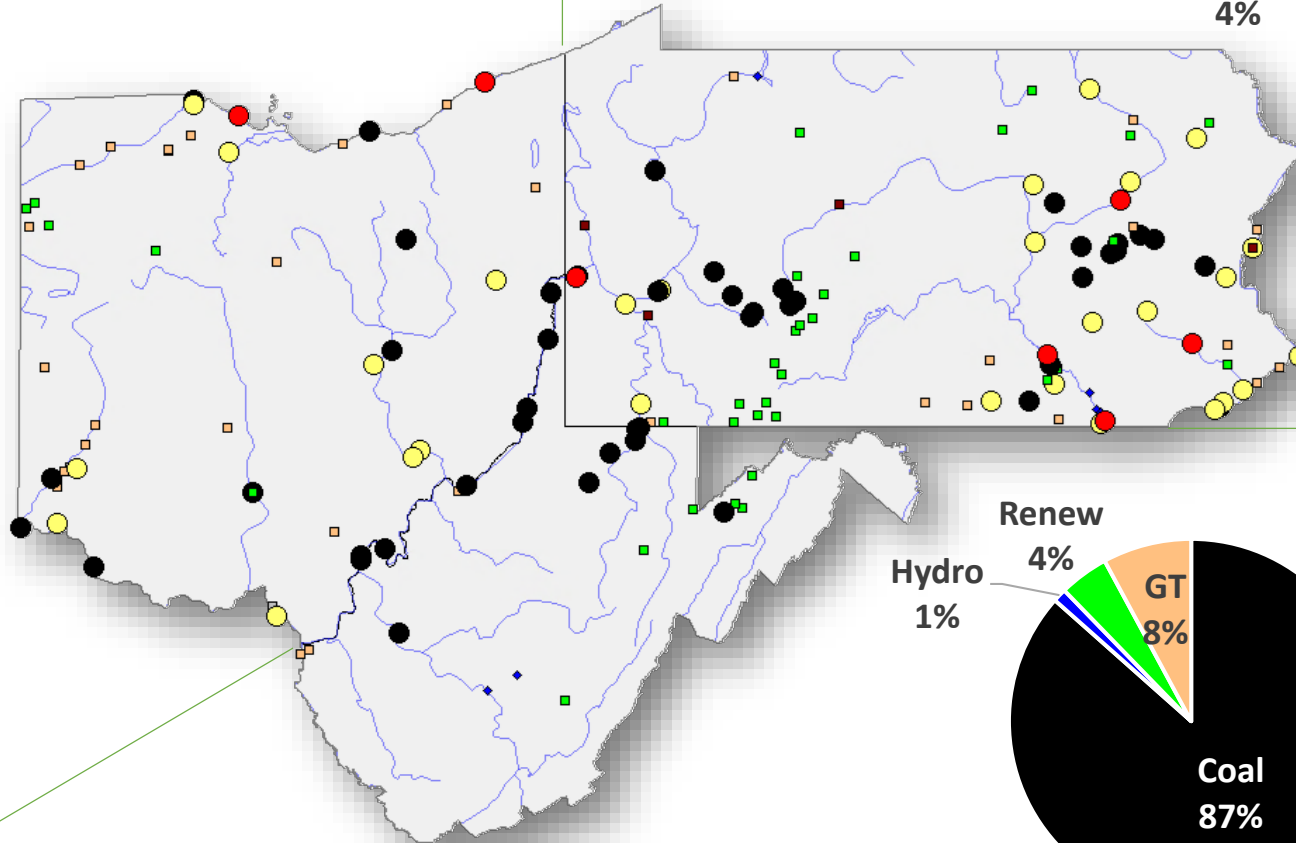
Tri-State Capacity

Thermoelectric dependence on water

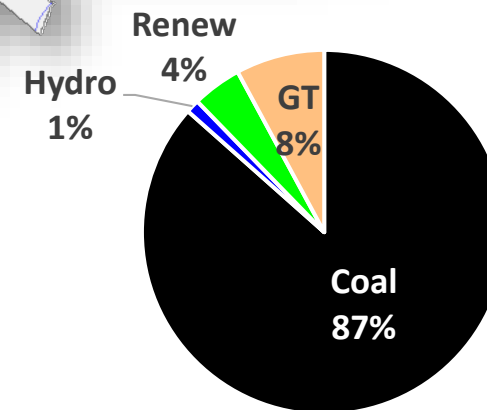
OH – 76% Capacity is Thermoelectric



PA – 86% Capacity is Thermoelectric



WV – 87% Capacity is Thermoelectric



Map Legend




- Thermoelectric
- ◇ Hydro
- Non-Water
- Coal
- Gas/Oil-ST
- GT
- NGCC
- Nuc
- Other
- Renew
- Water

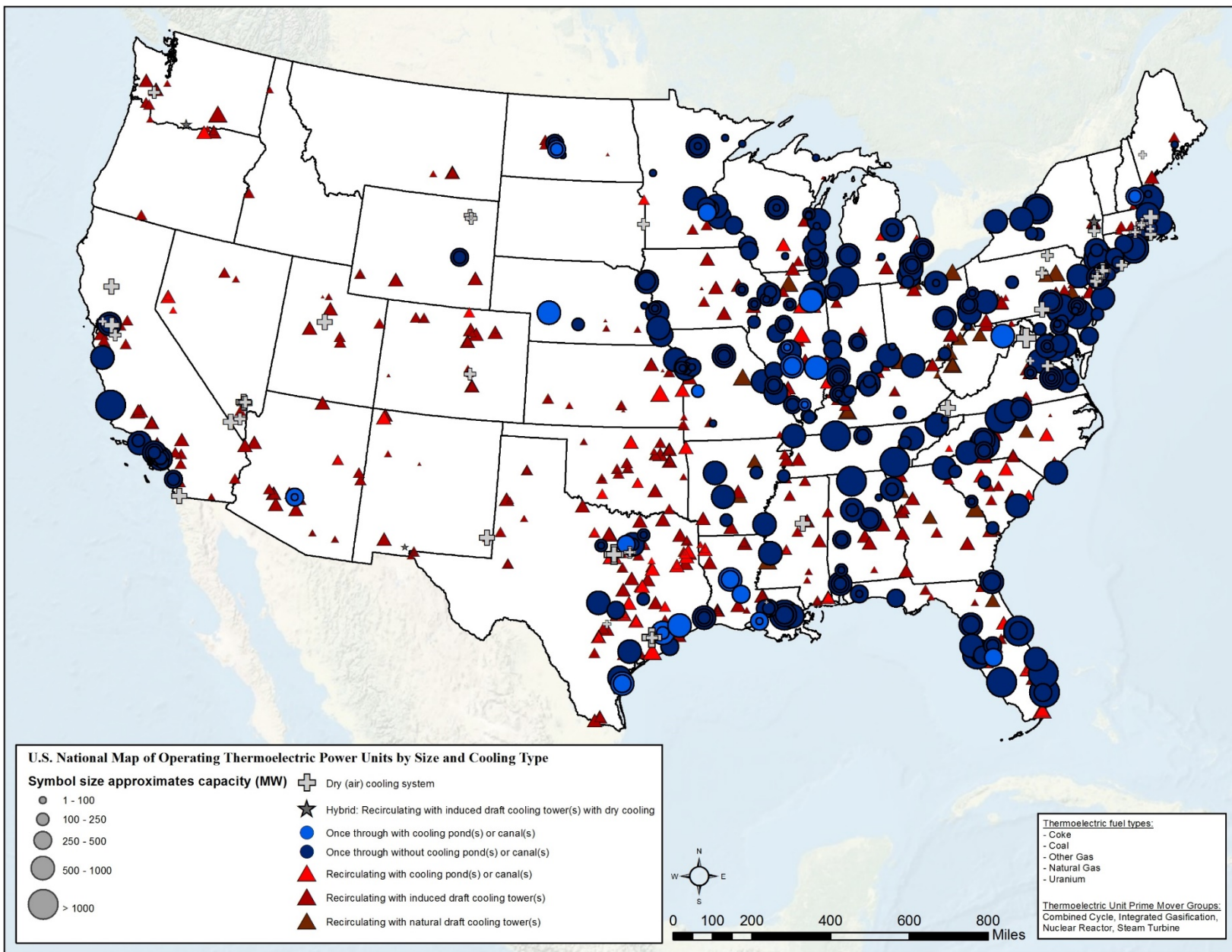


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Current U.S. Power Plant Cooling Systems

-  3.6% Dry cooling and Hybrid
-  43% Once Through
-  53% Recirculation



Data is from ABB Velocity Suite.

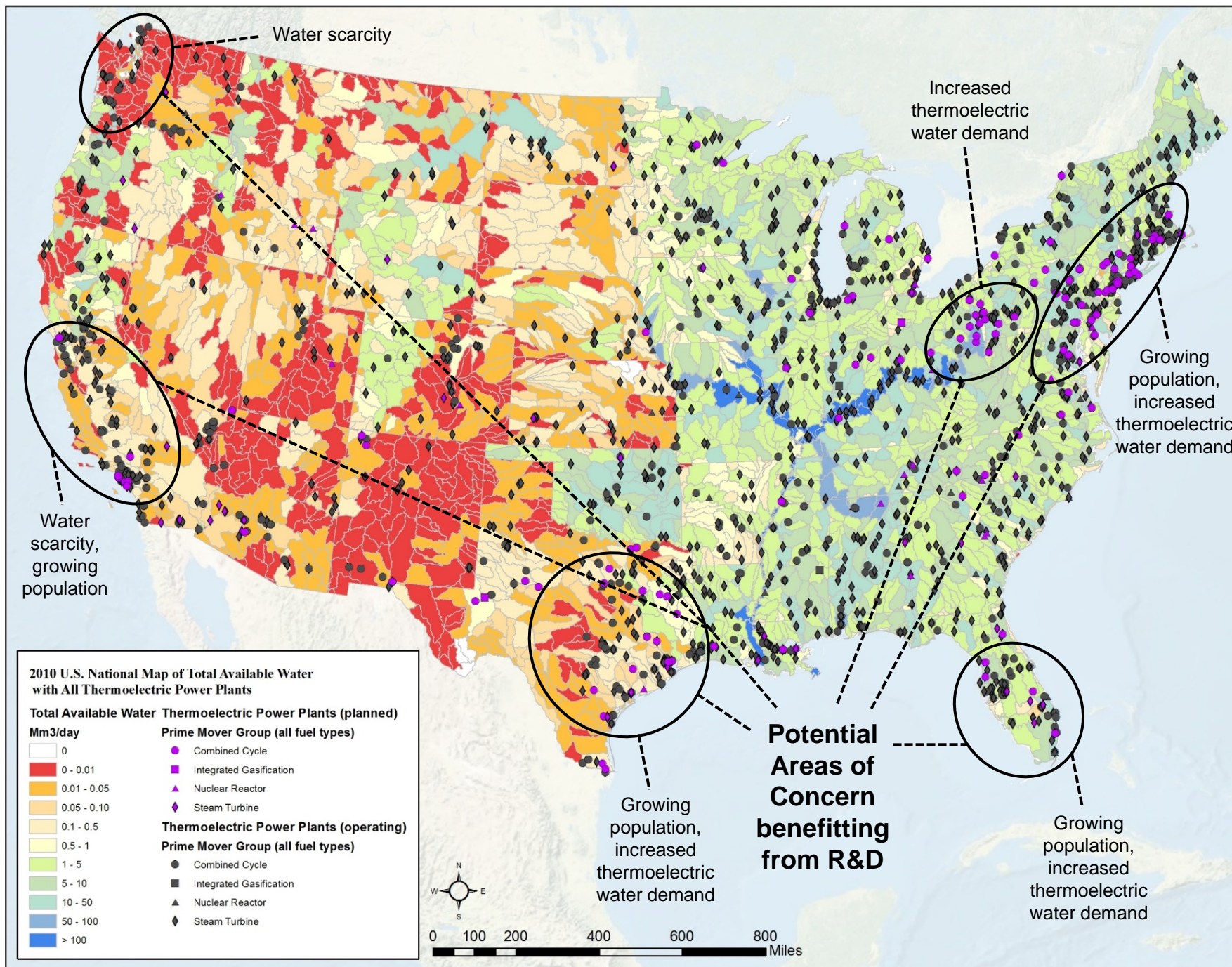


NATIONWIDE PERSPECTIVES

Thermoelectric Power Generation and Total Available Water

Six potential areas of concern (AOCs) highlight regions for R&D opportunities.

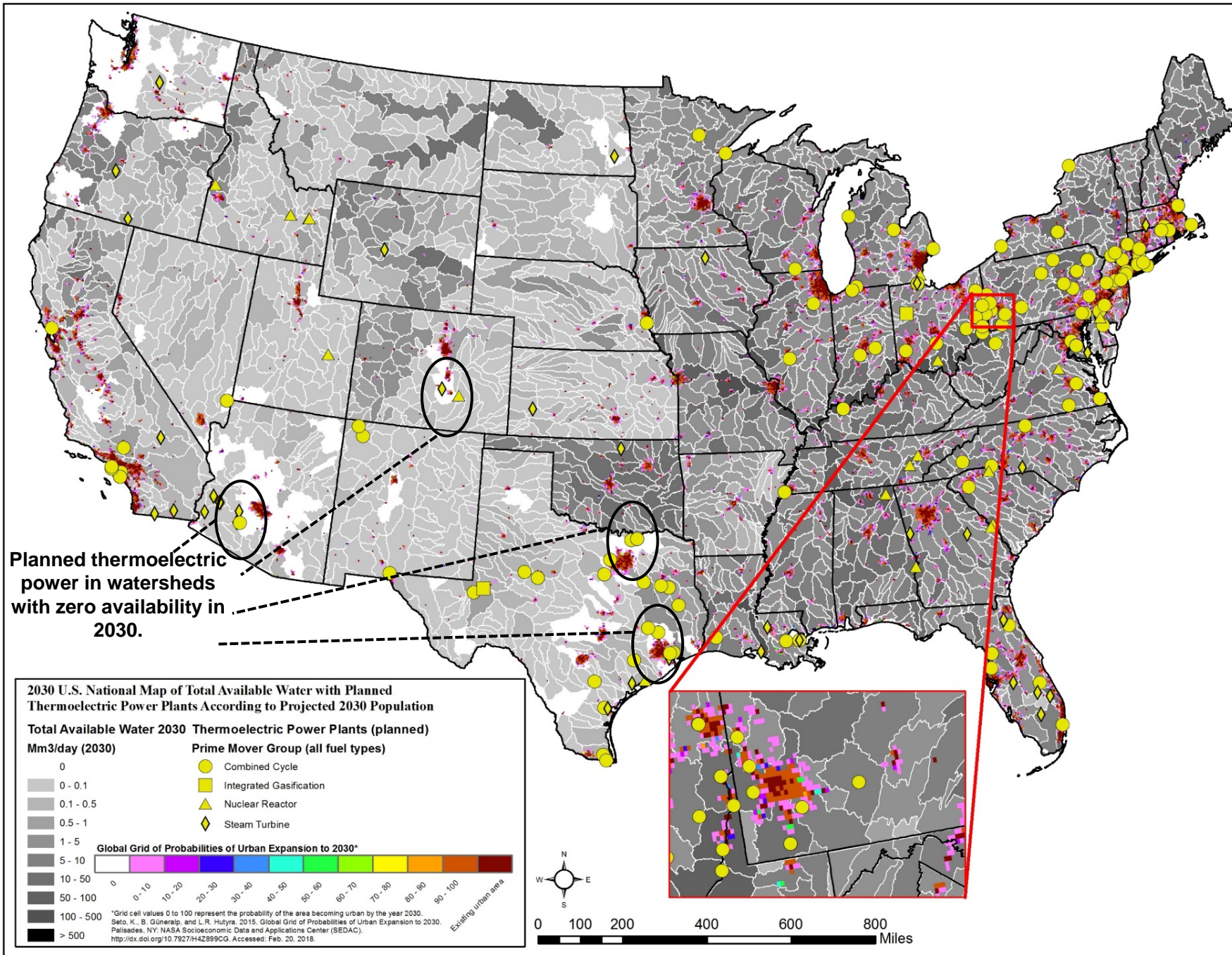
Data is from Sandia National Laboratories and ABB Velocity Suite.



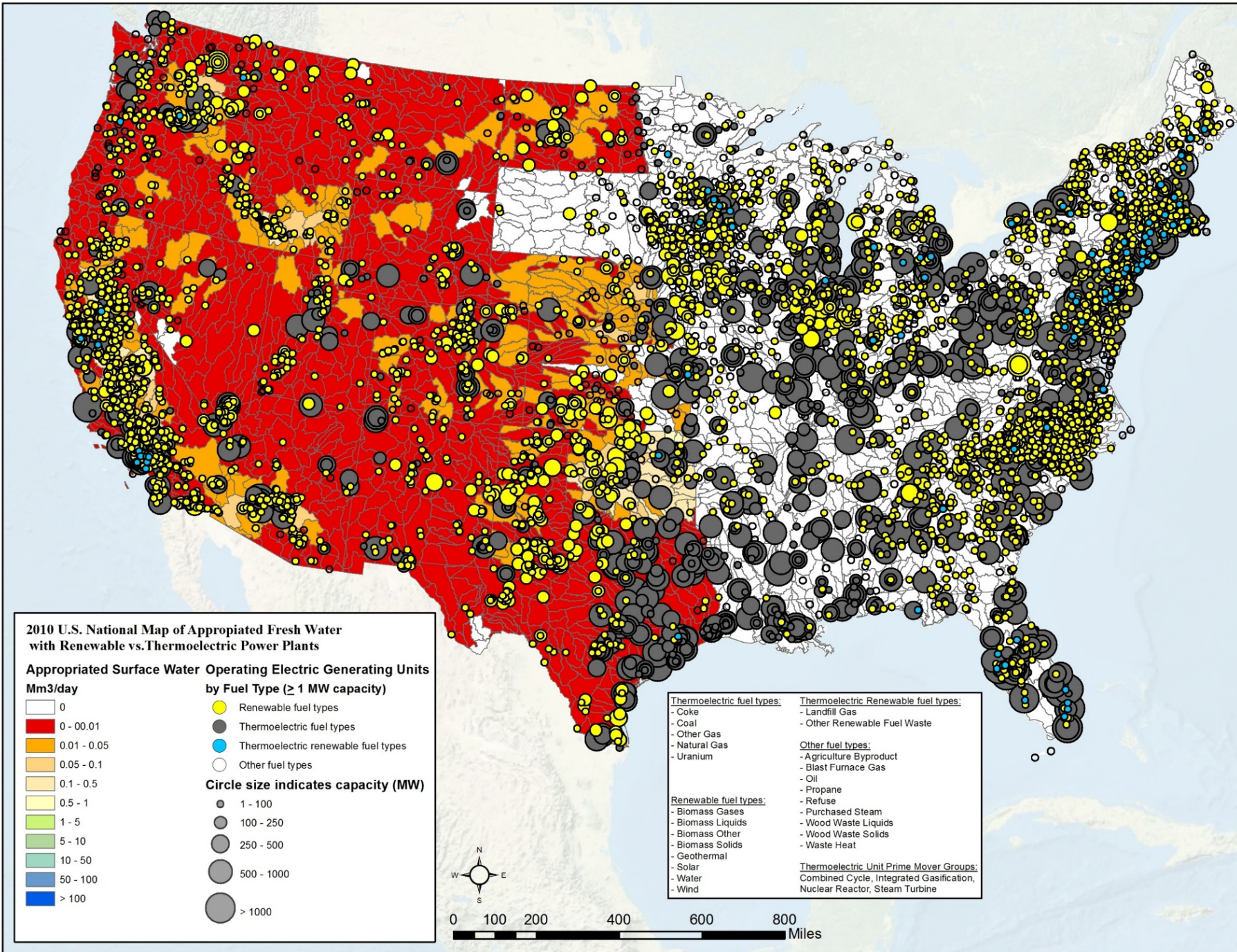
Projected 2030 Total Available Water and Planned Thermoelectric Power

Four HUC8 watersheds are projected to have zero water availability in 2030.

Data is from Sandia National Laboratories and ABB Velocity Suite.

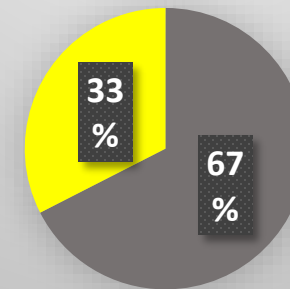


Appropriated Water and Power Sources



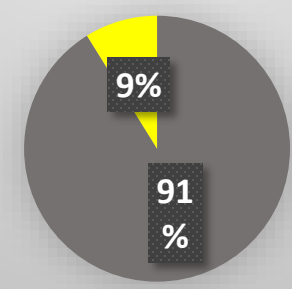
Western States Net Power Generation

- Thermolectric Net Generation
- Renewable Net Generation



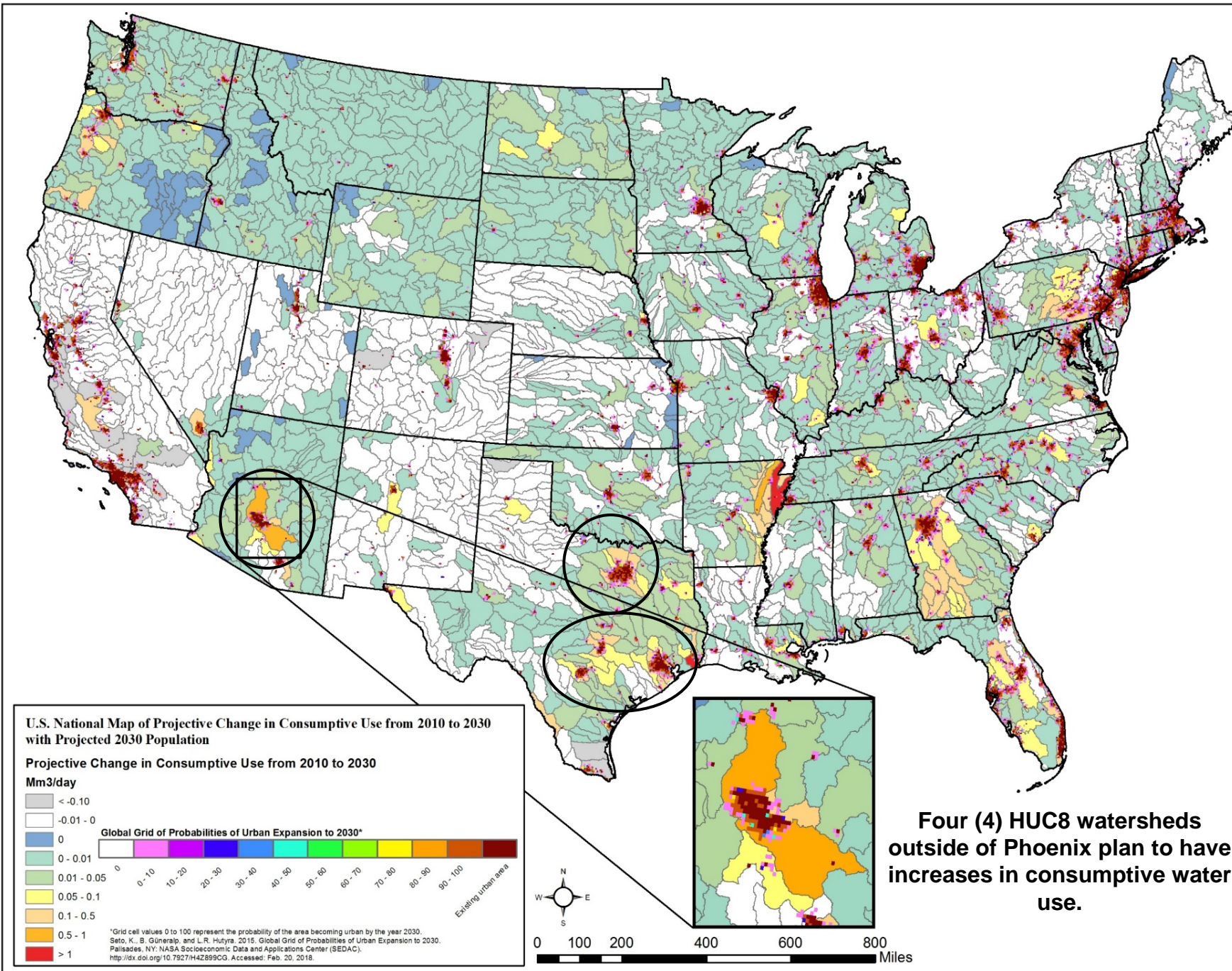
Eastern States Net Power Generation

- Thermolectric Net Generation
- Renewable Net Generation



Change in Consumptive Use and Growth in Population

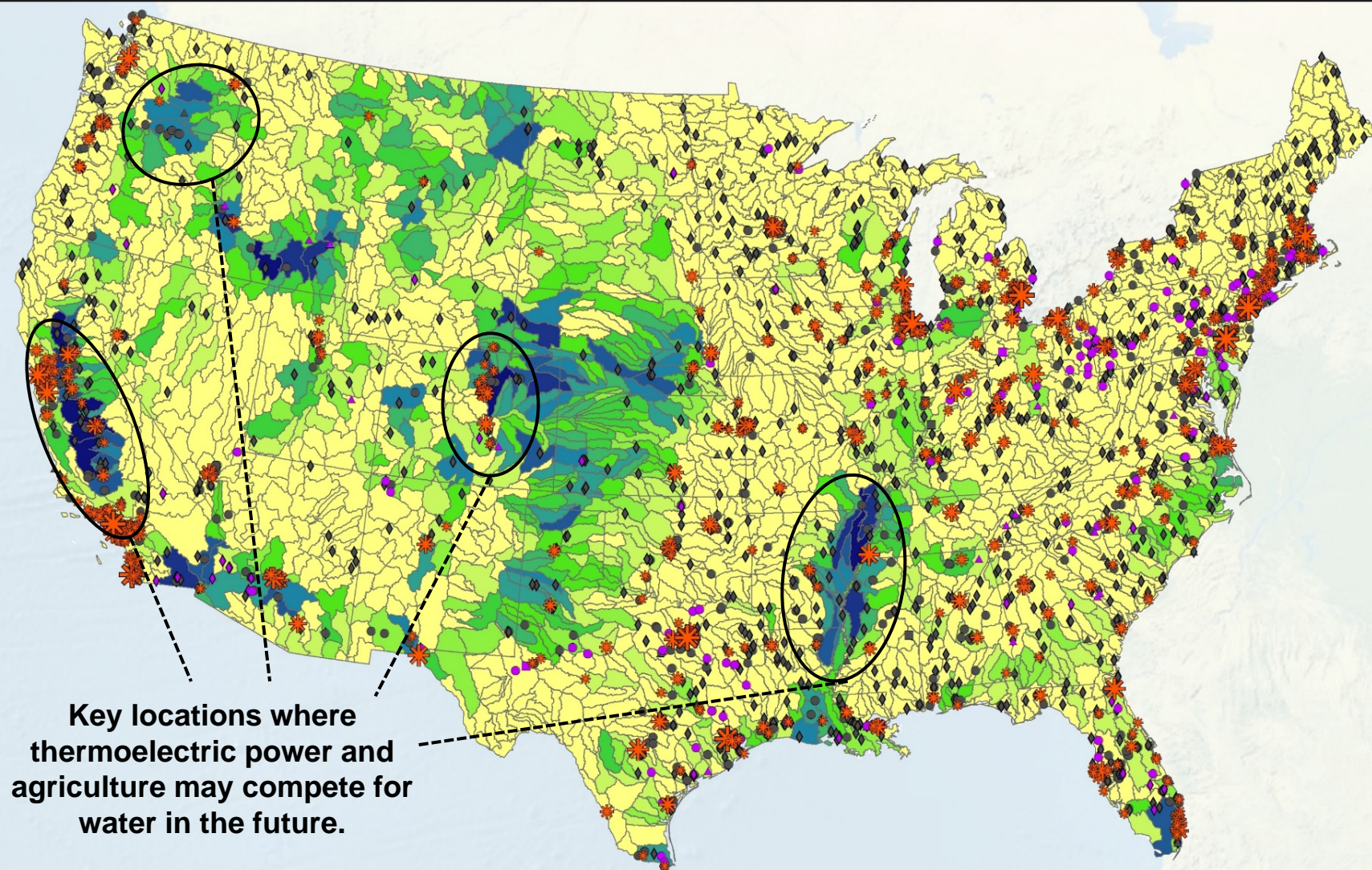
Three potential areas of concern (AOCs) highlight regions for R&D opportunities.



Data is from Sandia National Laboratories and ABB Velocity Suite.

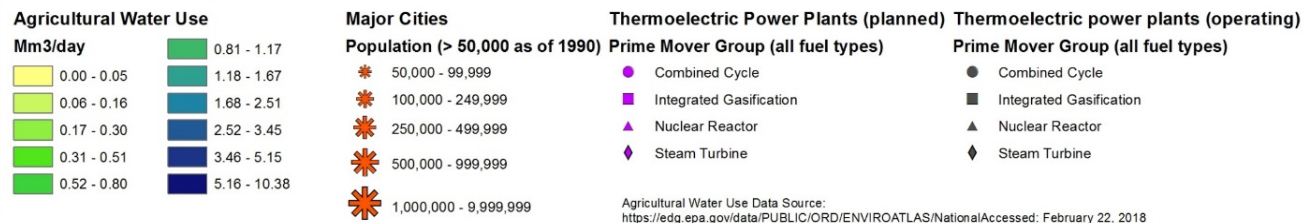
Agriculture and Thermoelectric Power

Agriculture and thermoelectric power are not active competitors for water.



Key locations where thermoelectric power and agriculture may compete for water in the future.

U.S. National Map of Agricultural Water Use with all Thermoelectric Power Plants



Data is from Sandia National Laboratories and ABB Velocity Suite.

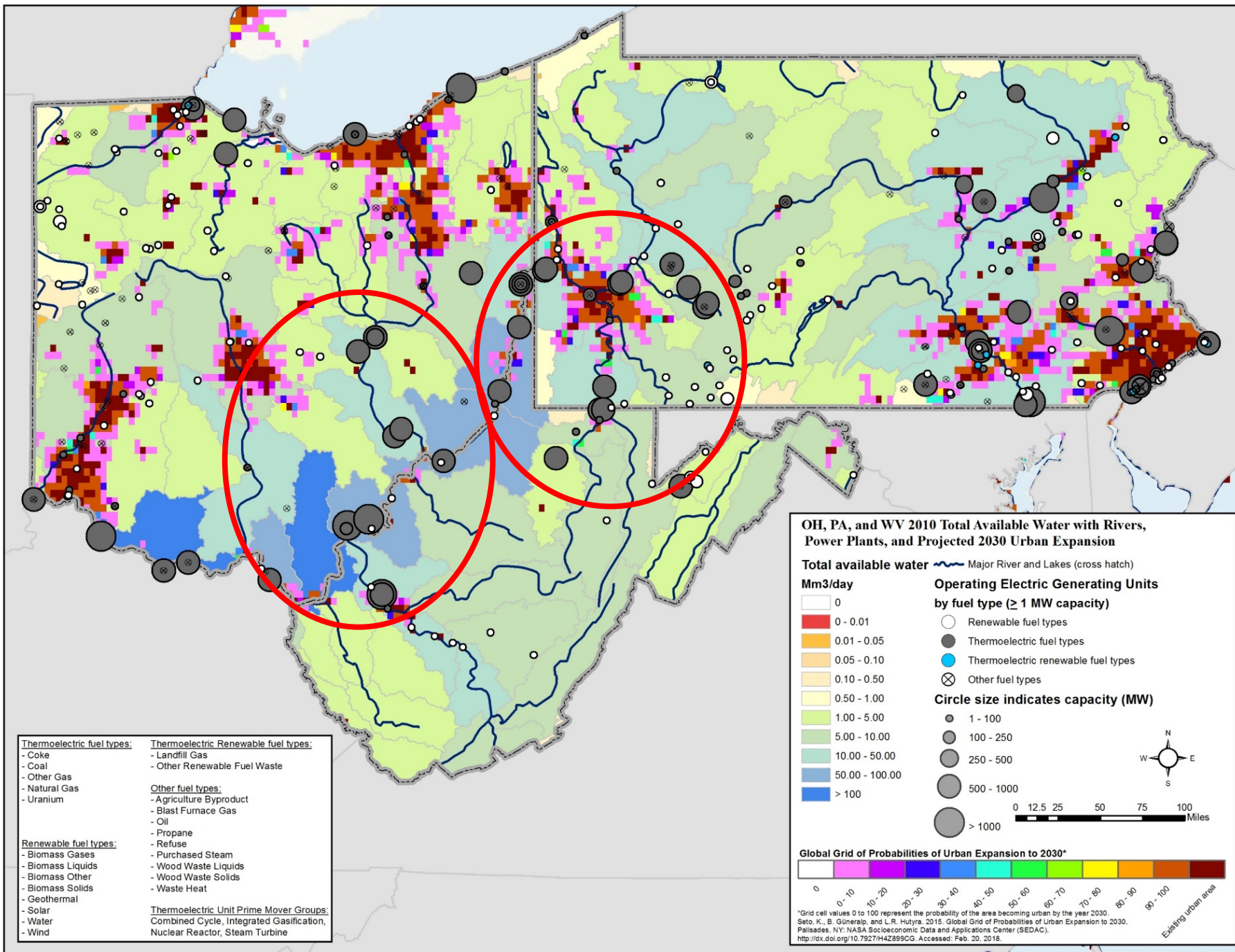
A photograph of an industrial facility, possibly a refinery or chemical plant, at night. The facility is illuminated with warm yellow lights, and its complex structures, including towers and piping, are reflected in a body of water in the foreground. The sky is a deep, dark blue. The text "REGIONAL PERSPECTIVES" is overlaid in white, bold, sans-serif font across the middle of the image.

REGIONAL PERSPECTIVES

Northern Appalachia

Density of thermoelectric power may impact effluent temperatures and water quality.

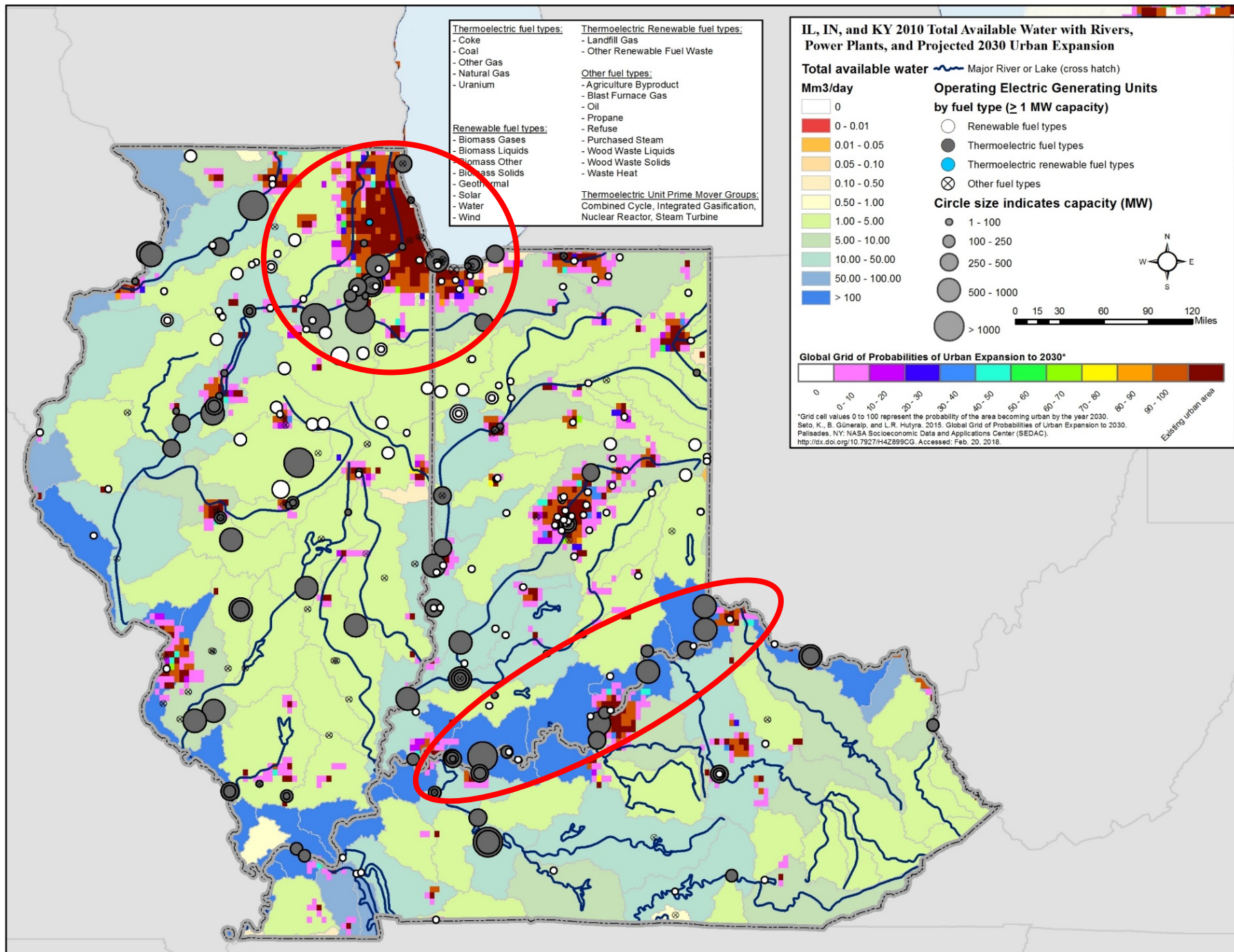
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Midwest

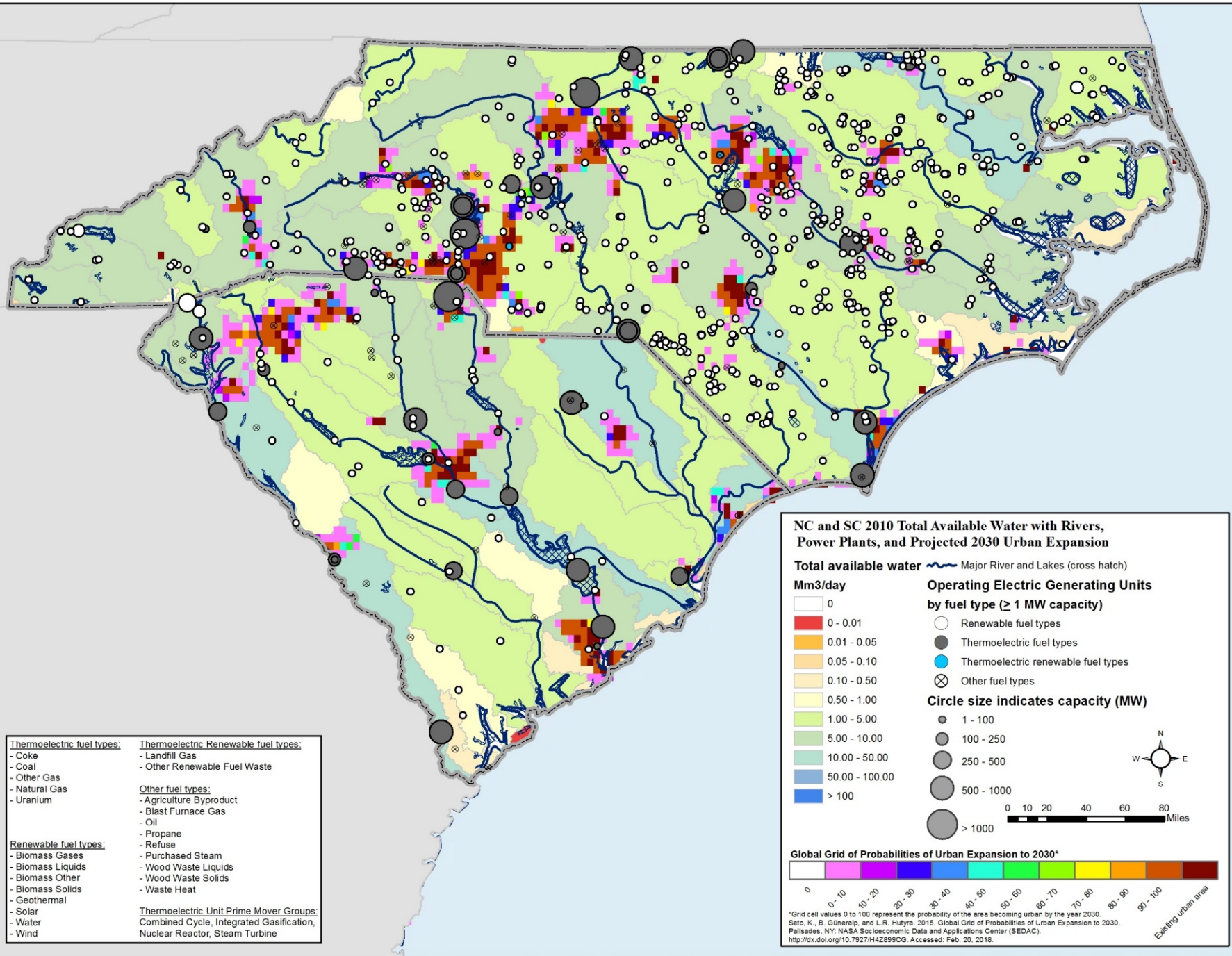
Agriculture is central to the region; advancements in water reuse may benefit the region.

Data is from Sandia National Laboratories and ABB Velocity Suite.



Southern Atlantic Coast

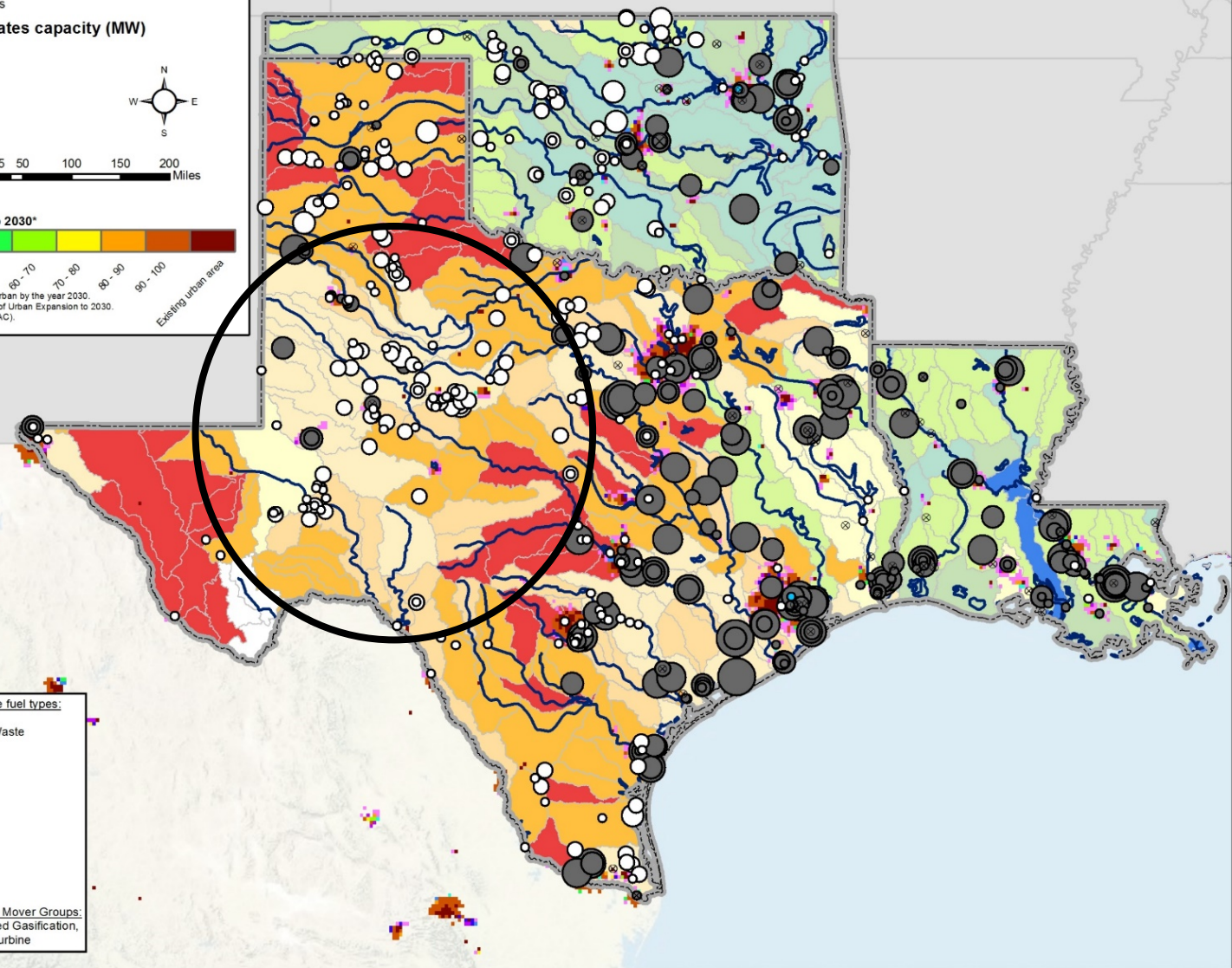
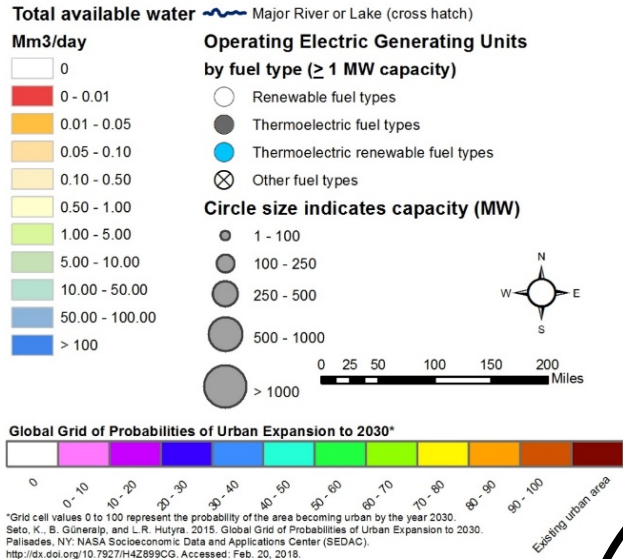
Highly diversified energy portfolio between renewables and thermoelectric power generation.



- | | |
|-----------------------------------|--|
| Thermoelectric fuel types: | Thermoelectric Renewable fuel types: |
| - Coke | - Landfill Gas |
| - Coal | - Other Renewable Fuel Waste |
| - Other Gas | |
| - Natural Gas | Other fuel types: |
| - Uranium | - Agriculture Byproduct |
| | - Blast Furnace Gas |
| | - Oil |
| | - Propane |
| | - Refuse |
| Renewable fuel types: | - Purchased Steam |
| - Biomass Gases | - Wood Waste Liquids |
| - Biomass Liquids | - Wood Waste Solids |
| - Biomass Other | - Waste Heat |
| - Biomass Solids | |
| - Geothermal | |
| - Solar | Thermoelectric Unit Prime Mover Groups: |
| - Water | Combined Cycle, Integrated Gasification, |
| - Wind | Nuclear Reactor, Steam Turbine |

Data is from Sandia National Laboratories and ABB Velocity Suite.

TX, OK, and LA 2010 Total Available Water with Rivers, Power Plants, and Projected 2030 Urban Expansion



- | | |
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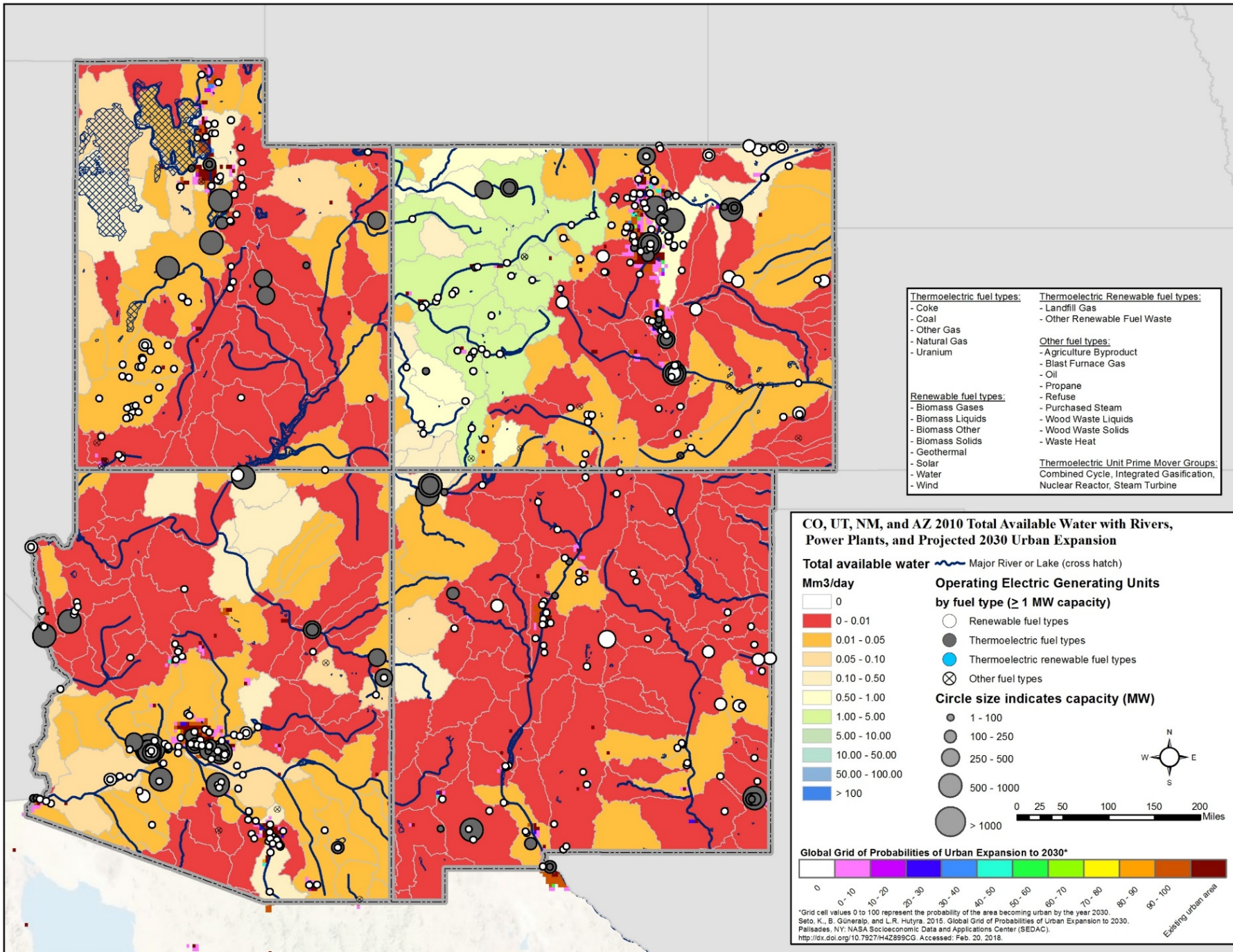
Western Gulf Coast

Permian basin has a high concentration of renewables, but struggles with water availability.

Data is from Sandia National Laboratories and ABB Velocity Suite.

Mountain West

Region is well-known for water scarcity challenges.

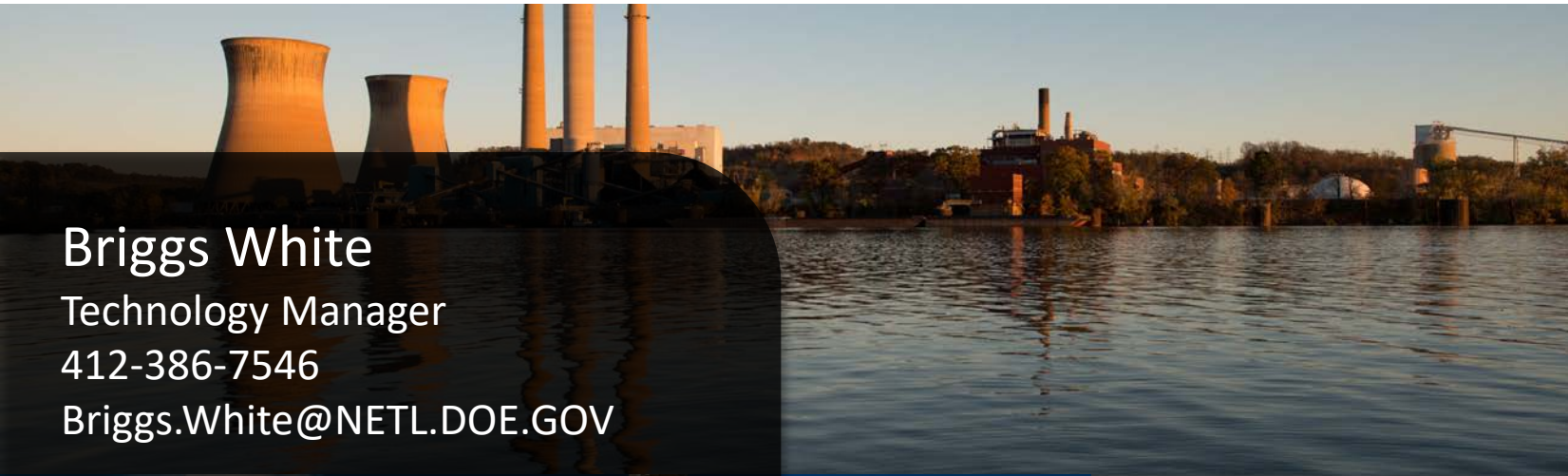


- | | |
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| - Solar | |
| - Water | |
| - Wind | |

Data is from Sandia National Laboratories and ABB Velocity Suite.

Crosscutting Research Contacts

<https://www.netl.doe.gov/research/coal/crosscutting>



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Thank you.

Questions?

References

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6. EPA EnviroAtlas – Thermoelectric Water Use by 12-Digit HUC for the Conterminous United States (2016)
7. ABB Velocity Suite, 2018
8. NASA – Global Grid of Probabilities of Urban Expansion to 2030

Eastern States include: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, New York, Pennsylvania, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Michigan, Ohio, Indiana, Kentucky, Tennessee, Alabama, Mississippi, Wisconsin, Illinois, Minnesota, Iowa, Missouri, Arkansas, and Louisiana.

Western States include: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Arizona, Washington, Oregon, Nevada, and California.

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