

# Applying Geographic Information System-Based Tool for Evaluating Siting Challenges for New Nuclear Capacity

## *- Water and Electric Transmission Availability*

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# ORNL Has Developed a Tool for Evaluating Siting Options New Electrical Generation Using GIS Screening/Modeling

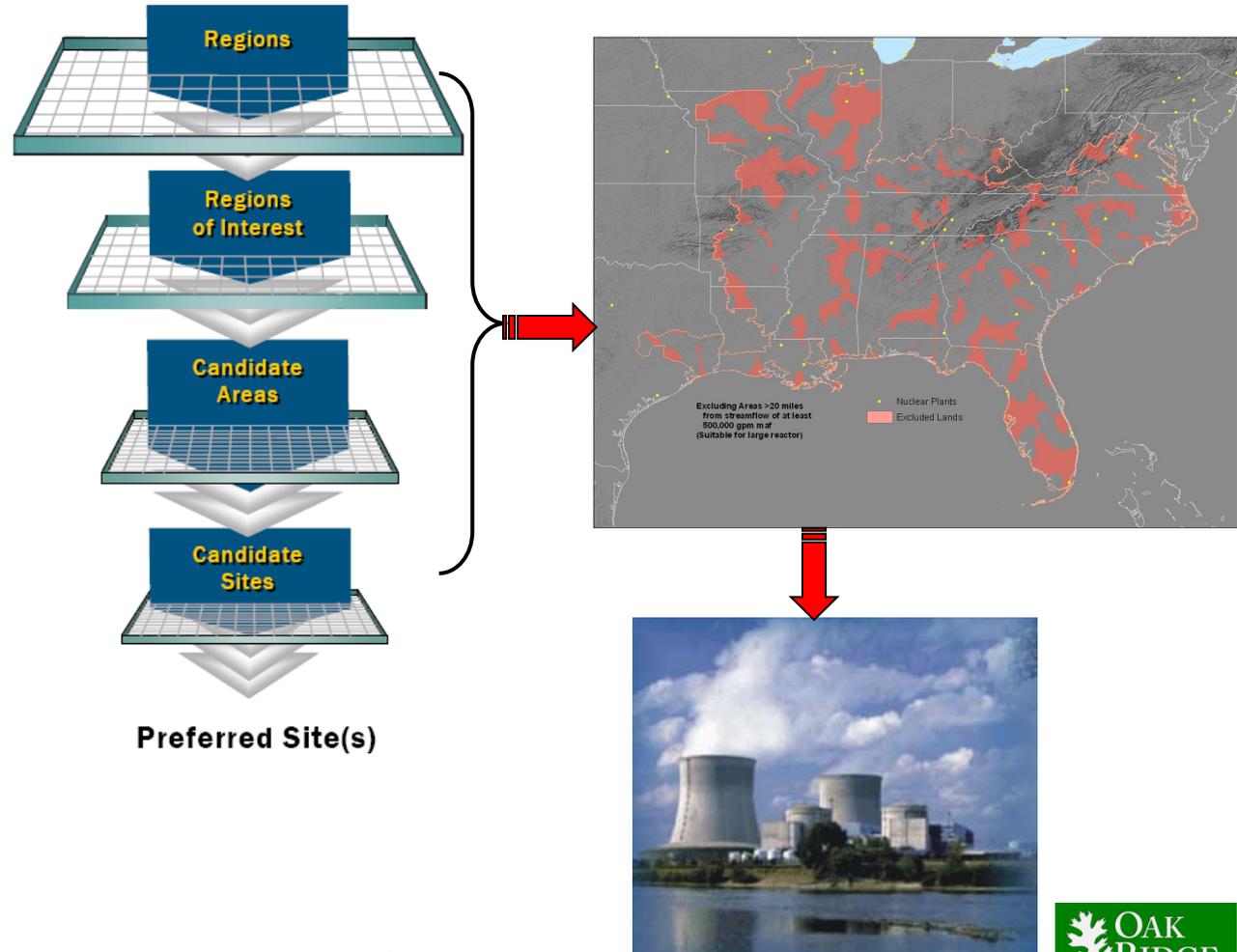
- Objectives of OR-SAGE (Oak Ridge Siting Analysis for power Generation Expansion) were to
  - Use industry-accepted parameters for screening
  - Use array of GIS data sources and spatial modeling capabilities at ORNL
- Adapted 2002 EPRI Siting Guide screening criteria and approach for obtaining early site permits (ESPs) for nuclear power plants
- Using 26 GIS datasets to scan continental U.S. (1.8 billion acres) on 100 m by 100 m cells (2.5 acres) to perform multi-level screening
- ORNL focused initially on evaluating siting options for commercial nuclear power plants
  - Large reactors, 1600 MW(e)
  - Small reactors, 350 MW(e)

# Application of GIS for Siting Evaluations Supports Identifying Siting Challenges and Candidate Sites

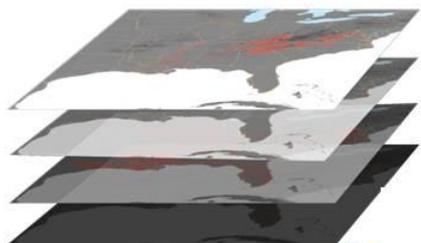
## Are there viable sites?

- Electrical transmission
- Population density
- Source for make-up water
- Seismic zones
- Hazardous operations
- Protected lands
- Siting of large vs small reactors

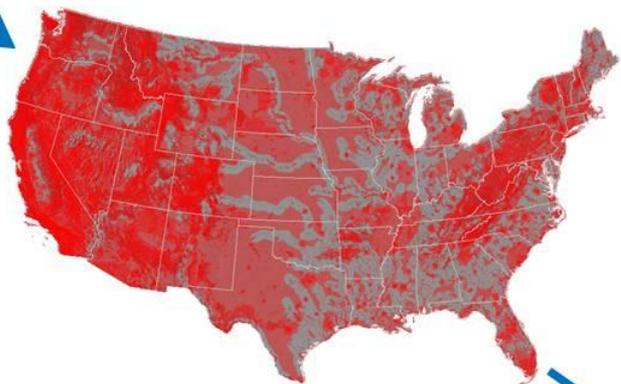
## Bechtel Approach



# GIS Approach Supports Adding/Deleting Screening Layers and Varying Values for a Given Screening Criteria => Flexibility



- Apply SSEC using GIS dataset
- Scan U.S. using grid size of 2.5 acres

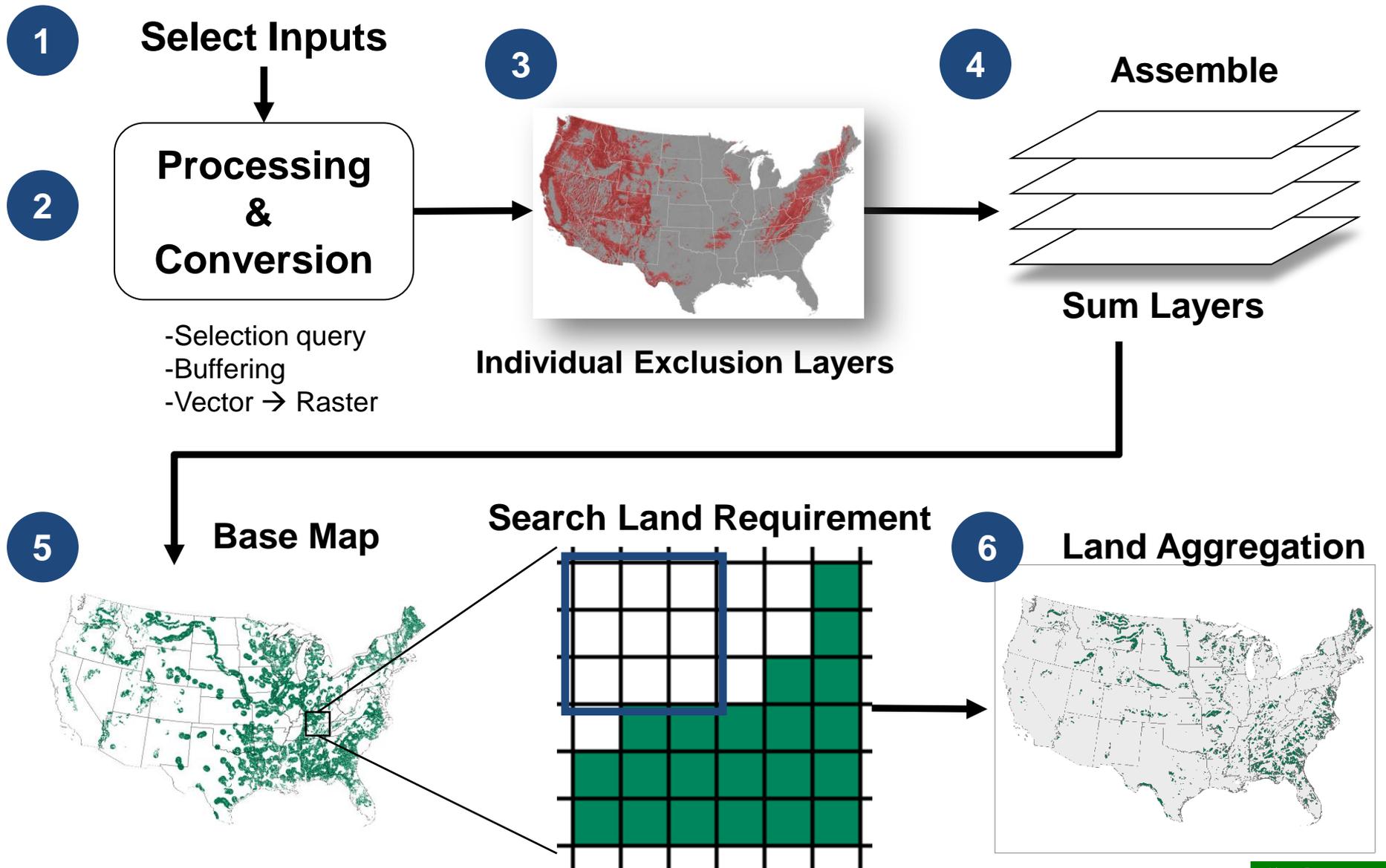


- Results using both exclusionary and avoidance criteria
- More intense red → excluded by multiple SSEC

- Analysis approach focuses on suitability of sites
- Supports quantitative analyses for comparing finite number of sites



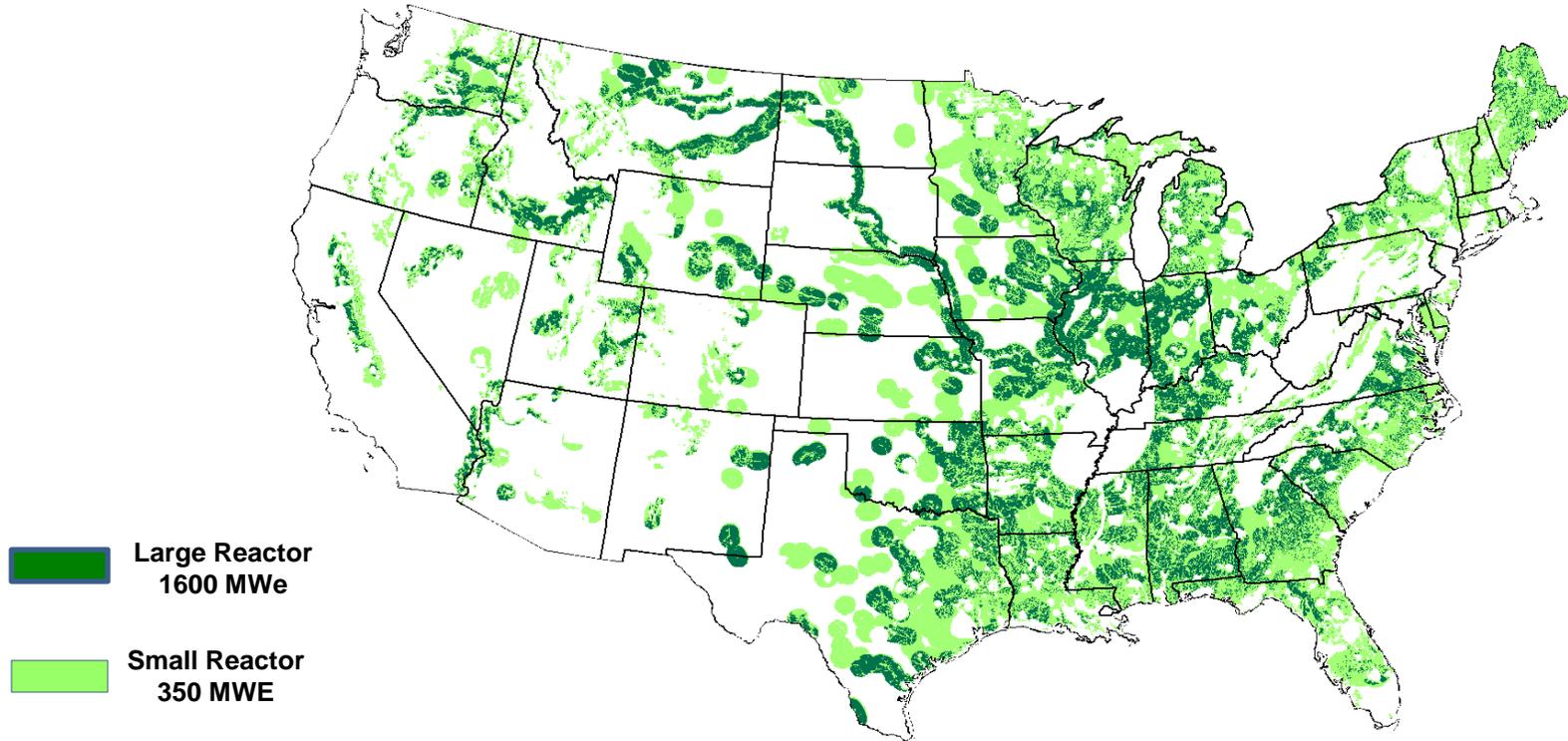
# GIS Analysis Is Multi-Step Process



# Baseline Screening Criteria Has Provided Good Correlation w/Existing Sites and Discrimination of Candidate Areas

<b>OR-SAGE Screening Criteria for Large and Small Reactors</b>	<b>Value</b>
<b>Population density (people/sq mi)</b>	<b>&gt;500</b>
<b>Safe shutdown earthquake (ground acc)</b>	<b>&gt;0.3</b>
<b>Wetlands / Open Water</b>	<b>- -</b>
<b>Protected lands</b>	<b>- -</b>
<b>Slope</b>	<b>&gt;12% grade</b>
<b>Landslide Hazard (moderate)</b>	<b>- -</b>
<b>100 – year floodplain</b>	<b>- -</b>
<b>Streamflow / cooling water make-up ( k gpm) within 20 miles – assumes closed-cycle cooling - limits plant to no more than 10% of resource</b>	<b>200 - large 50 - small</b>
<b>Proximity to hazardous operations – buffer (mi)</b>	<b>Variable</b>
<b>Proximity to fault lines – buffer (mi)</b>	<b>Depends on length of fault</b>

# National View of Siting Options for New Nuclear Capacity



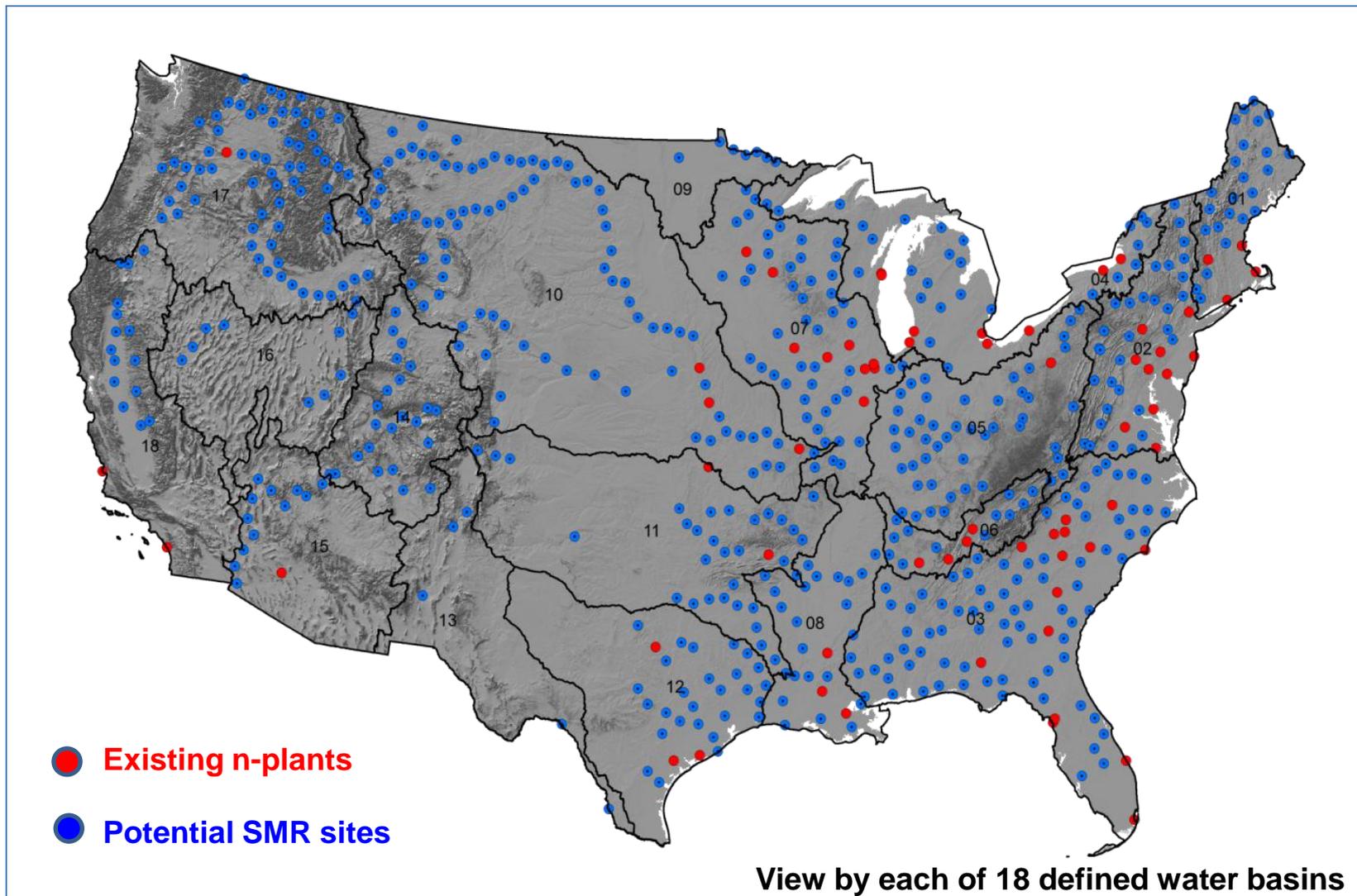
## Sample Results From OR-SAGE – Land Area Suitable for Siting

<u>Siting Case</u>	<u>Large Reactor</u>	<u>Small Reactor</u>
Basemap	22%	31%
Aggregation Analysis	13%	24%

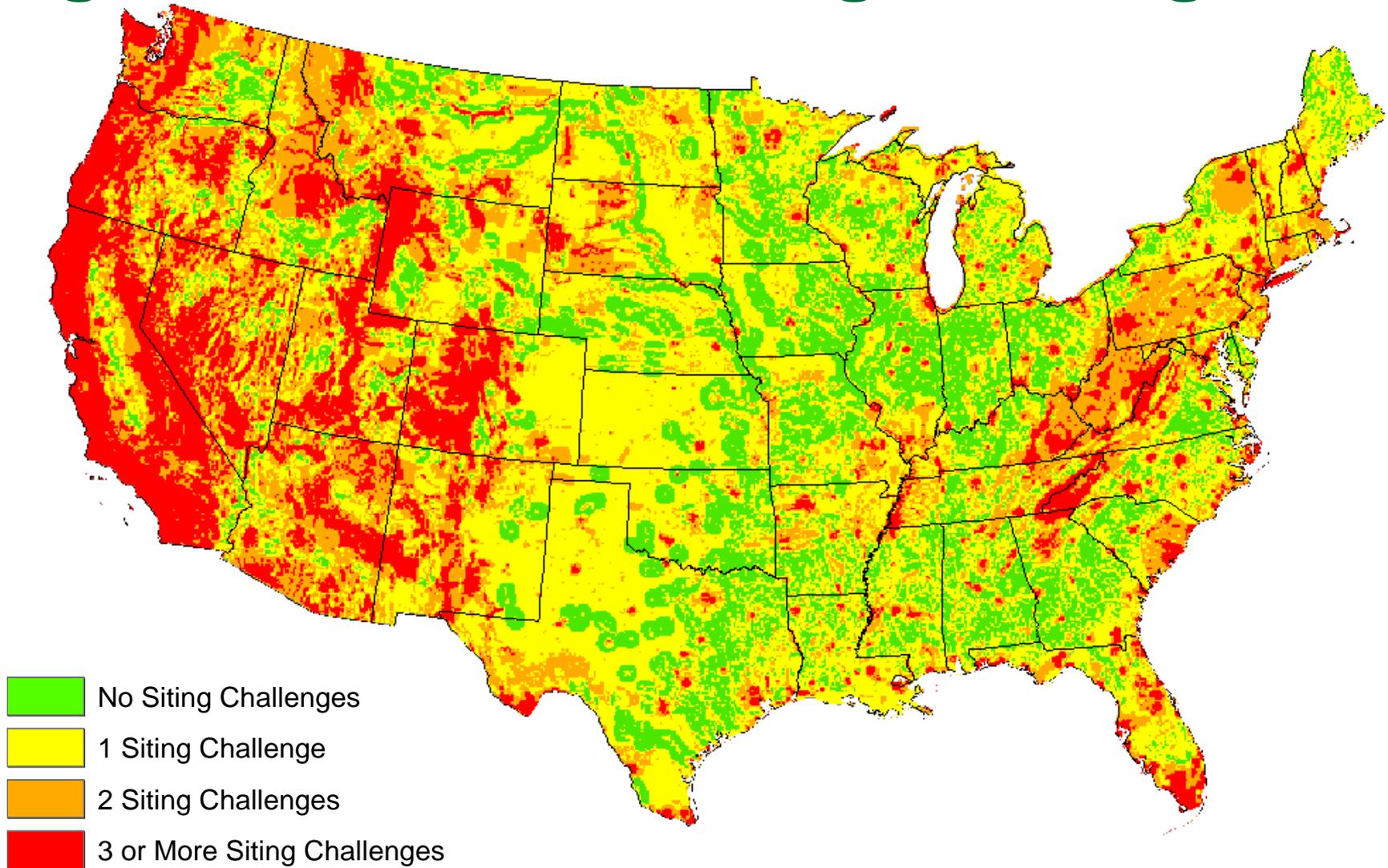
# Development of OR-SAGE Water Network Considerate of Important Natural Resource

- **Updated EPRI Siting Guide provides starting point**
  - “Rule of thumb” – do not use more than 10% of available flow
  - Cooling sources acceptable if located within 20 miles of site
- **USGS data provides basic data on stream/river flows**
  - Based upon actual flow gage data (12,000 selected gages)
  - Methodology for estimating ungaged locations
  - Compiled data on annual average flows and 7Q10 low flows
- **OR-SAGE uses a “composite stream flow GIS layer”**
  - 7Q10 as more conservative approach
  - Lake and reservoir data

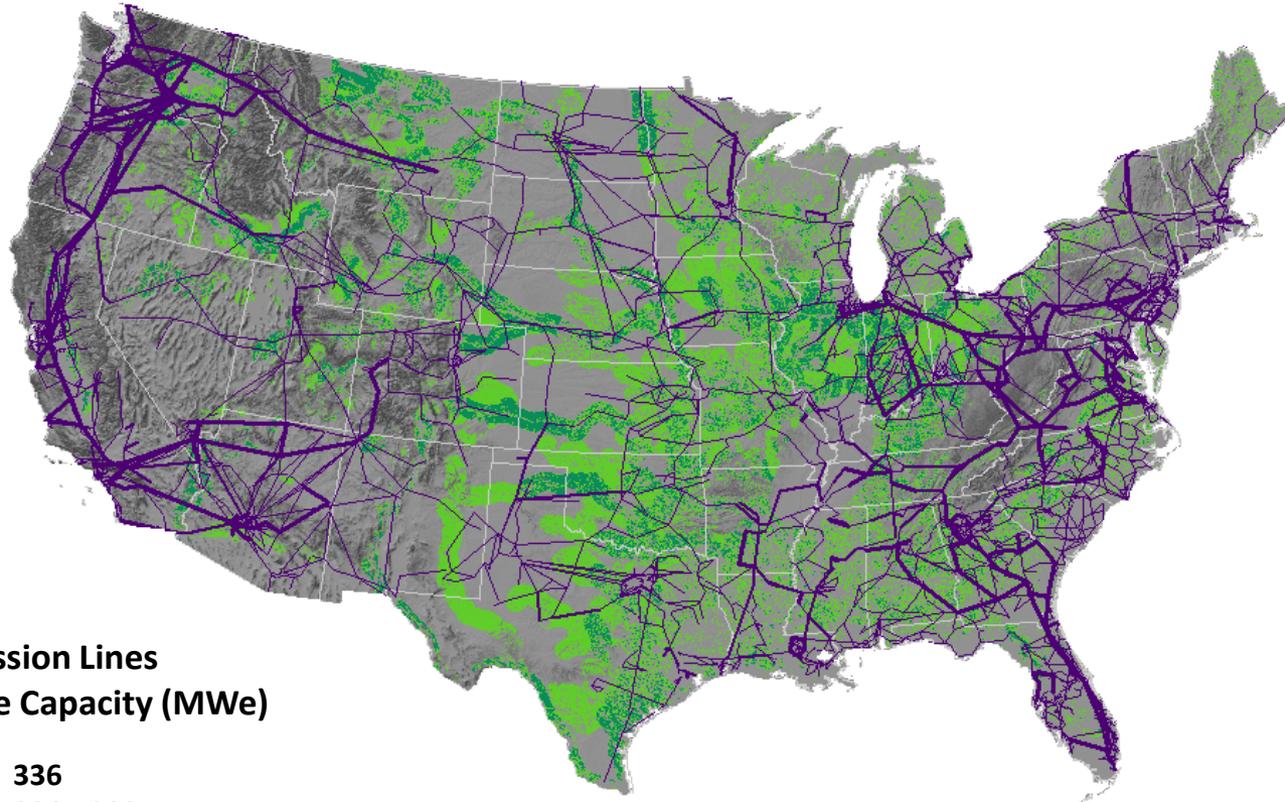
# Results for SMR Hypothetical Plant Placement Using ORNL Siting Algorithm



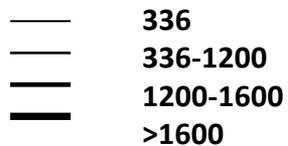
# Small Reactor Composite Map Shows Degree of Potential Siting Challenges



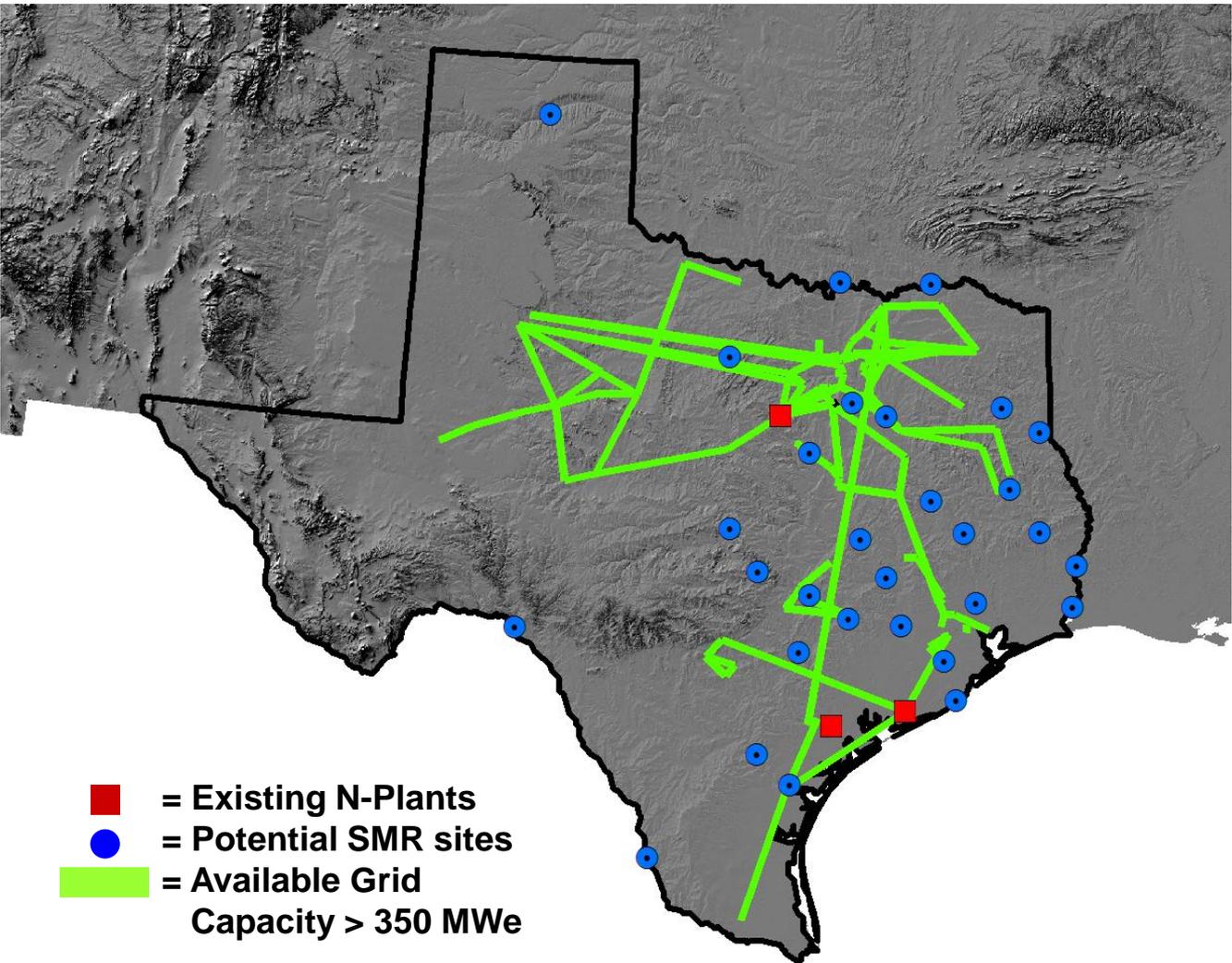
# Including Additional Layers Such As Electrical Transmission/Transportation Systems is Straightforward with GIS



**Transmission Lines  
Available Capacity (MWe)**



# Analysis of Potential SMR Sites & Proximity to Available Grid Capacity Yields Key Insights



- = Existing N-Plants
- = Potential SMR sites
- = Available Grid Capacity > 350 MWe

Distance to Grid (miles)	Number of SMR Sites
1-10	9
11-30	8
31-50	7
51-80	2
> 80	4



# Using GIS Screening/Modeling Provides Basis for Evaluating Array of Siting Related Options and Issues

- OR-SAGE siting evaluations done for nuclear, concentrated solar, clean coal, and compressed air energy storage technologies
- Additional analyses can address
  - Projections for future power demands
  - Socioeconomic / political aspects
  - Infrastructure resources
- ORNL's vision for use of OR-SAGE is to support decision makers for evaluating options for energy policies



*Demo of OR-SAGE results for siting large and small reactors in ORNL's Visualization Facility, EVEREST*