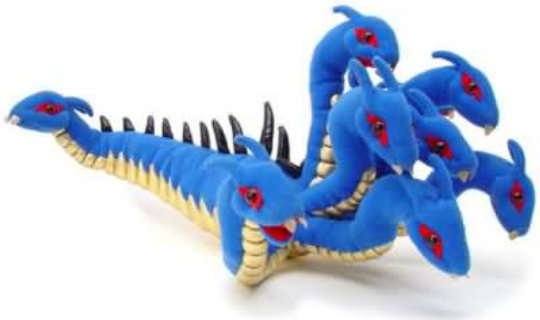
HyDRA:

Hydrogen Demand and Resource Analysis Tool

Witt Sparks

National Renewable Energy Laboratory

June 12, 2008



Project ID #AN8

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Overview

Timeline

Project start date – September 2006

Project end date – On Going

Percent complete – 50% complete

Budget

Total project funding – 100% DOE share

Funding received in FY 2007 – $305k

Funding for FY 2008 – $249k

Barriers

Systems Analysis Barriers

Stove-piped/siloed analytical capability

Inconsistent data, assumptions, and guidelines

Suite of models and tools

Partners

NREL project with support from *A Mountain Top, LLC* for programming expertise

Objective

Develop a web-based GIS tool to allow analysts, decision makers, and general users to view, download, and analyze hydrogen demand, resource, and infrastructure data spatially and dynamically.

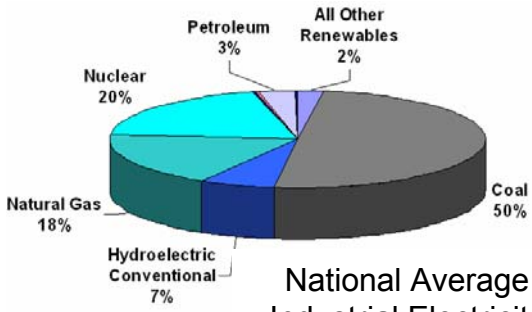
Milestones

June 2007	November 2007	May 2008	September 2008
Application Milestones			
• HyDRA beta released to users • General mapping functionality • Dynamically change assumptions • Security	• Legend and Layer control • User action queuing • Data import and export	• Restrict access to sensitive data • Graph data from selected layers	• Improve performance and look and feel • Macro System Model Interface
Data Milestones			
• 17 datasets		• 31 datasets	• 10-plus new datasets

Approach

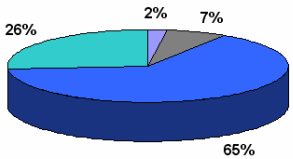
Spatial Analysis for Hydrogen

- Energy Carrier
- Produced from Various Feedstocks



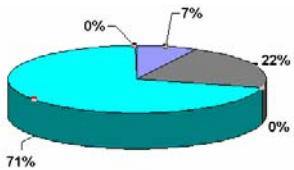
National Average Industrial Electricity Rate = $0.0525/kWh

Resource, Demand, and Infrastructure Vary Regionally



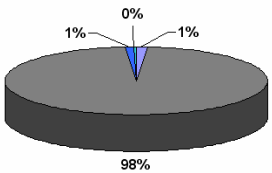
Oregon – $0.0443/kWh

- Move Beyond National Averages
- Facilitate Regional and Local Analyses



Vermont – $0.0796/kWh

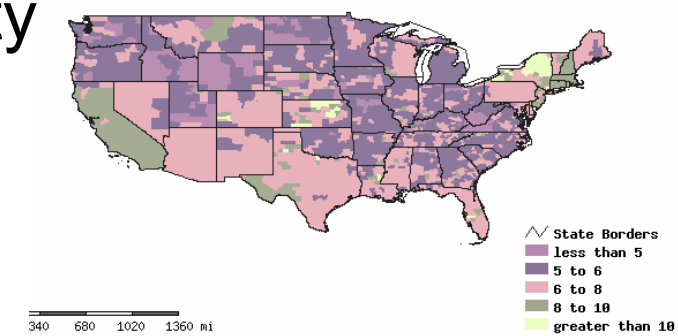
Wyoming – $0.0391/kWh



Builds on Existing Tools and Models

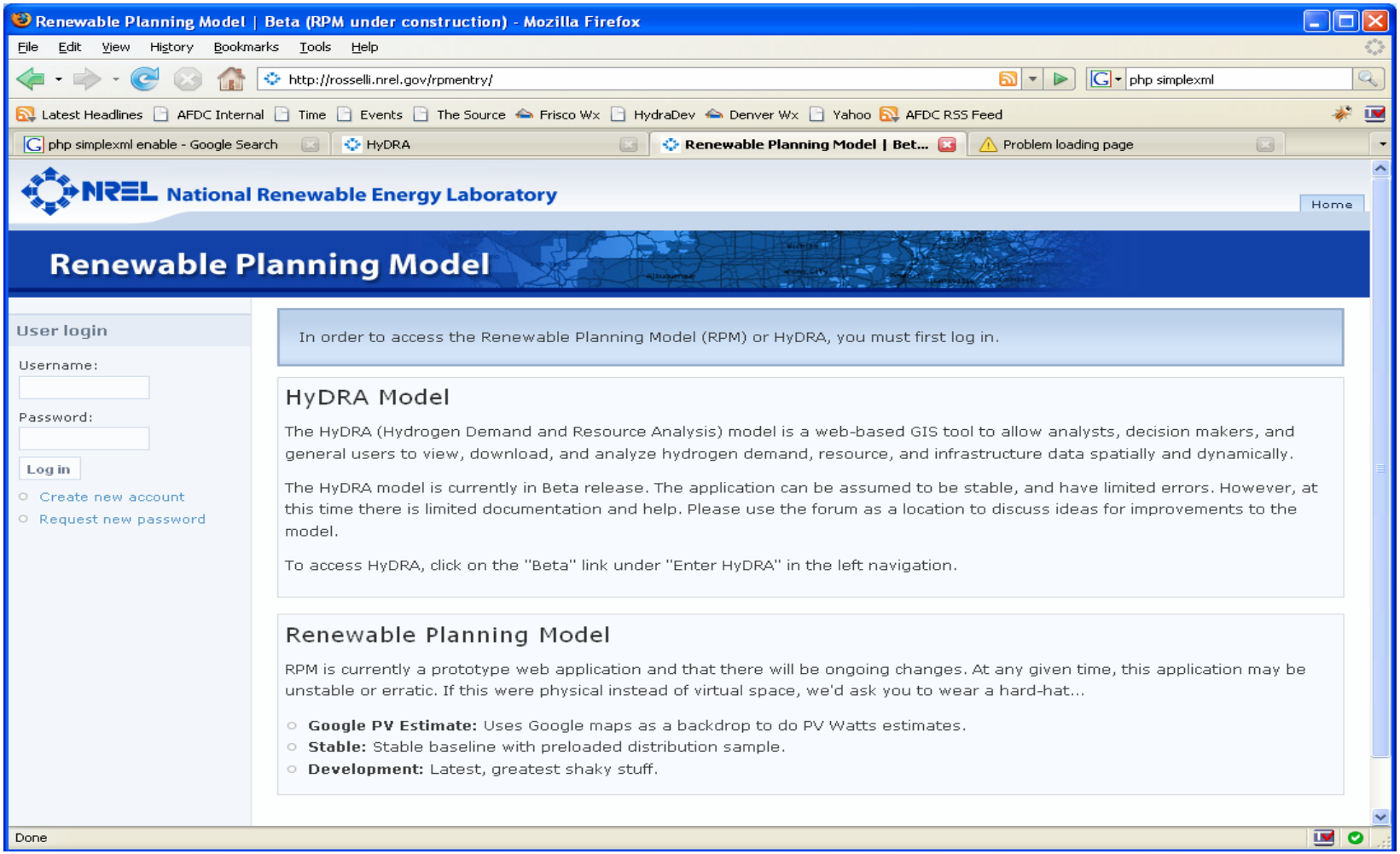
Accomplishments

- Created and integrated 48 datasets viewable as graphical maps.
  - Resource Cost and Availability
  - Hydrogen Production Cost
  - Resource Consumption
  - Hydrogen Demand
  - Infrastructure

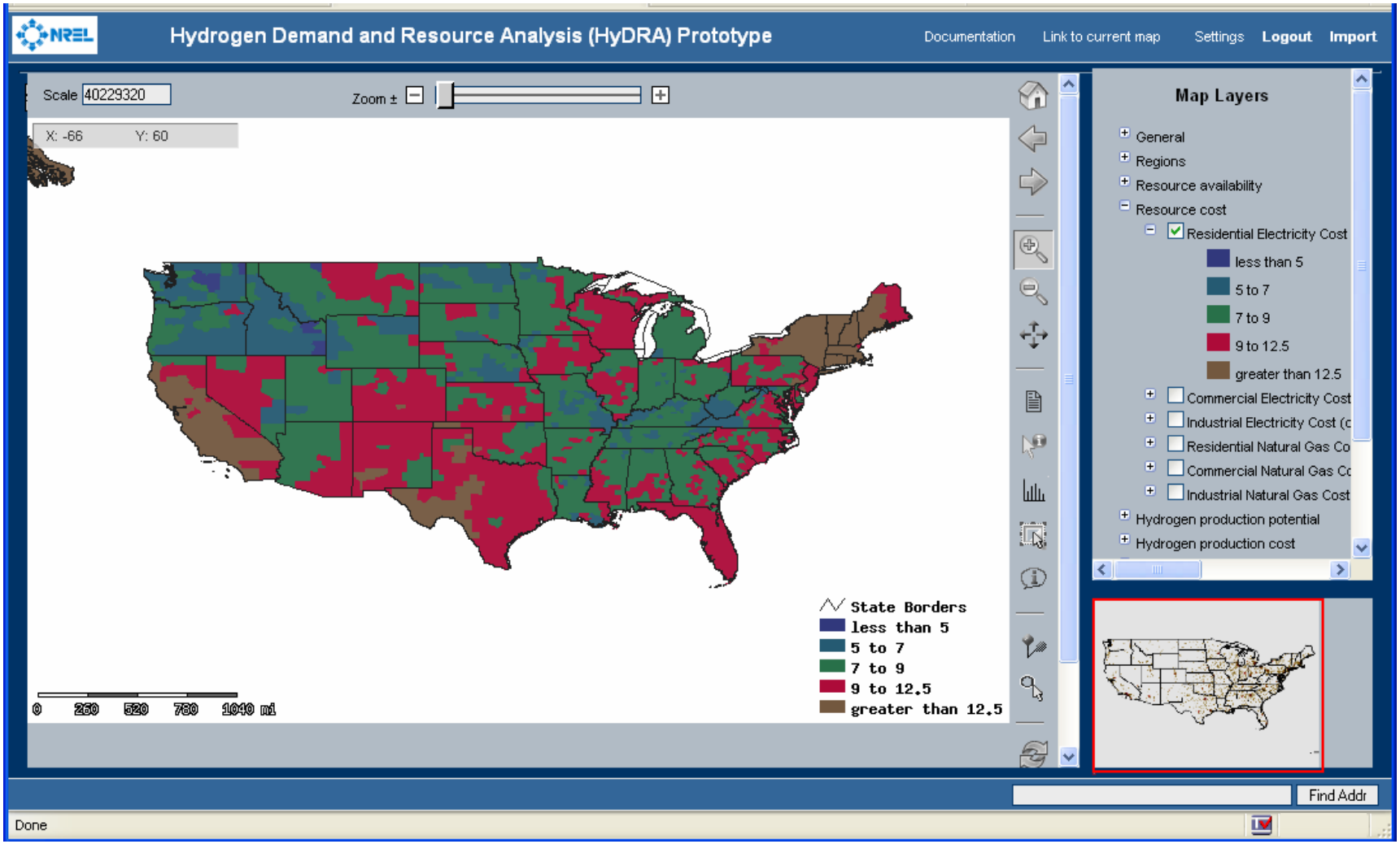


- Implemented data manipulation and analysis tools.
- Implemented application security

Accomplishments – Data Security



Accomplishments – Electricity Cost



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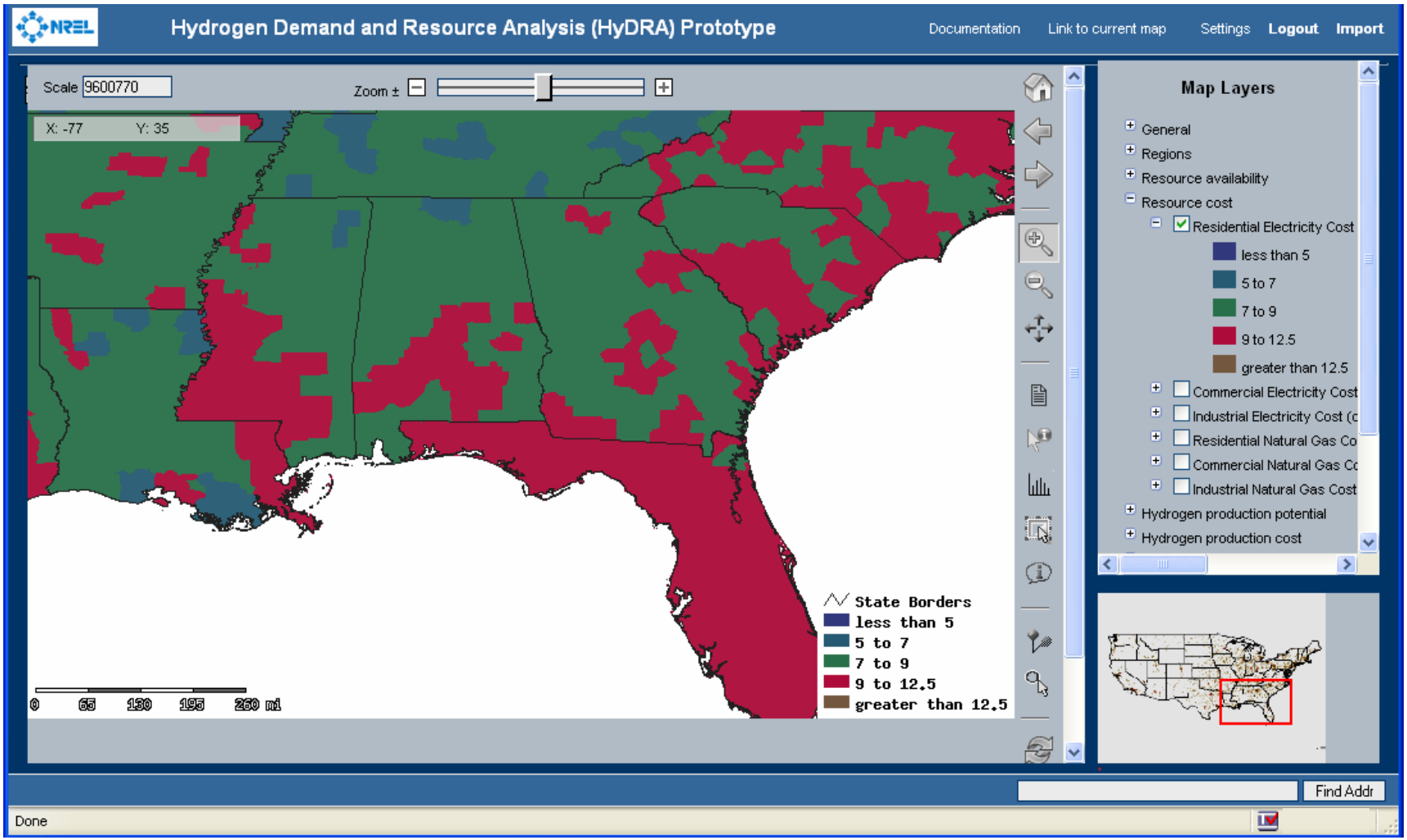
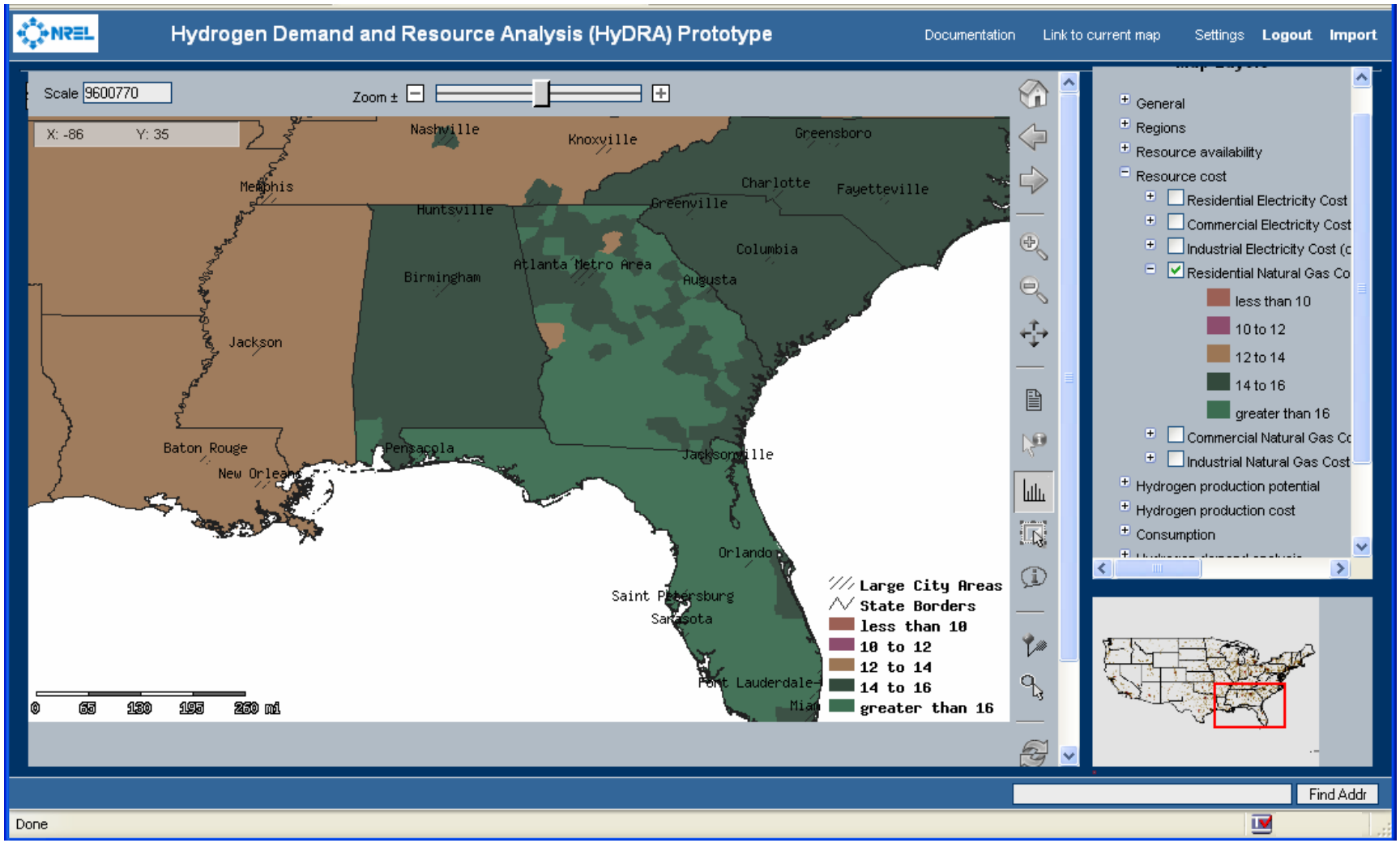


Accomplishments – Natural Gas Cost



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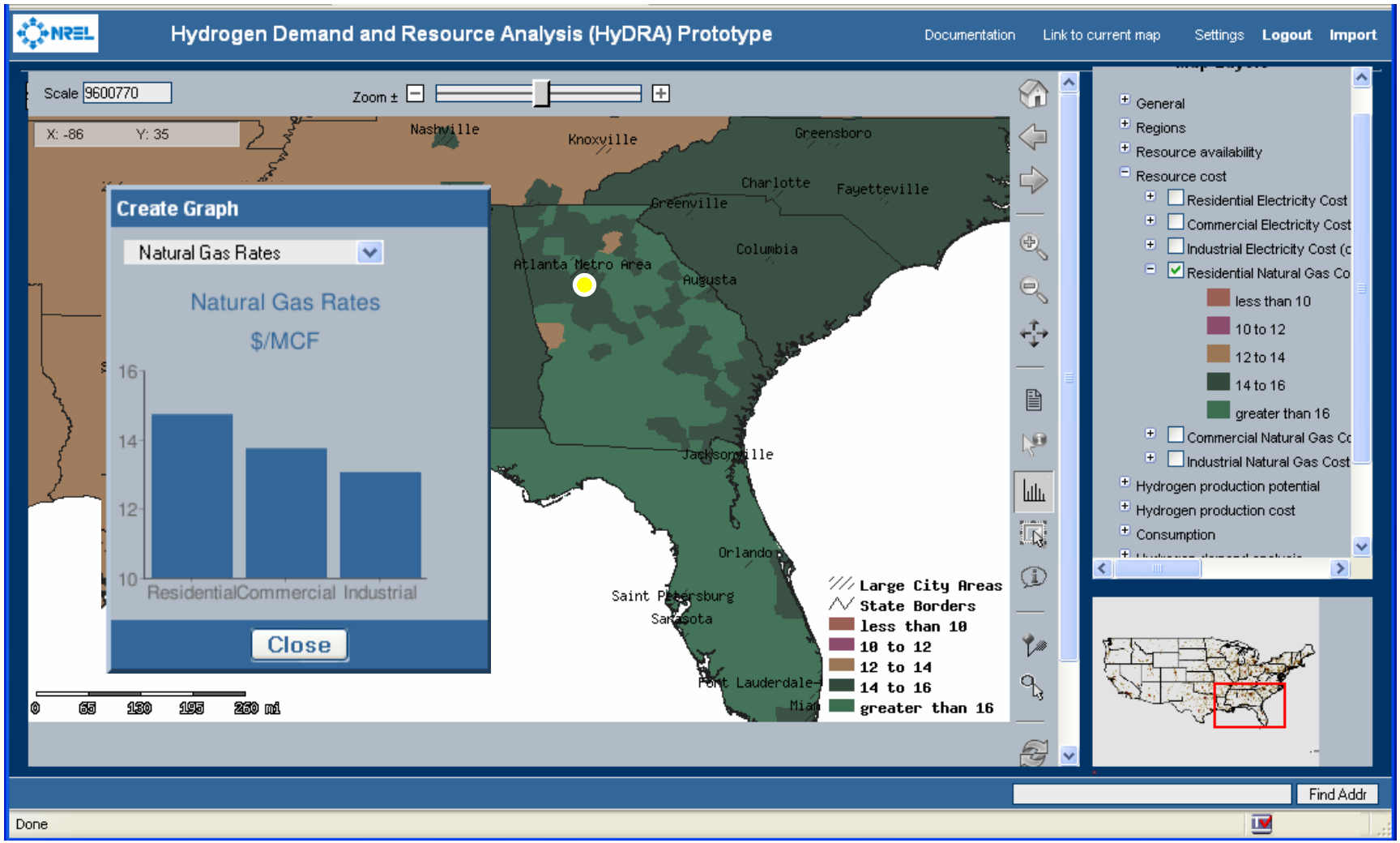

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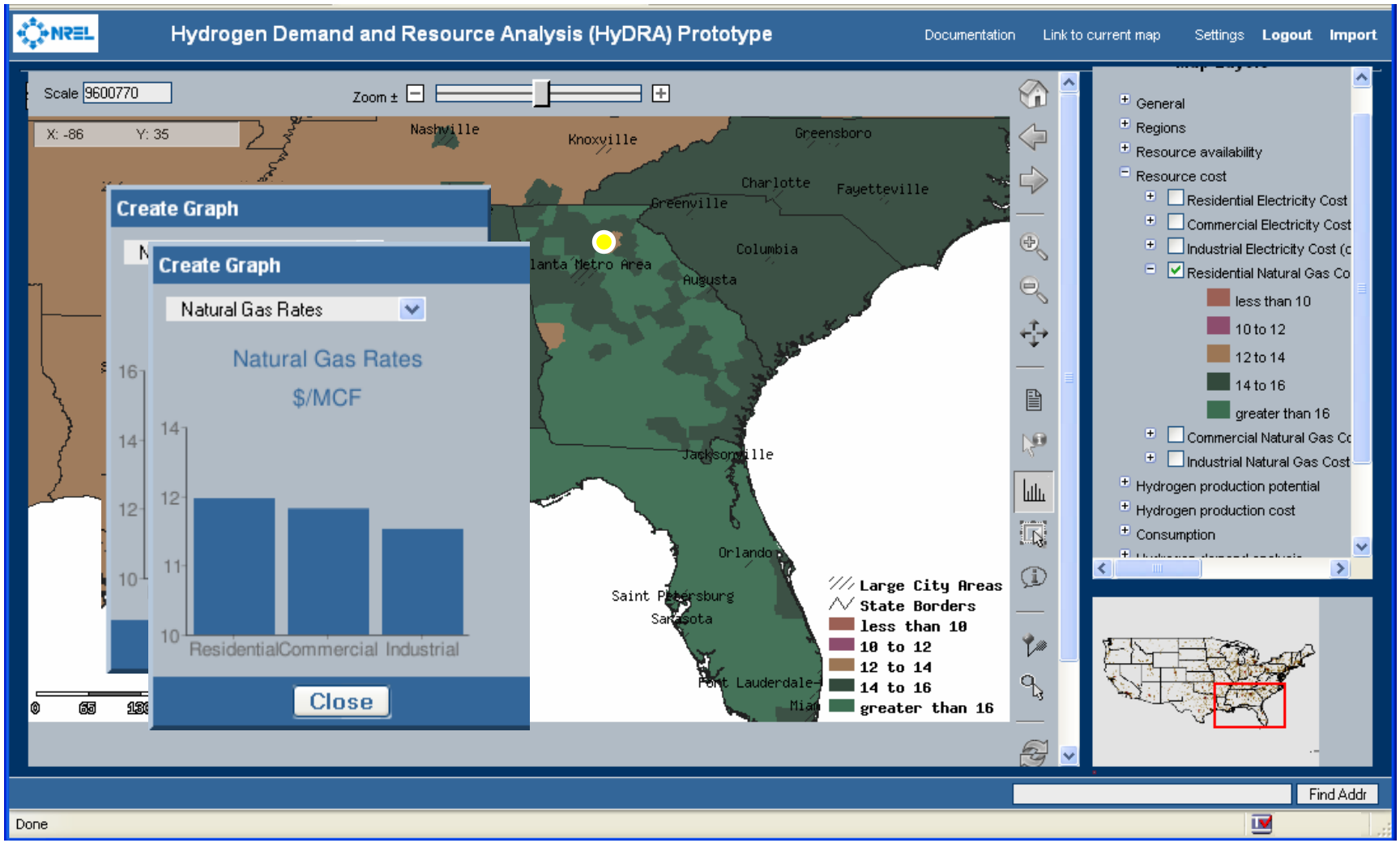
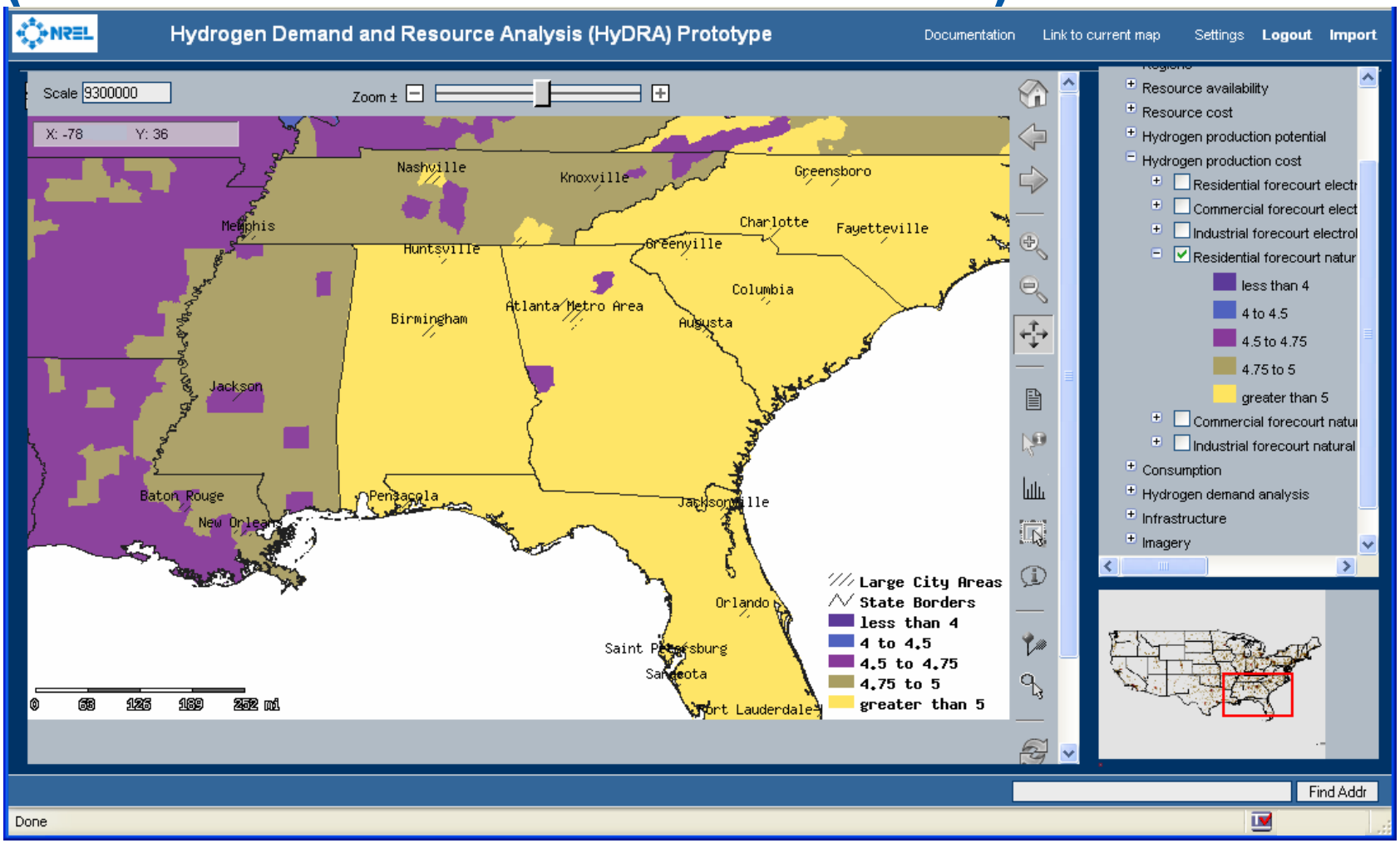


Accomplishments – Hydrogen Production Cost (Forecourt SMR from Natural Gas)



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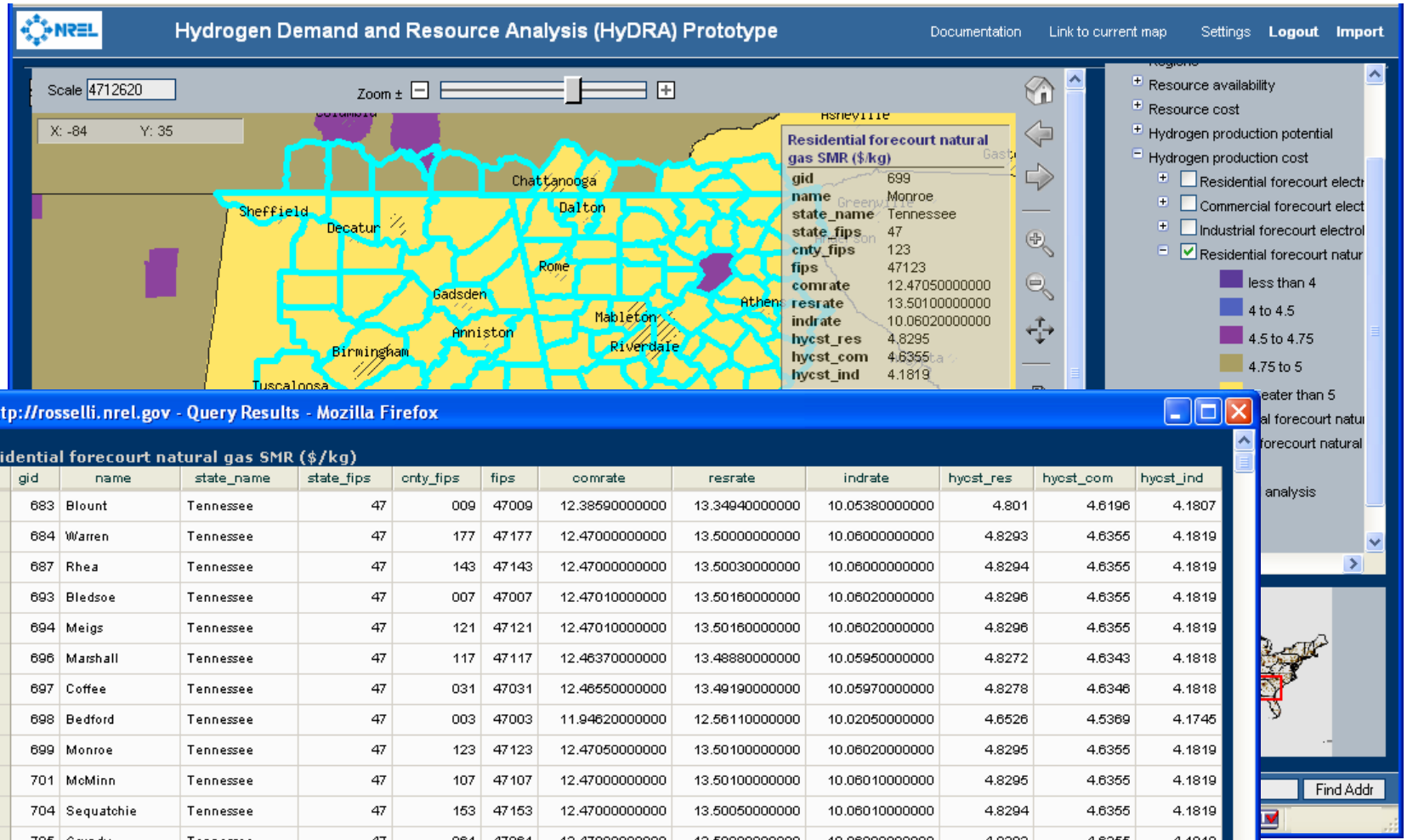

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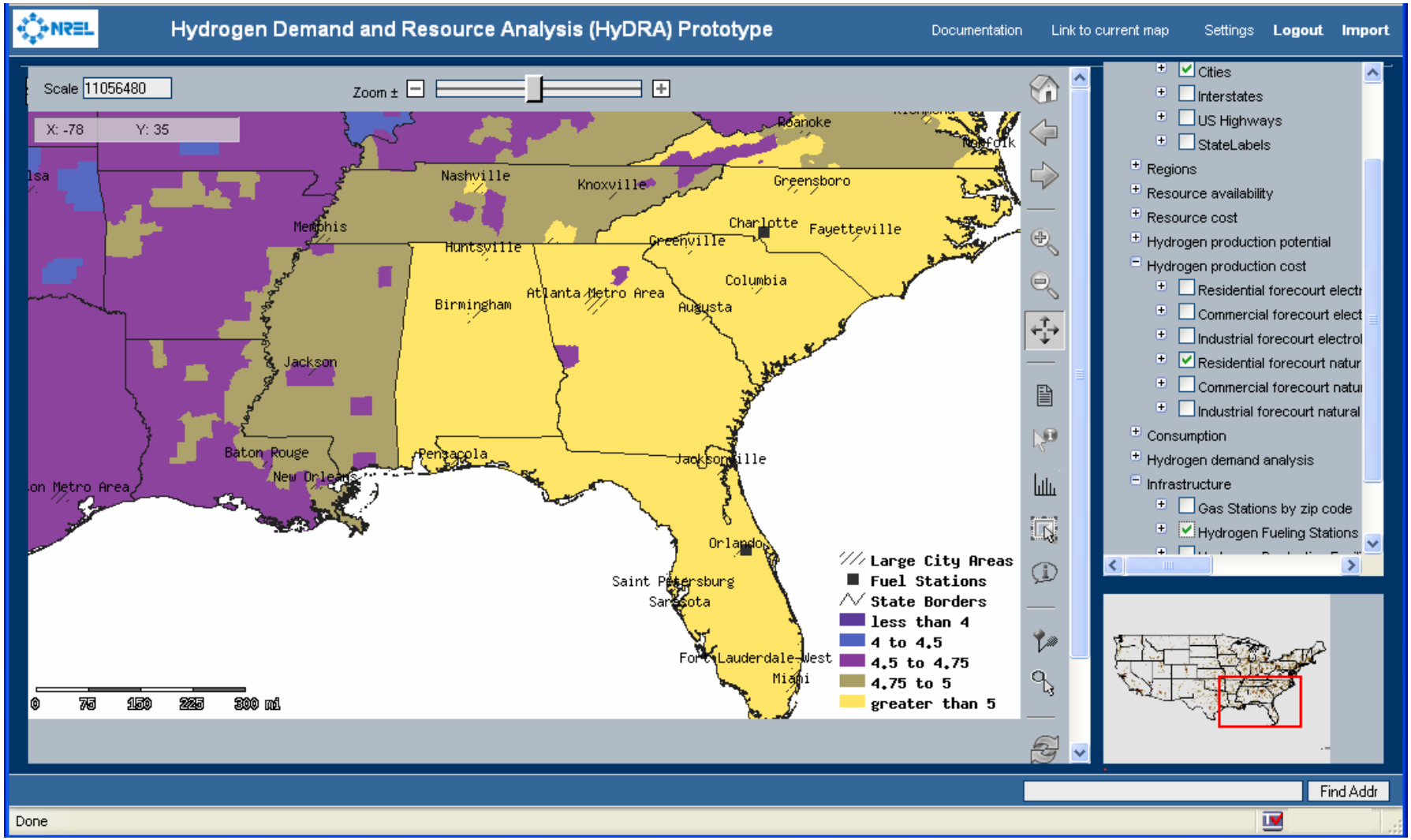
	684	Warren	Tennessee	47	177	47177	12.47000000000	13.50000000000	10.06000000000	4.8293	4.6355	4.1819
	687	Rhea	Tennessee	47	143	47143	12.47000000000	13.50030000000	10.06000000000	4.8294	4.6355	4.1819
	693	Bledsoe	Tennessee	47	007	47007	12.47010000000	13.50160000000	10.06020000000	4.8296	4.6355	4.1819
	694	Meigs	Tennessee	47	121	47121	12.47010000000	13.50160000000	10.06020000000	4.8296	4.6355	4.1819
	696	Marshall	Tennessee	47	117	47117	12.46370000000	13.48880000000	10.05950000000	4.8272	4.6343	4.1818
	697	Coffee	Tennessee	47	031	47031	12.46550000000	13.49190000000	10.05970000000	4.8278	4.6346	4.1818
	698	Bedford	Tennessee	47	003	47003	11.94620000000	12.56110000000	10.02050000000	4.6526	4.5369	4.1745
	699	Monroe	Tennessee	47	123	47123	12.47050000000	13.50100000000	10.06020000000	4.8295	4.6355	4.1819
	701	McMinn	Tennessee	47	107	47107	12.47000000000	13.50100000000	10.06010000000	4.8295	4.6355	4.1819
	704	Sequatchie	Tennessee	47	153	47153	12.47000000000	13.50050000000	10.06010000000	4.8294	4.6355	4.1819
	705	Grundy	Tennessee	47	061	47061	12.47000000000	13.50000000000	10.06000000000	4.8293	4.6355	4.1819
	708	Hamilton	Tennessee	47	065	47065	12.53390000000	15.42760000000	10.27010000000	5.1921	4.6475	4.2214

Accomplishments – Hydrogen Highway



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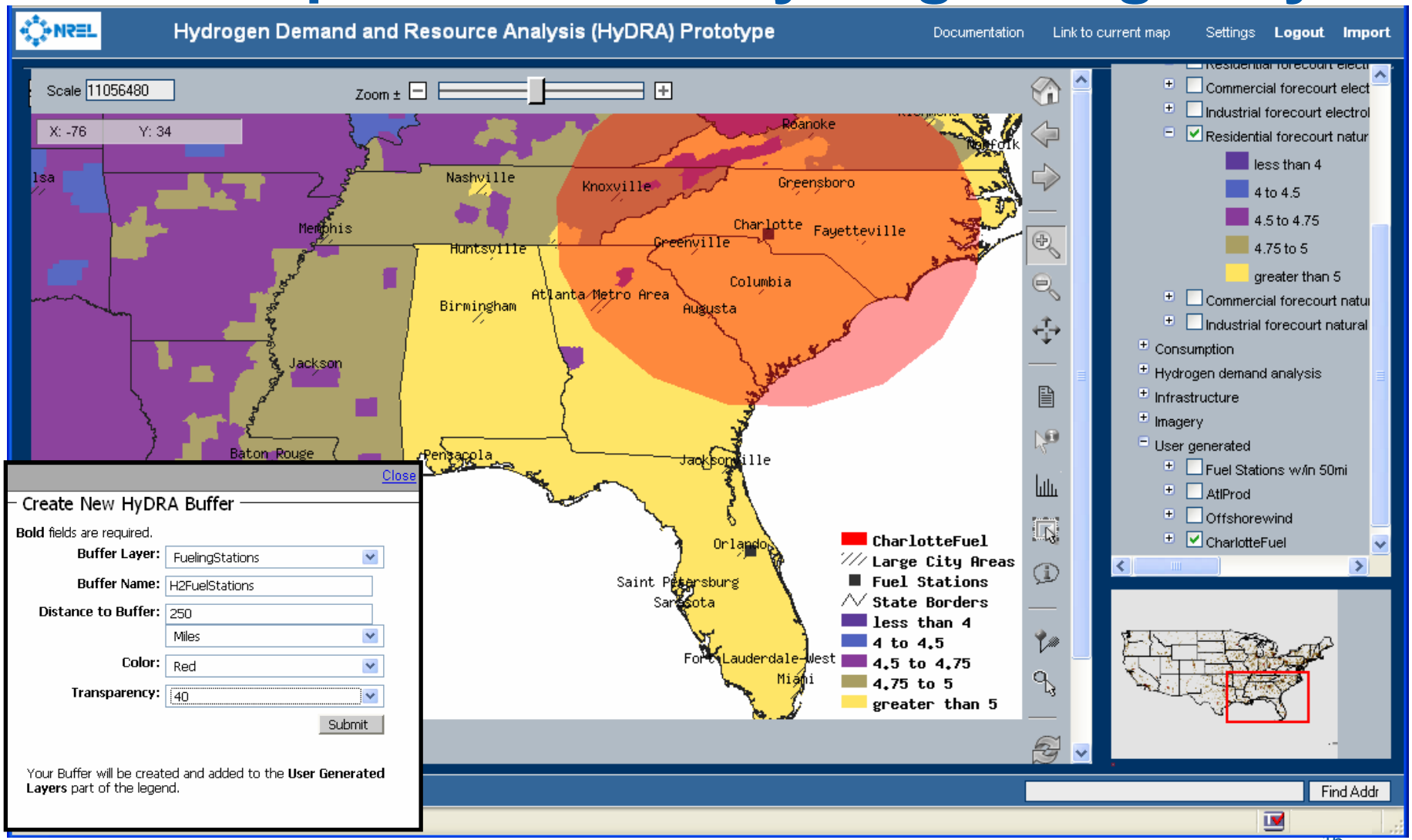

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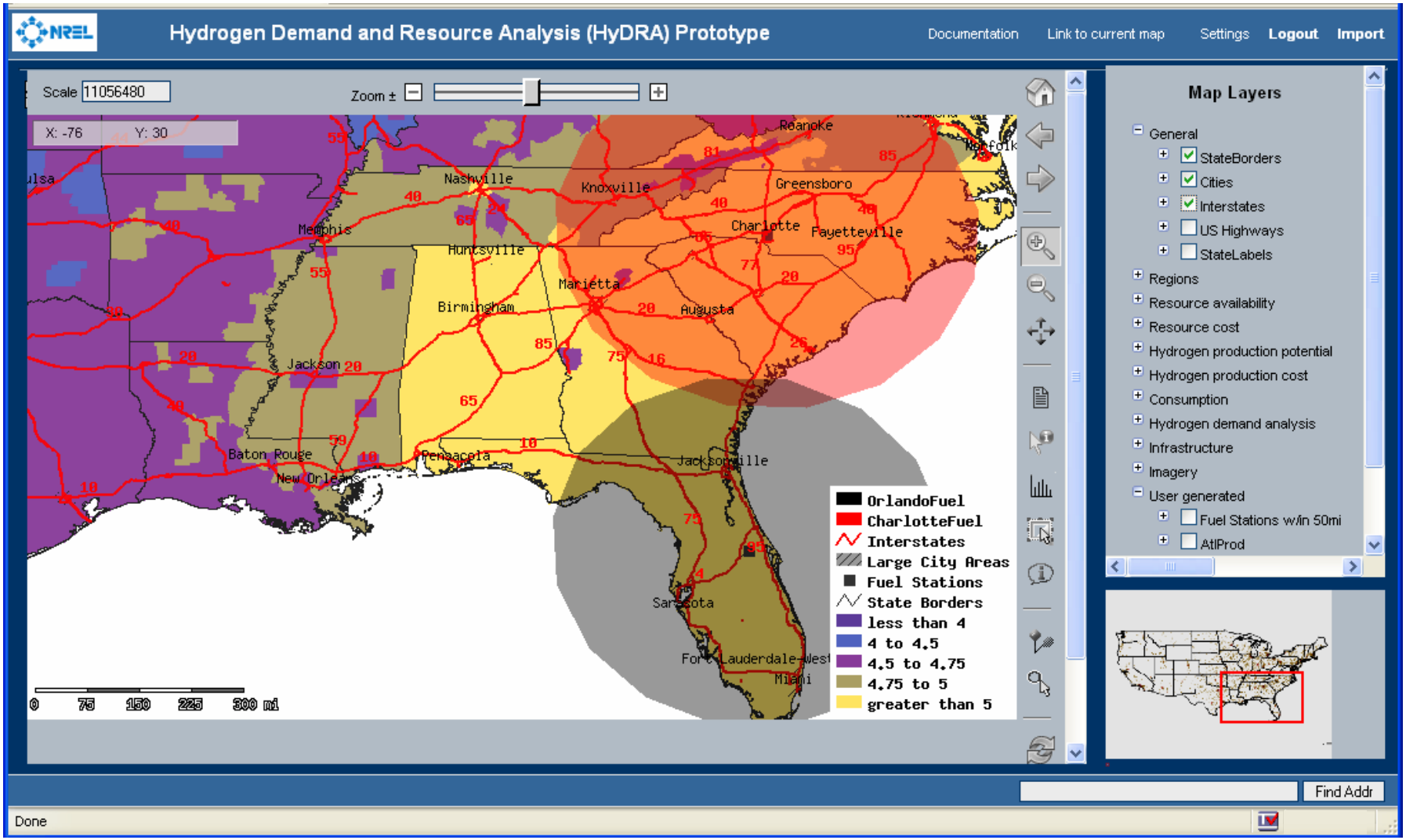

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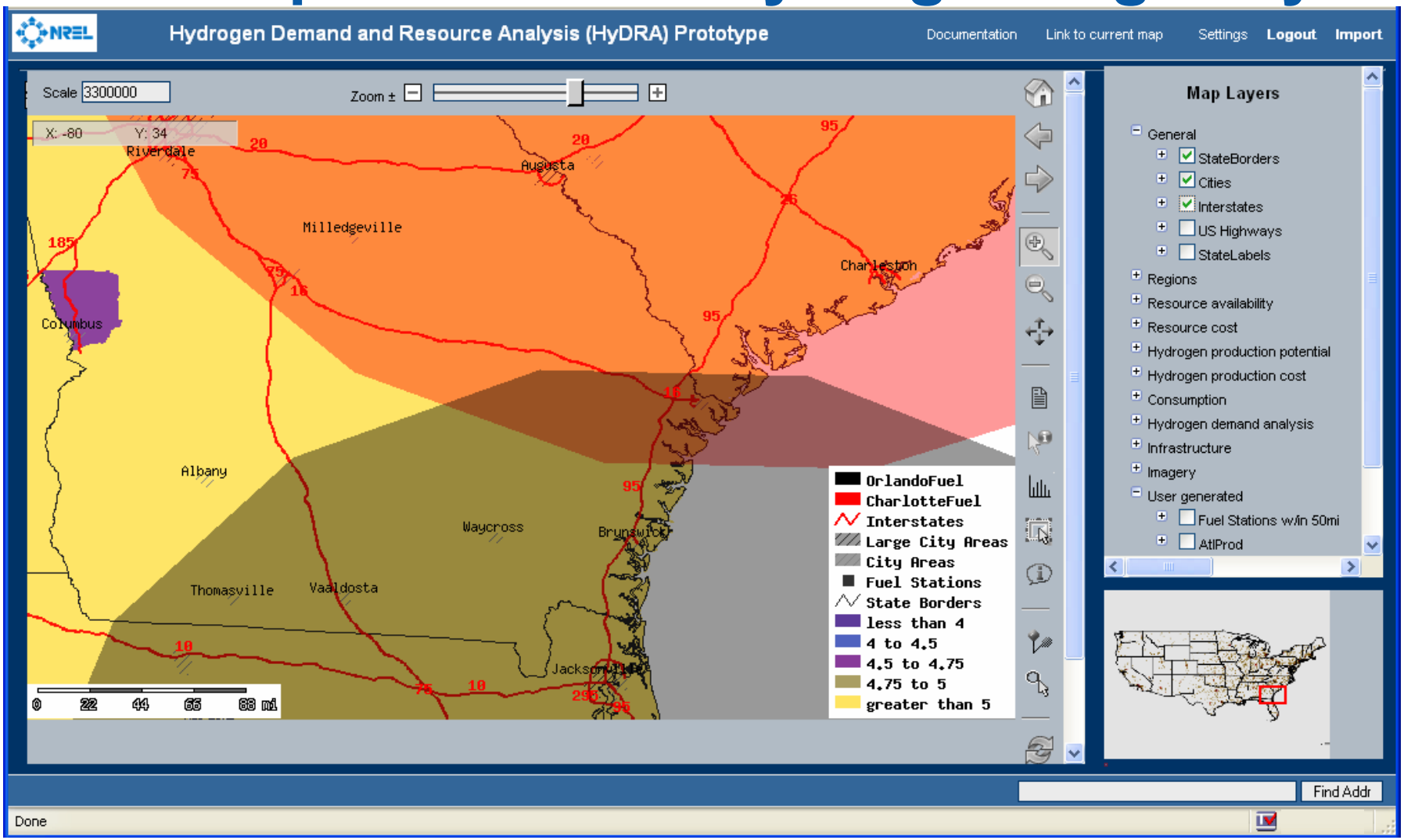
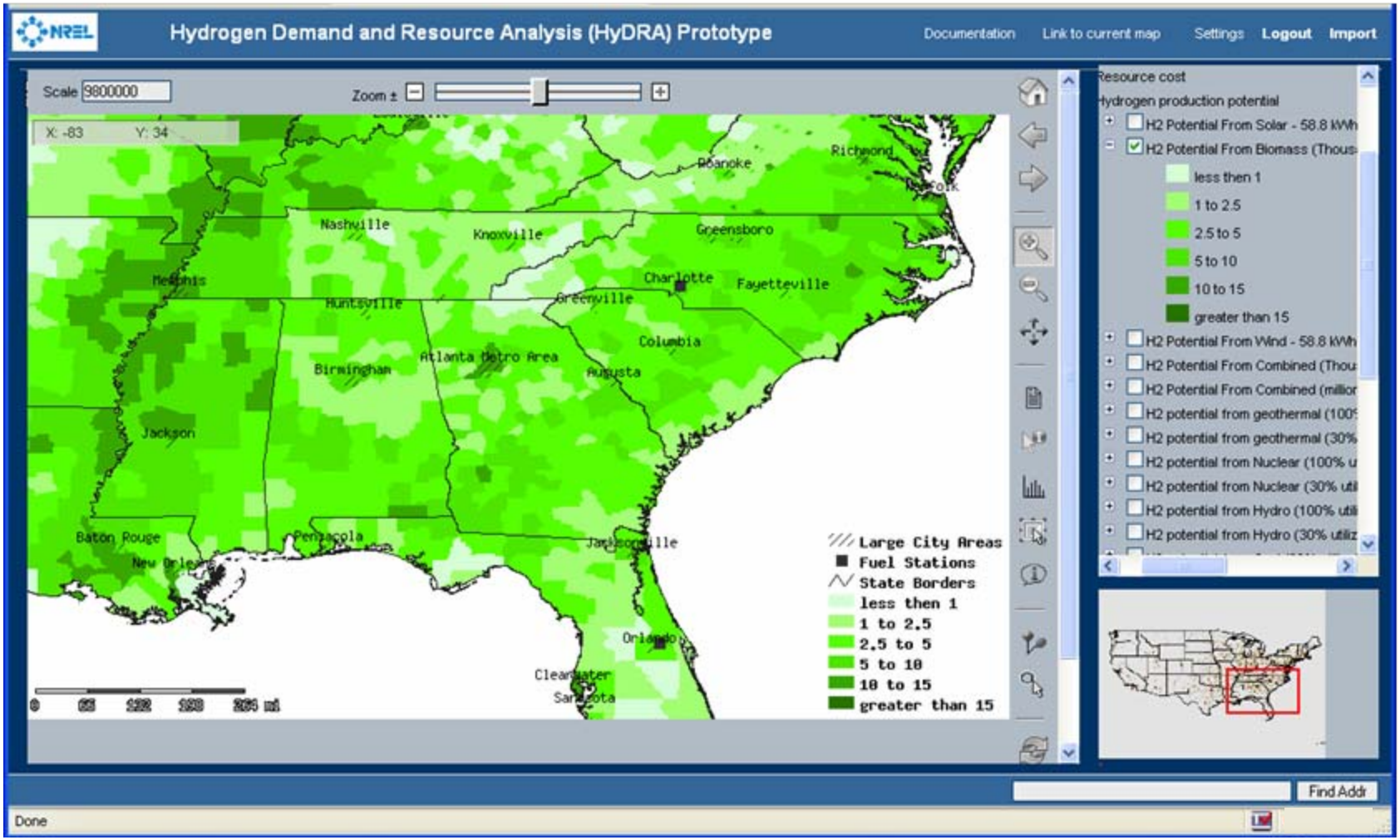


Accomplishments – Hydrogen Production from Biomass



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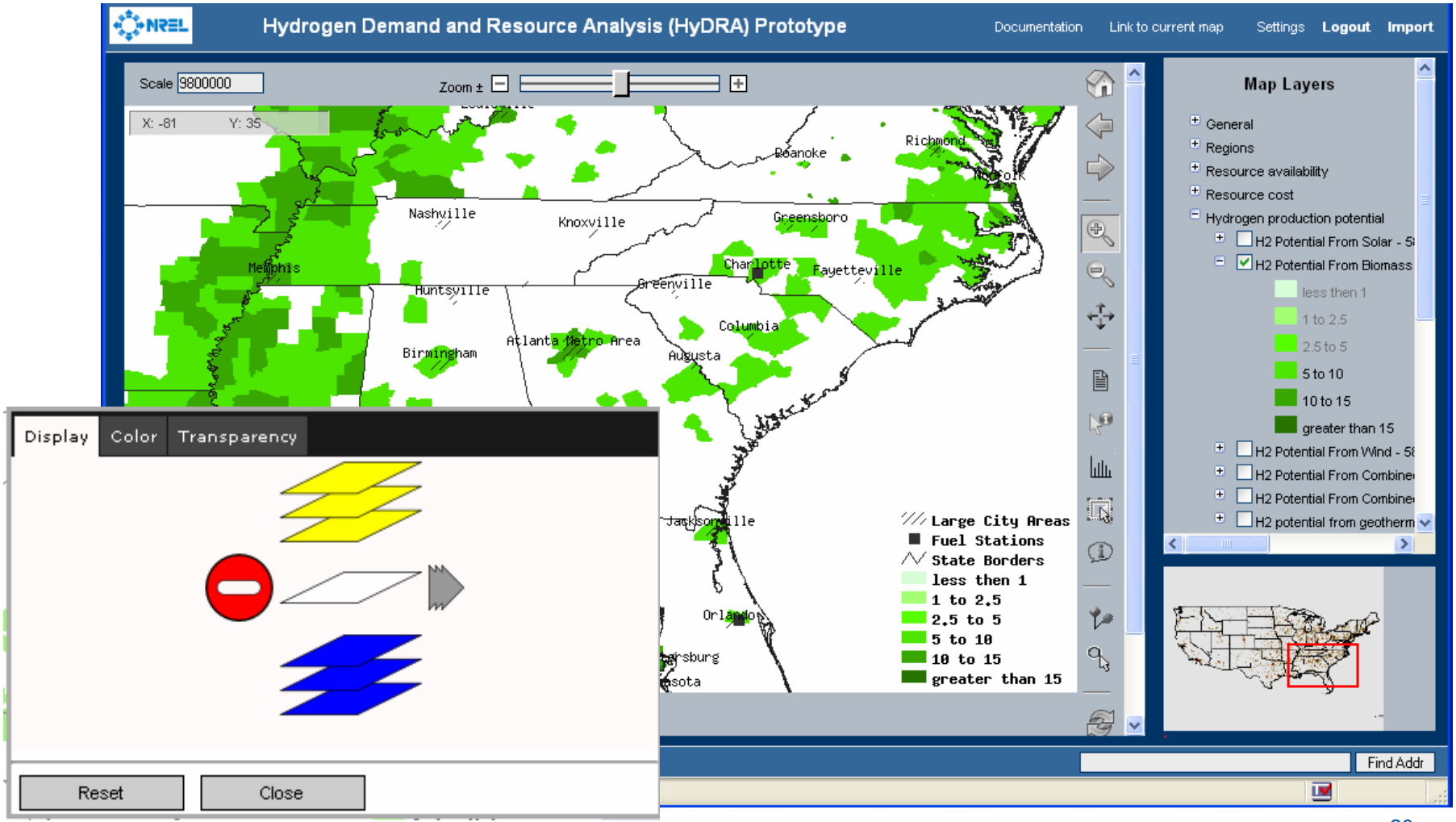
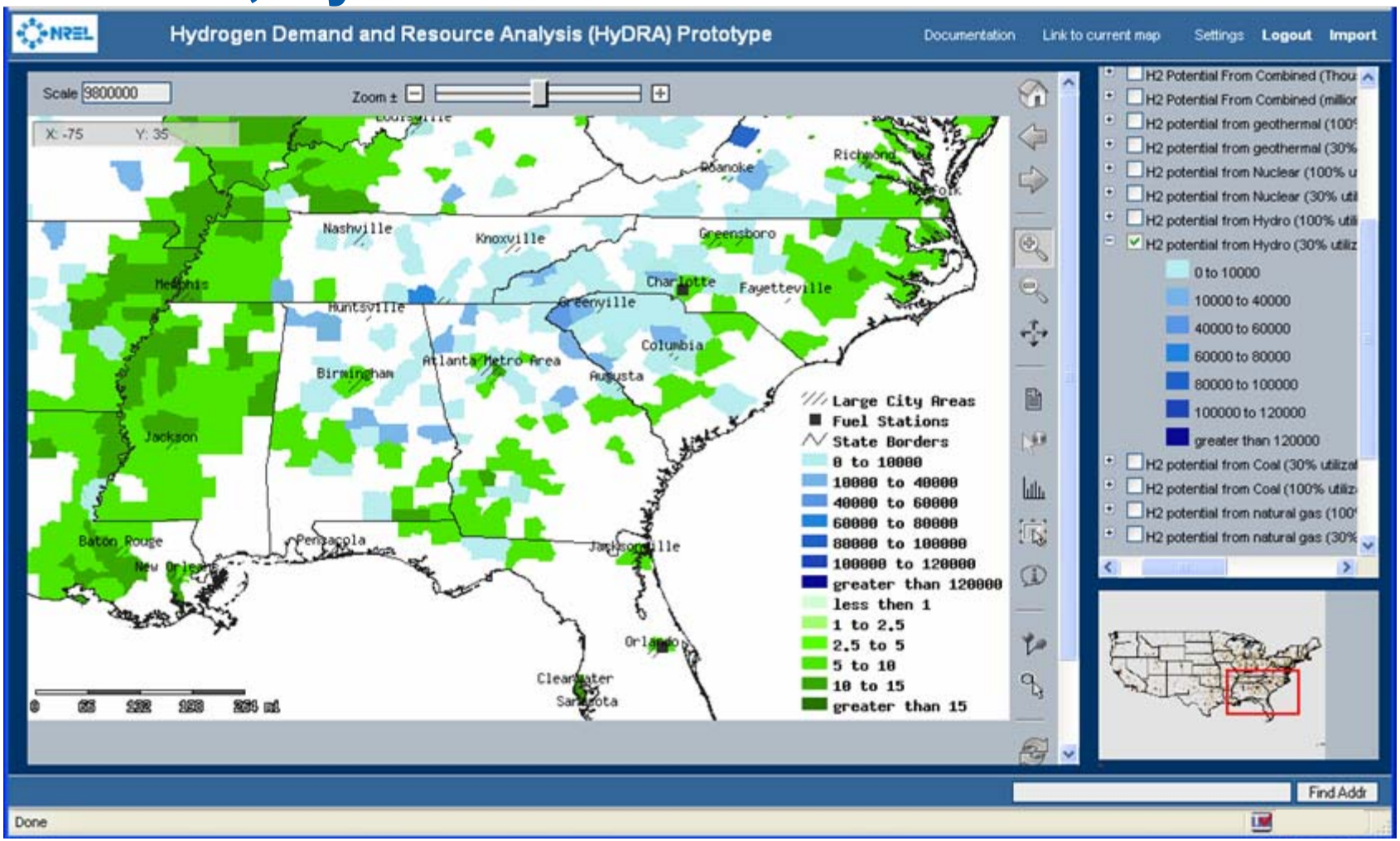
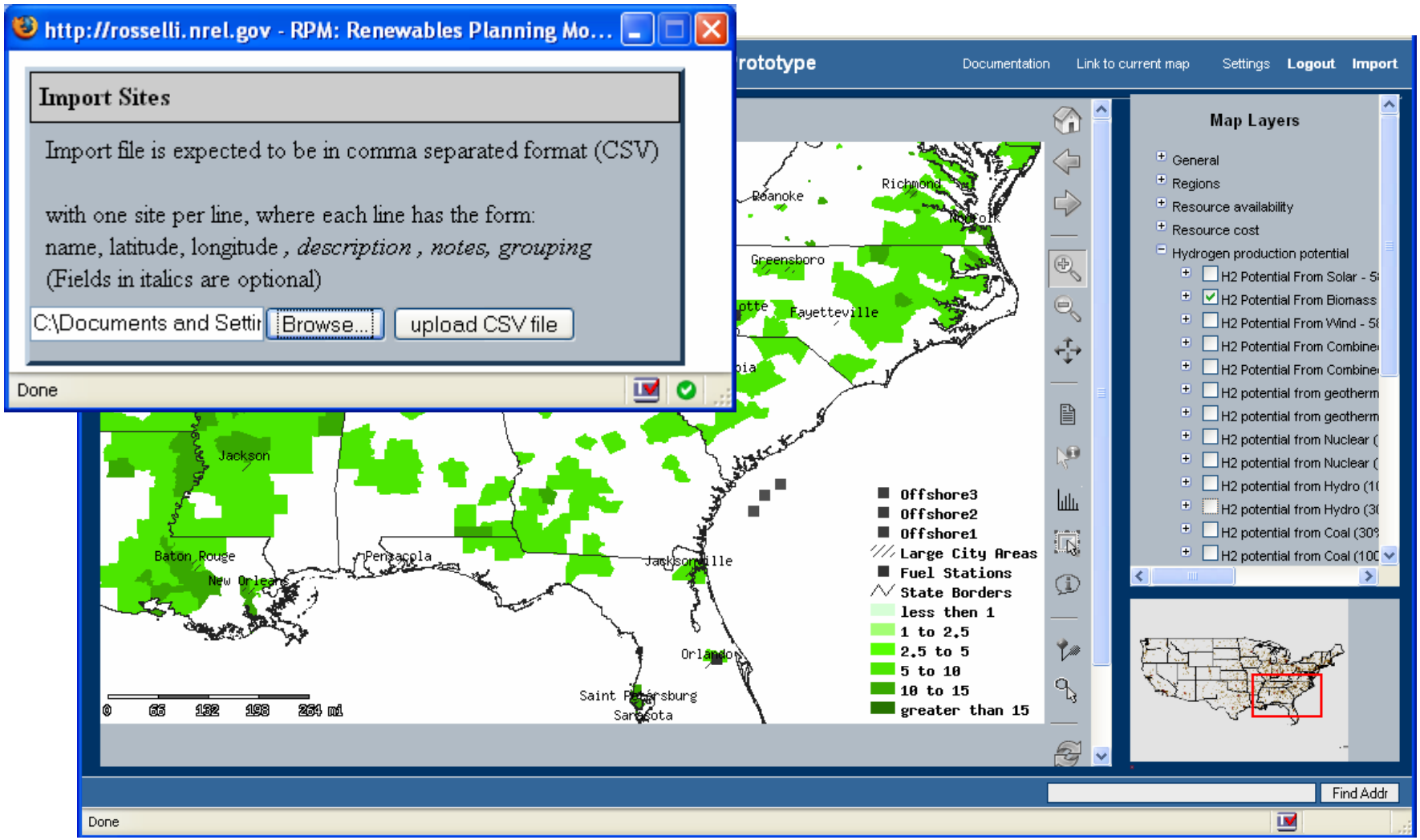


Accomplishments – Hydrogen Production from Biomass, Hydroelectric



Accomplishments – User Data Import



Future Work – Additional Map Data

In Progress

- Hydrogen Pipelines*
- Oil refineries*
- Power plants*
- Water reservoirs/dams *
- Natural gas pipelines*
- Natural gas storage*
- LNG terminals*
- Electric substations *
- Electric lines *
- Hydrogen producers*

Planned

- Geologic hydrogen storage
- Carbon sequestration
- Rail infrastructure
- Feedstock transportation costs
- Hydrogen transportation costs

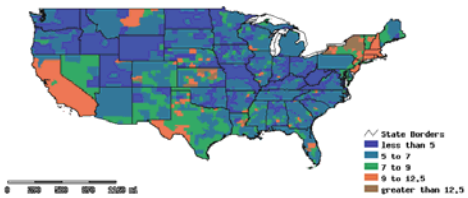
*Data restricted to federal employees

Future Work - MSM Integration

Step 1: Manually integrate forecourt SMR and electrolysis costs

County by county analysis

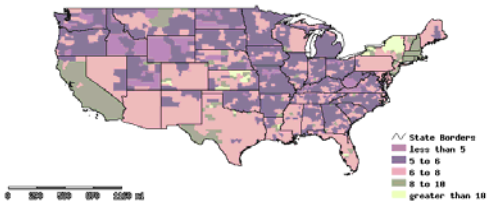
Allows us to validate integration with known results



Electric Rate

MSM

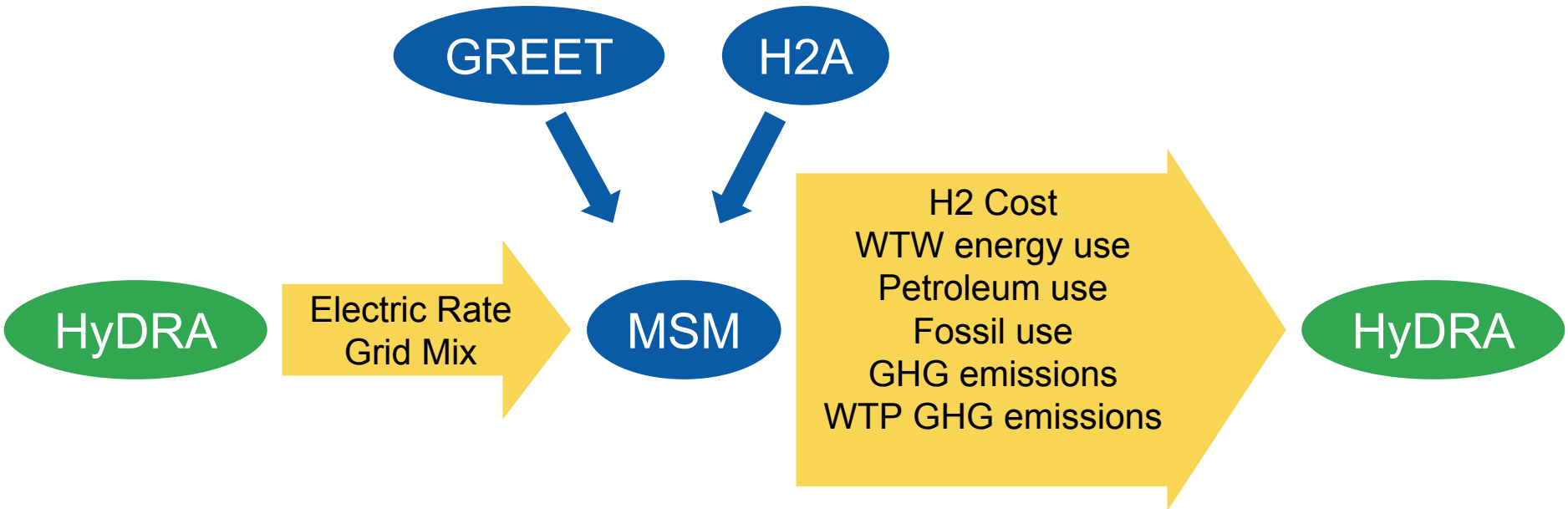
H2 Cost



Step 2: Build new electricity emissions layer for HyDRA

Future Work - MSM Integration

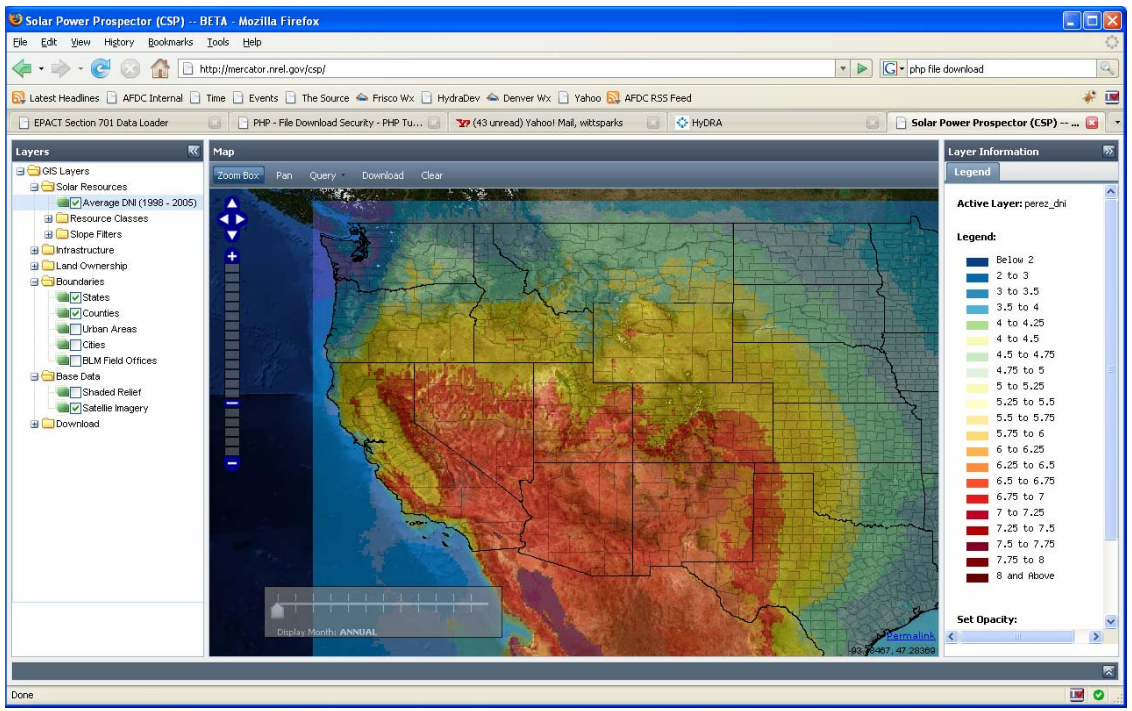
Step 3: Programmatically integrate cost and emissions forecourt electrolysis



Future Work – Application Enhancement

- Hydra now has many new features and data layers
- Responsiveness and usability are becoming more important
- New technologies are emerging

- Improved look and feel
- Increased Performance
- Based on other work being done at NREL



Future Work - Schedule

September 2008:

- New content
- Initial MSM interface
- Re-architecture to improve usability and performance

FY 2009 and beyond:

- Temporal functionality
- Expanded MSM integration
- Additional resource and infrastructure layers
- Optimization capabilities
- Build user base beyond hydrogen

Summary

HyDRA concept is a web-based, dynamic, highly interactive demand and resource tool

- View, download, and report on resource, demand, and infrastructure data
- Spatially represent analysis results
- Provides a tool for regional analysis

Hydra is built on existing work at NREL

- GIS resource analysis
- Hydrogen demand scenario analysis
- Renewable Planning Model

To access the HyDRA application, visit:

https://rpm.nrel.gov/rpmentry/ and request a login.