Open Source Tools for National Applied General Equilibrium Modeling

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October 17, 2017

Blaise Pascal, Treatise on Vacuum (c.1651)

Je n'ai fait celle-ci plus longue que parce que je n'ai pas eu le loisir de la faire plus courte.

I would have written a shorter letter, but I did not have the time.

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Motivation in Current Work with EDF

An important byproduct of our project will be an open-source dataset suitable for analysis of energy-economy-environment issues in North America. We begin with the national input-output table and downscale to the county level using regional economic statistics from the Bureau of Economic Analysis (sectoral value added and price household expenditure). We also employ data from Census Bureaus (foreign trade statistics) and International Trade Administration for bilateral trade statistics. Input-output tables will further be complemented by physical energy quantities and energy prices from the Department of Energys State Energy Data System (SEDS) of EIA.

Additional Motivation

Existing subnational models have largely relied on a commercial database (IMPLAN) to characterize base year state and county-level economic activity in the United States. IMPLAN sells a national dataset at the state level for $. A national *county-level* database is available but very expensive. The open-source tools for combining data and building a benchmark equilibrium database will be useful to many research groups across the country.

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Existing Models which could Use This Dataset

ADAGE (US EPA)

USREP (MIT Joint Program)

Integration of economy-wide CGE model with electricity-sector optimization model

MIT USREP model

- Computable General Equilibrium (CGE) model of the U.S. economy
- Representation of integrated economic-energy system at state/regional and detailed sectoral level

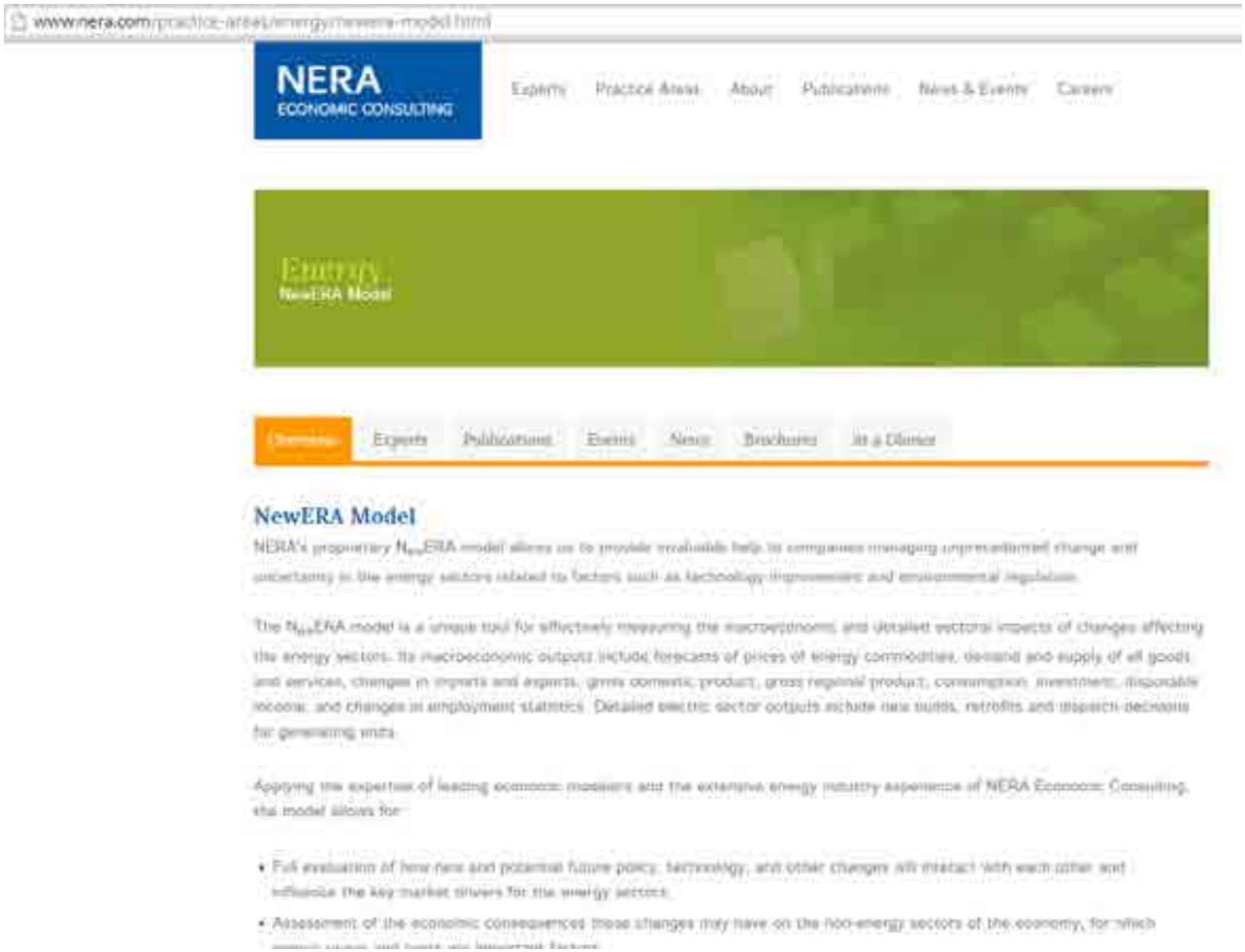
INTEGRATED MODEL FEATURES

- Full integration of both models using state-of-the-art numerical techniques
- Combines macroeconomic framework with technology-rich representation of electricity sector including detailed treatment of renewable energy
- Enables economic assessment of climate policies with significant electric sector role

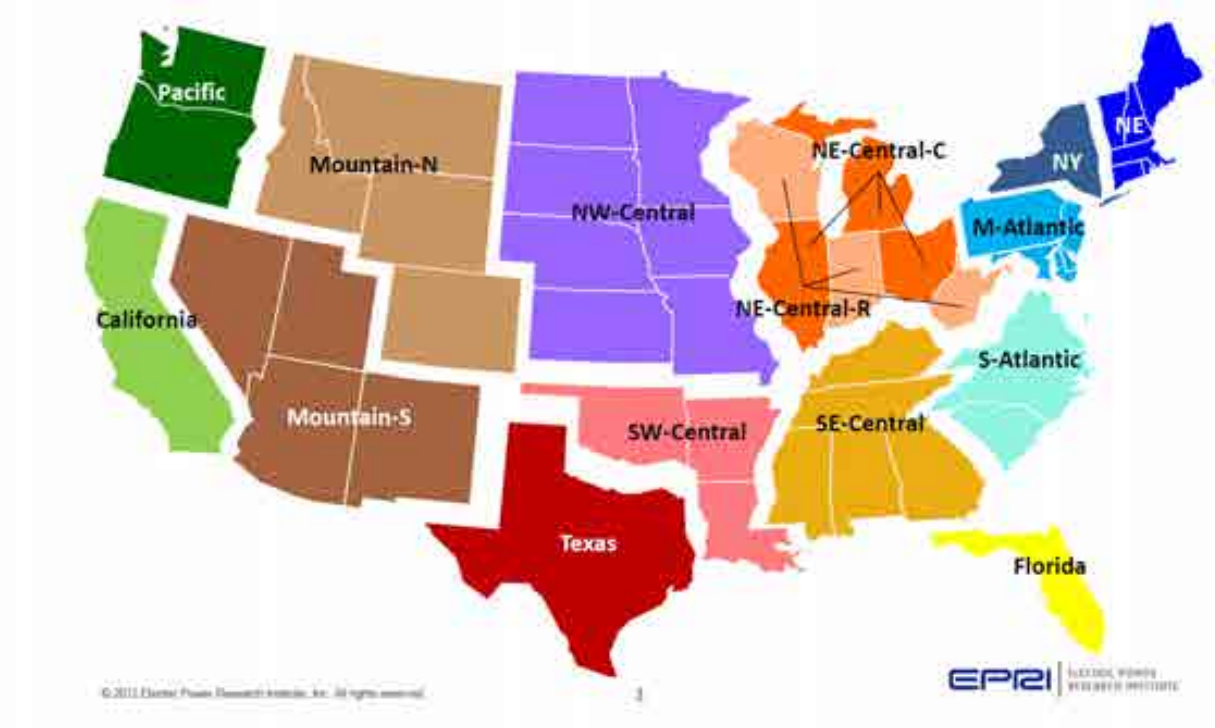
NREL's ReEDS model

- Capacity expansion & dispatch linear programming model for the US electricity sector including all major generator types
- High spatial and temporal resolution to represent renewable resources and transmission expansion

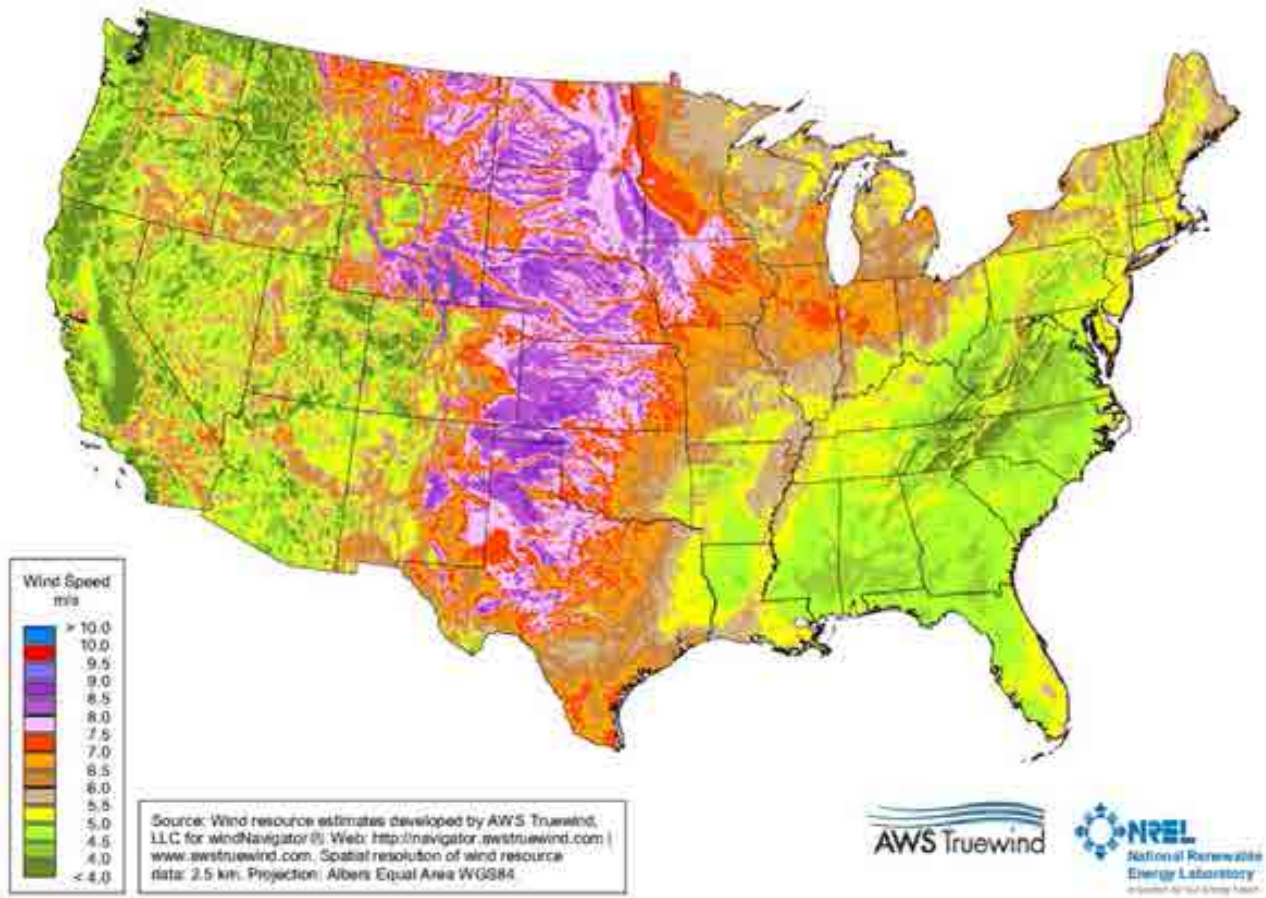
NewERA (NERA Economic Consulting)



The US REGEN Model (Blanford and Young)



Assessment of Wind Resources



Regional Policies Incorporated in the Model

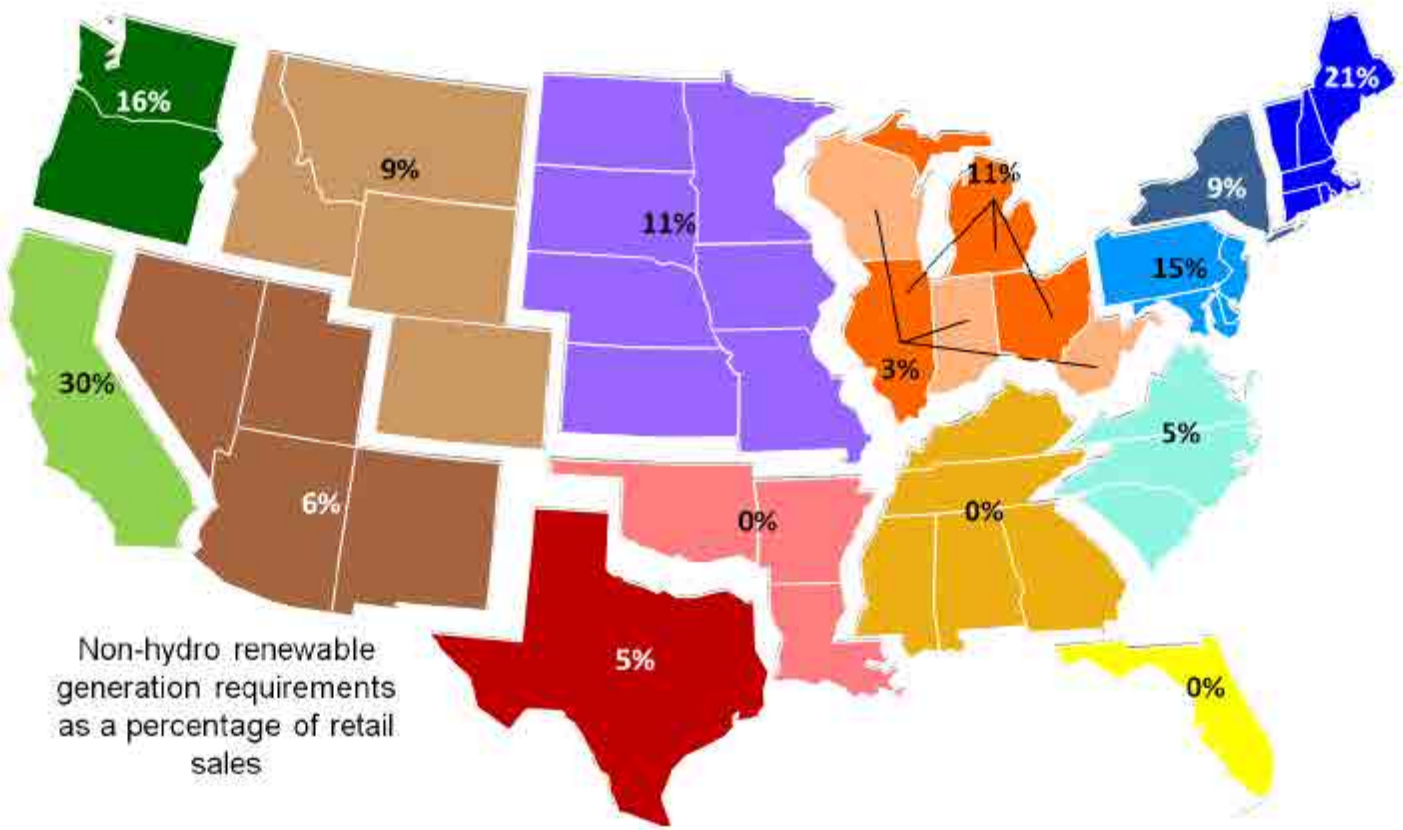


Figure 2-17
State-level RPS requirements aggregated to 15 US-REGEN regions

A Cautionary Perspective: Curb Your Enthusiasm

It is well-known that modelers and policy analysts gain access to policymaking arenas based on what they know. Therefore, critics of models are quick to employ various types of technical standards when evaluating policy models in order to assess validity and reliability of claims to knowledge. This article argues that, in the effort to make models better, overreliance on technical standards misses the important political and policy reasons to model: models call attention to the modelers and to their advice about important policy problems of the day. In this sense, models are used as symbols, as claims to authority, whether or not the underlying knowledge is technically up to snuff. Drawing on the experience of energy policy models, this article explores the problem of models as knowledge versus models as symbols and it examines the muddle that conflicts between them produce. (*Policy Sciences* February 1984, Volume 16, Issue 3, pp 227-243)

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A Partial Work Agenda

- Representation of trade flows and integration of gravity estimates based on the commodity flow survey.
- Integration of household data from the American Community Survey (PUMS)
- Direct access to US Census records could improve both trade and household data collection.
- Data set construction and reconciliation tools based on commercial modeling language (GAMS), yet this should not restrict access for non-commercial users (NEOS).

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Site Resources
- Press Release

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- Is this form legitimate?
- Get help with your form

Related Sites
- American FactFinder
- Business Help Site
- Economic Census
- NAICS
- Bureau of Transportation Statistics
- North American Transportation Statistics Database

Contact Us
Need help with finding or

Commodity Flow Survey

The Commodity Flow Survey (CFS), undertaken through a partnership between the Census Bureau and the Bureau of Transportation Statistics (BTS) is the Economic Census. The CFS produces data on the movement of goods in the United States. It provides information on commodities shipped, their va destination of shipments of commodities from manufacturing, mining, wholesale, and selected retail and services establishments.

2017 Commodity Flow Survey Respondents

Collection for the 2017 Commodity Flow Survey is ongoing. For inquiries on the Commodity Flow Survey, please visit the following:

- New To complete your 2017 Survey Questionnaire through our online reporting system, please click here.
- New To contact the Commodity Flow Survey Staff about the 2017 Survey Questionnaire, please click here.

2012 Data

New The 2012 CFS Public Use Microdata file is now available through the Public Use Microdata tab on this page.

- 2012 CFS Final estimates are now available on the American FactFinder.
- For more information on metropolitan areas in the CFS, please visit the Economic Census CFS Areas.
- For instructions on how to navigate through American FactFinder for the CFS: Navigate Through AFF for CFS [PDF, 2.7 MB]
- The 2012 CFS data are also available in a print report series:

  U.S. Summary Report [PDF, 8.3 MB]

American Community Survey (ACS)

- About the Survey
- Respond to the Survey
- News & Updates
- **Data**
  - Data Tables & Tools
  - Data via FTP
  - Summary File Data
  - **PUMS Data**
  - Variance Replicate Tables
  - Race/Ethnicity and American Indian & Alaska Native Data
  - Custom Tables
- Guidance for Data Users
- Geography & ACS
- Technical Documentation
- Methodology
- Library
- Operations and Administration

PUMS Data

Tweet Share

Supporting documentation for the data below is available on the PUMS Documentation page.

PUMS Data 2005 - Current

Available through the American FactFinder website

2011-2015 ACS 5-year PUMS

2015 ACS 1-year PUMS

2010-2014 ACS 5-year PUMS

2014 ACS 1-year PUMS

2009-2013 ACS 5-year PUMS

2011-2013 ACS 3-year PUMS

2013 ACS 1-year PUMS

2008-2012 ACS 5-year PUMS

2010-2012 ACS 3-year PUMS

2012 ACS 1-year PUMS

2007-2011 ACS 5-year PUMS

2009-2011 ACS 3-year PUMS

Available through the FTP site

2004 ACS PUMS

2003 ACS PUMS

2002 ACS PUMS

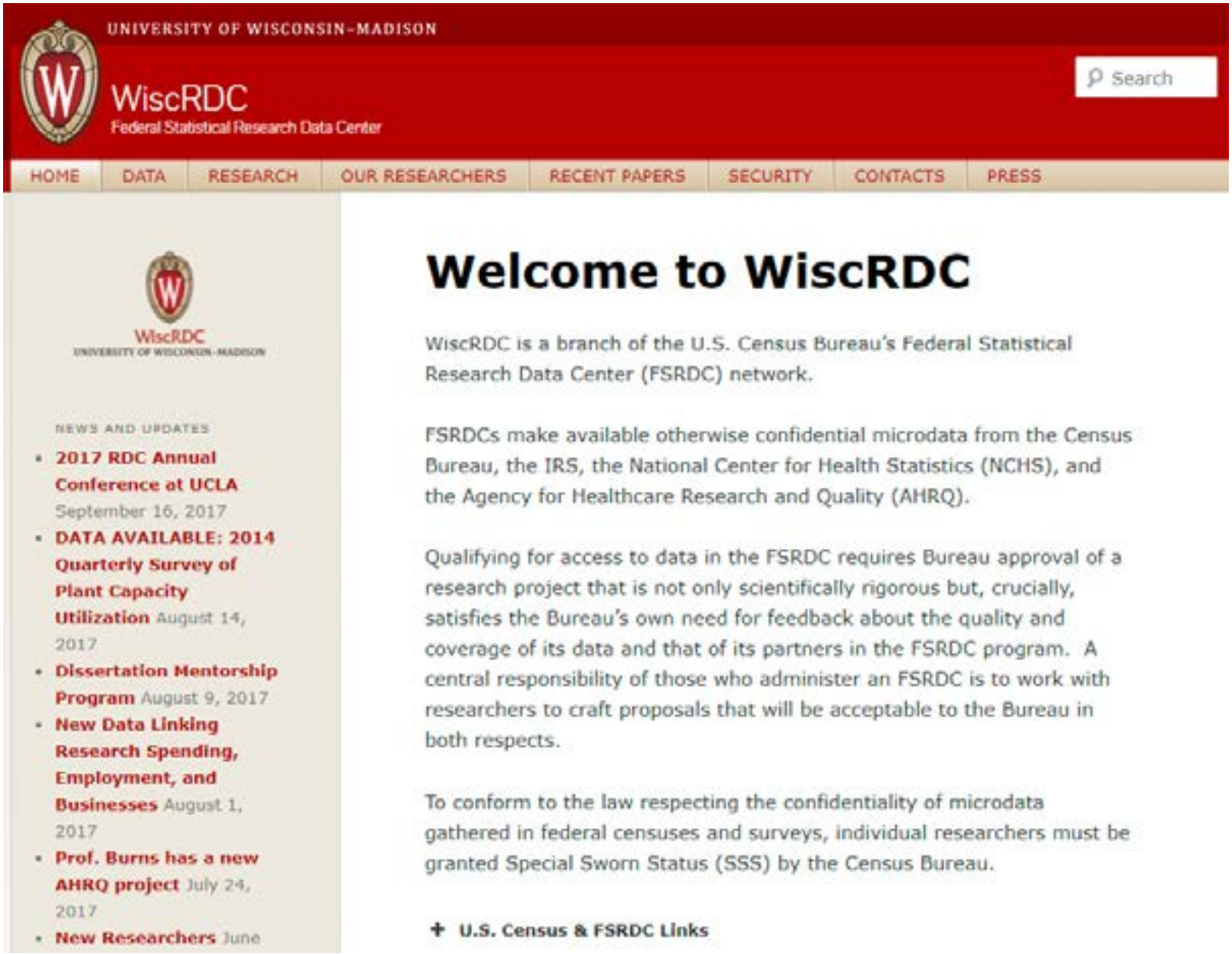
2001 ACS PUMS

2000 ACS PUMS

1996-98 PUMS Files Available on DVD

Microdata for select test areas is available on DVD.

- To request a DVD, email your name and mailing address and specify dataset (PUMS 1996-1998) to acso.dvd.order@census.gov. You may be contacted for additional information before your request is filled.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NEWS AND UPDATES
2017 RDC Annual Conference at UCLA September 16, 2017
DATA AVAILABLE: 2014 Quarterly Survey of Plant Capacity Utilization August 14, 2017
Dissertation Mentorship Program August 9, 2017
New Data Linking Research Spending, Employment, and Businesses August 1, 2017
Prof. Burns has a new AHRQ project July 24, 2017
New Researchers June
Welcome to WiscRDC
WiscRDC is a branch of the U.S. Census Bureau's Federal Statistical Research Data Center (FSRDC) network.
FSRDCs make available otherwise confidential microdata from the Census Bureau, the IRS, the National Center for Health Statistics (NCHS), and the Agency for Healthcare Research and Quality (AHRQ).
Qualifying for access to data in the FSRDC requires Bureau approval of a research project that is not only scientifically rigorous but, crucially, satisfies the Bureau's own need for feedback about the quality and coverage of its data and that of its partners in the FSRDC program. A central responsibility of those who administer an FSRDC is to work with researchers to craft proposals that will be acceptable to the Bureau in both respects.
To conform to the law respecting the confidentiality of microdata gathered in federal censuses and surveys, individual researchers must be granted Special Sworn Status (SSS) by the Census Bureau.
+ U.S. Census & FSRDC Links

NEOS Server: State-of-the-Art Solvers for Numerical Optimization

The **NEOS Server** is a free internet-based service for solving numerical optimization problems. Hosted by the Wisconsin Institute for Discovery at the University of Wisconsin in Madison, the NEOS Server provides access to more than 60 state-of-the-art solvers in more than a dozen optimization categories. Solvers hosted by the University of Wisconsin in Madison run on distributed high-performance machines enabled by the HTCondor software; remote solvers run on machines at Arizona State University, the University of Klagenfurt in Austria, and the University of Minho in Portugal.

The **NEOS Guide** website complements the NEOS Server, showcasing optimization case studies, presenting optimization information and resources, and providing background information on the NEOS Server.

Latest NEOS News

June 27, 2017	**The NEOS Server will be down for maintenance Wednesday, July 5th from 8am - 10am CDT.**
June 10, 2017	You can use your NEOS user account to submit authenticated jobs through the web or XML-RPC interfaces. More information is available in our XML-RPC API.
May 28, 2017	We have re-enabled user accounts with improved functionality and security. You will need to reset your password to access an existing account.
Jan 1, 2017	***Sign up for a NEOS user account to receive better service!*** When you Sign Up for a user account and Sign In before you submit your jobs, you will

NEOS Guide

- NEOS Case Studies
- NEOS Optimization Guide
- NEOS Server Information
- Optimization Resources, LP FAQ and NLP FAQ

NEOS Server

- Submit a job to NEOS
- View Job Queue and Job Results
- User's Guide to the NEOS Server
- NEOS Server FAQ
- NEOS Support

Advanced Tools

- Statistics: solvers, web sites, cluster
- Job Archives (password required)
- Downloads: Client Tools (GitHub) and Kestrel

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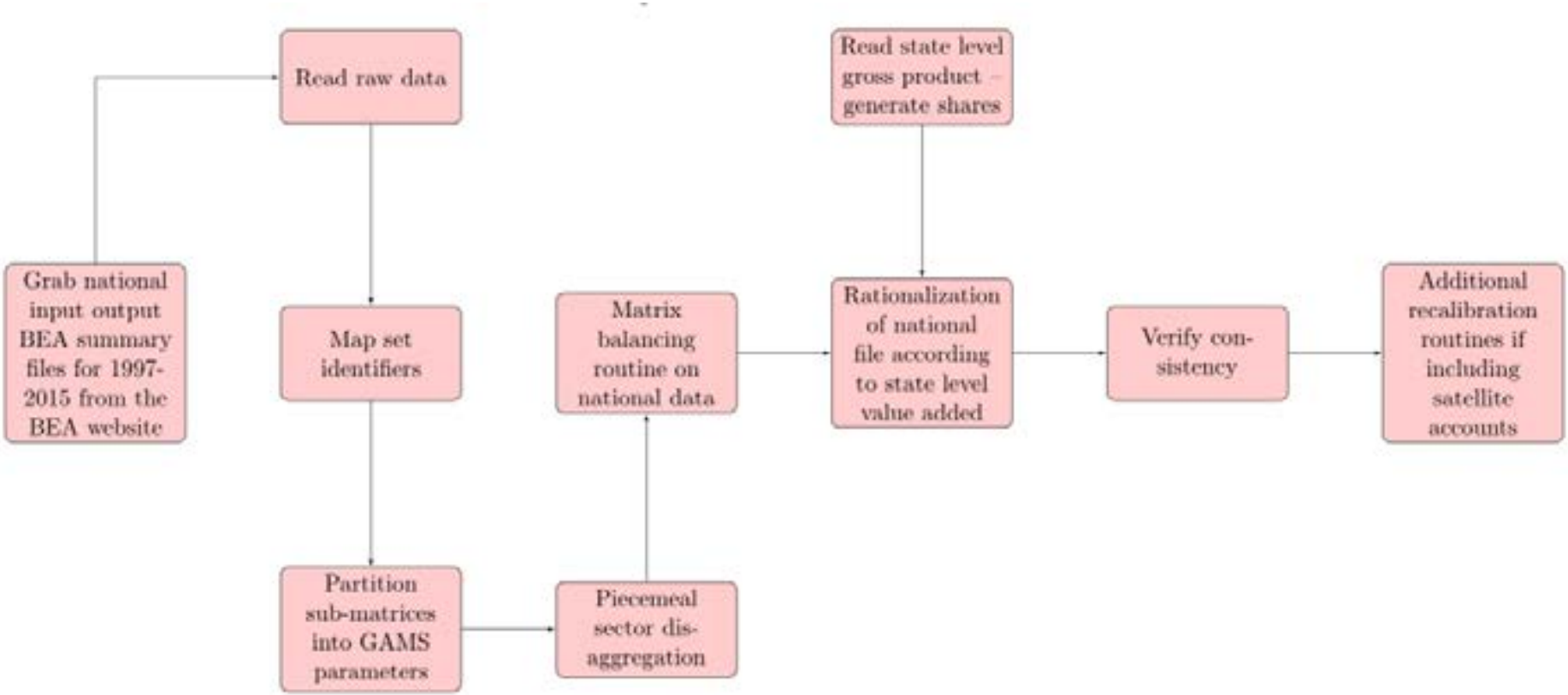
Status Report

- Features of the package: micro-consistent state level data, the build stream, a MR/MS CGE model and tools for adding in additional data and rebalancing.
- Flow chart: highlighting build structure and where data sources are from.
- Overview of the social accounting matrix.
- Dimensionality
- The canonical regional model (flows).
- SEDS integration for an energy oriented model?
- Hydrology applications – Central Sands water data
- **blueNOTE** (**N**ational **O**pen source **T**ools for general **E**quilibrium modeling)

Package

- Micro-consistent sub-national social accounting matrices.
- All code for the build stream.
- A multi-regional, multi-sectoral computable general equilibrium model
- Matrix balancing routines for inclusion of additional satellite data
- Access to online platform for solving the model without GAMS license (NEOS)

Build stream



Model/data syntax: Variables and sets

Table 1: Nomenclature in the Regional CGE Model

Type	Item	Description
Sets:	s,g	Sectors/Goods
	r	Regions
	m	Margin type
	va	Value added component
Activity Levels:	$Y_{r,s}$	Sectoral output
	$A_{r,s}$	Armington composite
	$X_{r,s}$	Supply allocation
	$M_{r,m}$	Margin supply
Prices:	$p^{Y}_{r,s}$	Output market price
	$p^{A}_{r,s}$	Armington composite price index
	$p^{D}_{r,s}$	Regional market price for goods
	p^{N}_{s}	National market price for goods
	p^{FX}	Foreign exchange rate
	$p^{VA}_{r,va}$	Value added rates
	p^{M}_{m}	Margins markup

Model/data syntax: Parameters

Table 2: Parameters in the Regional CGE Model

Parameter	Description
$\bar{ys}_{r,g,s}$	Sectoral supply
$\bar{id}_{r,s,g}$	Intermediate demand
$\bar{va}_{r,va,s}$	Factor demand
$\bar{m}_{r,s}$	Imports
$\bar{x}_{r,s}$	Exports of goods and services
$\bar{mn}_{r,s}$	National imports
$\bar{xn}_{r,s}$	National exports
$\bar{d}_{r,s}$	Regional supply
$\bar{ms}_{r,s,m}$	Margin supply
$\bar{md}_{r,m,s}$	Margin demand
$\bar{s}_{r,s}$	Aggregate supply
$\bar{a}_{r,s}$	Armington supply
$\bar{ta}_{r,s}$	Tax net subsidy rate on intermediate demand
$\bar{tm}_{r,s}$	Import tariff
$\bar{cd}_{r,s}$	Final demand
$\bar{yh}_{r,s}$	Household production
$\bar{bop}_{r}$	Balance of payments
$\bar{g}_{r,s}$	Government demand
$\bar{i}_{r,s}$	Investment demand

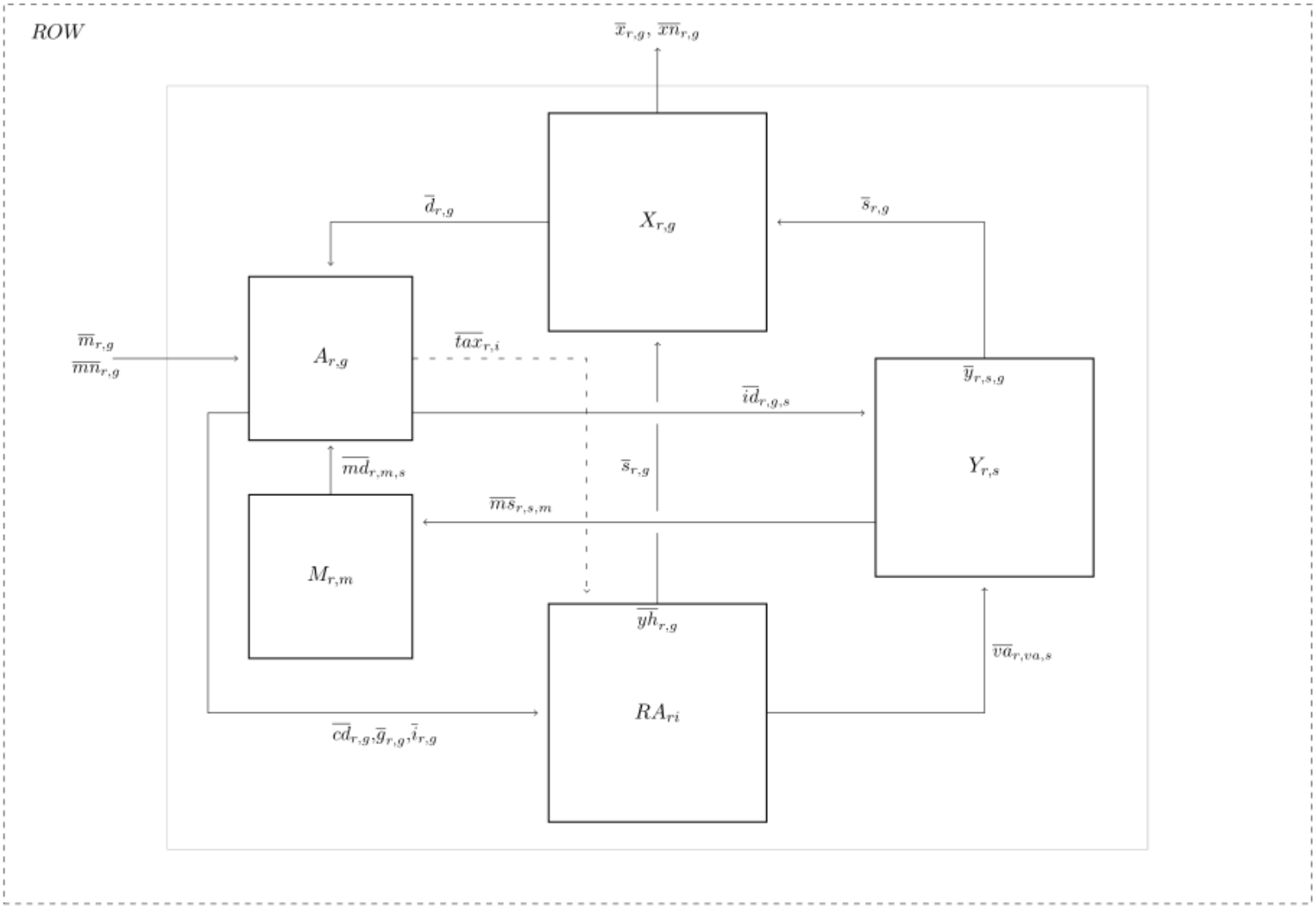
Social Accounting Matrix

Table 3: Regional Social Accounting Matrix

		Production	Exports	Absorption Composite	Margins	Output Market	Regional Market	National Market	Domestic Composite	Factors	Margins Market	Trade	Institutions
		$Y_{r,s}$	$X_{r,s}$	$A_{r,s}$	$M_{r,m}$	$p^Y_{r,s}$	$p^D_{r,s}$	p^N_s	$p^A_{r,s}$	$p^{VA}_{r,va}$	p^M_m	p^{FX}	
Production	$Y_{r,s}$					$\bar{ys}_{r,s,g}$							
Exports	$X_{r,s}$						$\bar{d}_{r,s}$	$\bar{xn}_{r,s}$				$\bar{x}_{r,s}$	
Absorption Composite	$A_{r,s}$								$\bar{a}_{r,s}$				
Margins	$M_{r,m}$										$\bar{ms}_{r,s,m}$		
Output Market	$p^Y_{r,s}$		$\bar{s}_{r,s}$		$\bar{ms}_{r,s,m}$								
Regional Market	$p^D_{r,s}$			$\bar{d}_{r,s}$									
National Market	p^N_s			$\bar{mn}_{r,s}$									
Domestic Composite	$p^A_{r,s}$	$\bar{id}_{r,g,s}$											$\bar{cd}_{r,s}$, $\bar{g}_{r,s}, \bar{id}_{r,s}$
Factors	$p^{VA}_{r,va}$	$\bar{va}_{r,va,s}$											
Margins Market	p^M_m			$\bar{md}_{r,m,s}$									
Trade	p^{FX}			$\bar{m}_{r,s}$									
Institutions						$\bar{yh}_{r,s}$				$\bar{va}_{r,va,s}$		$\bar{bop}_r$	

Model Flows

Figure 1: The Regional Economic Structure



Dimensionality of the dataset

Social accounting matrices for all 50 states from 1997-2014.

- Based on summary files of 57 sectors.
- Option for disaggregation using the 2007 389 sectoring scheme.
- Regionalization achieved mainly through gross state product data.

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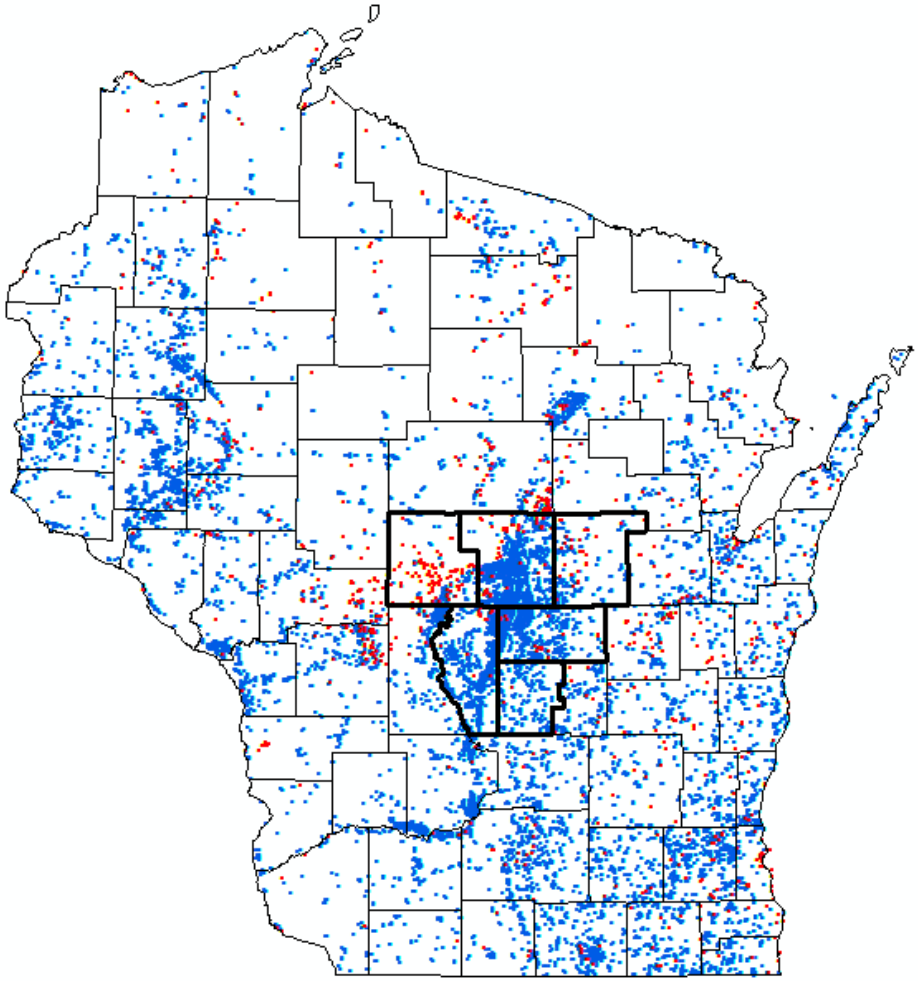
Irrigation in the Central Sands

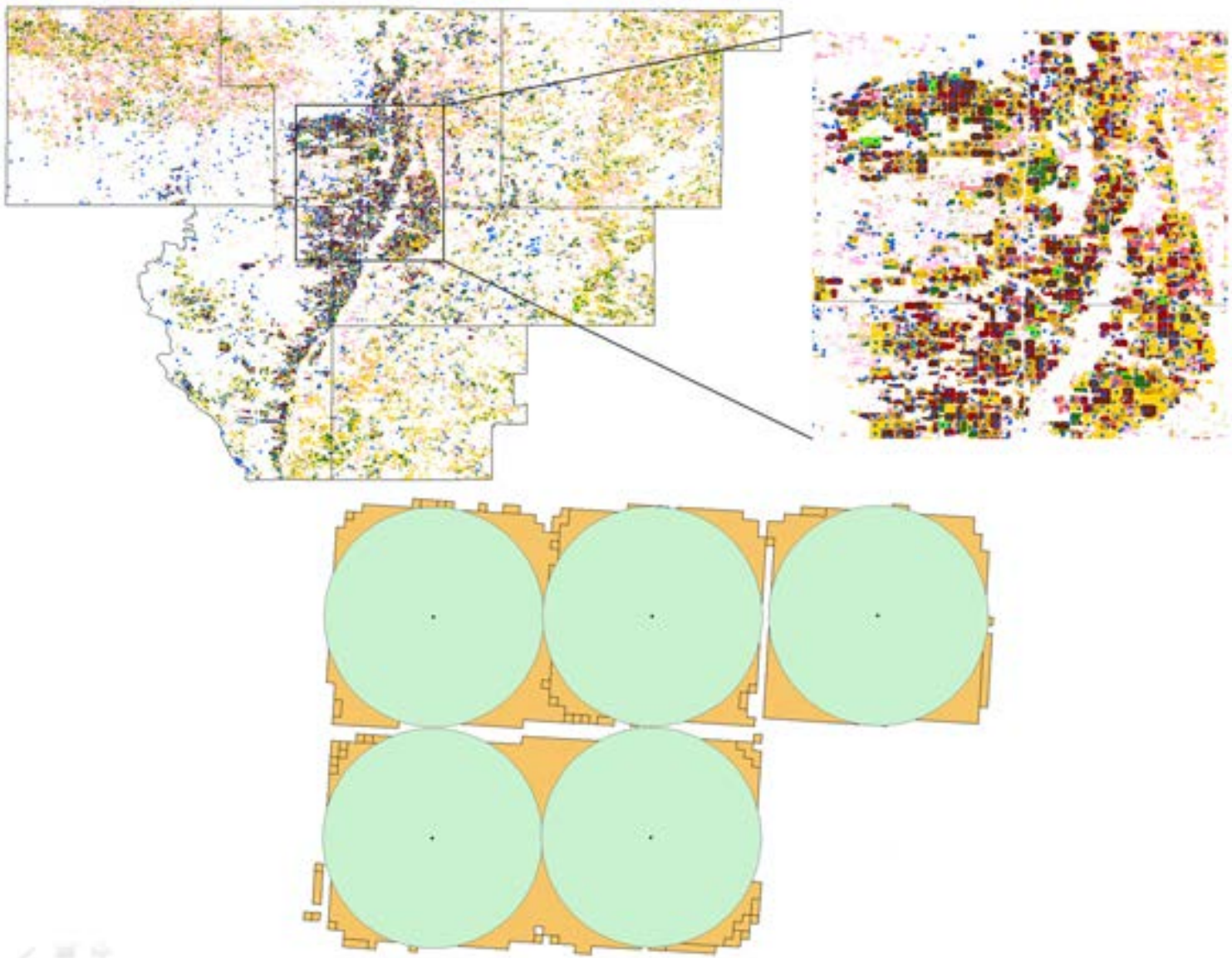
Water withdrawal satellite accounts are derived from Wisconsin Department of Natural Resources GIS data on registered water withdrawal wells in Wisconsin.

- Groundwater, surface water from the Great Lakes and non-Great Lakes.
- Aggregate use categories are provided: Irrigation, Public Supply, etc.
- Irrigation water withdrawals are mapped to crop types using the Cropland Data Layer (CDL) from the National Agricultural Statistical Service.

Irrigation in the Central Sands



Data: Water Mapping



Groundwater Statistics

Table 5: Groundwater Withdrawals

		Adams	Marquette	Portage	Waupaca	Waushara	Wood
Withdrawals (bill. gallons)	*Grains*	6.7	0.5	6.0	0.5	5.0	0.2
	Vegetables, fruit, and nuts	6.8	0.1	7.0	0.2	5.9	0.9
	Oil seeds	1.1	0.1	0.7	0.1	1.1	
	Other crops	0.4	0.1	0.7	0.1	0.6	0.1
	Raw milk			0.1	0.1		
	Public administration	0.3	0.1	2.7	1.4	0.2	1.6
Gallons per dollar output	*Grains*	850.2	53.5	389	29.9	421.5	17.4
	Vegetables, fruit, and nuts	127.4	6	57.9	17.7	102.6	21.9
	Oil seeds	313.1	16.3	149.6	18.3	244.8	8.1
	Other crops	97.7	19.1	68.3	12	97.9	3.4
	Raw milk		1.1	2.4	0.6	0.3	
	Public administration	2.4	2.1	4.4	3.4	1.6	0.8

Notes: Groundwater withdrawals are provided in billions of gallons for the year 2011. Empty elements in tier 1 are associated with non-empty elements of tier 2 due to rounding. Some sectors were omitted due to negligible levels of withdrawals. Surface water withdrawals are excluded from the table. See table 22 in appendix E for more information.
Sources: Wisconsin DNR, USDA Cropland Data Layer.