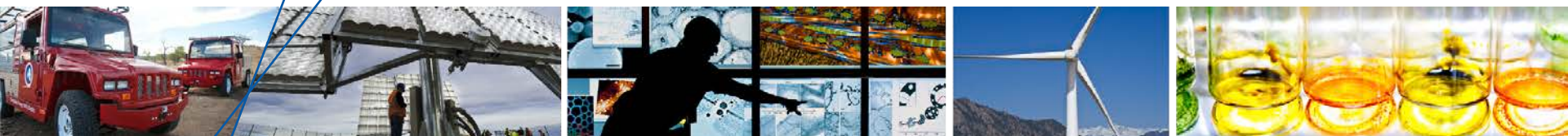


# Cloud Based Applications and Platforms

Using the cloud to facilitate access, use, and  
contribution of worldwide energy data and information



## Cloud Computing East 2014

Debbie Brodt-Giles

May 15, 2014

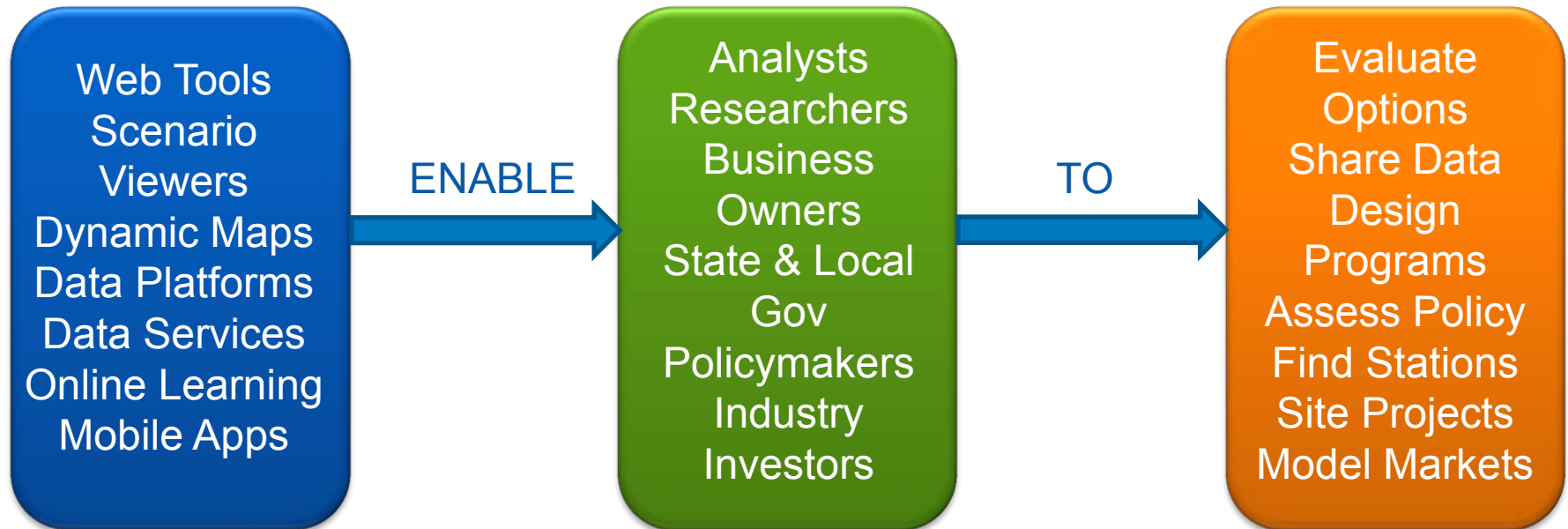
NREL/PR-6A20-61991

# Discussion Areas

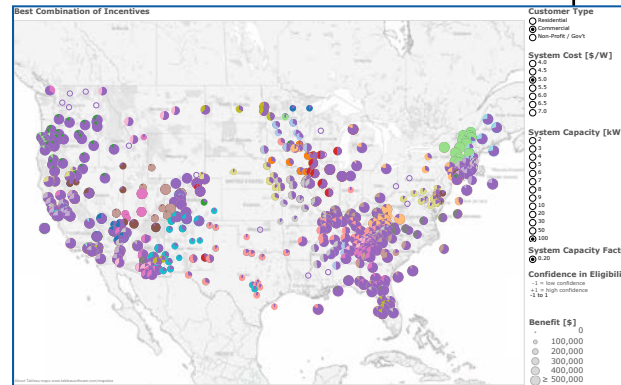
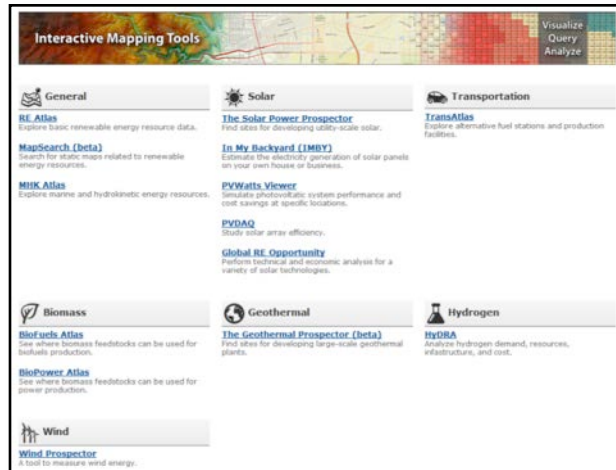
- **Background on NREL's Data, Analysis & Visualization Group in the Strategic Energy Analysis Center**
- **Why do we use the cloud?**
- **What types of projects make sense to have on the cloud?**
- **Lessons learned**
- **What is the process for getting applications on the cloud?**
- **General cloud strategy and next steps**

# Data Analysis & Visualization Group Mission

**Enable transformation of energy systems and markets by providing tools and analysis to transform data to knowledge to decisions**



# Examples: Geographic Information Science

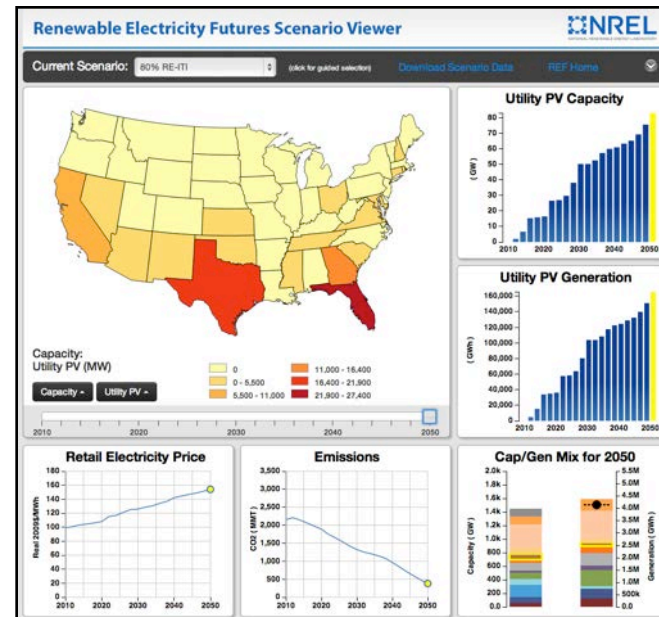


Logical Inference Analysis of Policies & Incentives

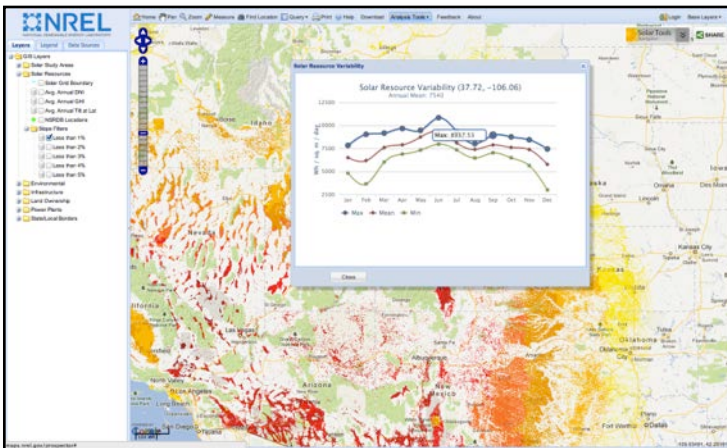


Geo-based Options Screening

## NREL Geospatial Data Repository



Interactive Temporal/Spatial Viewer



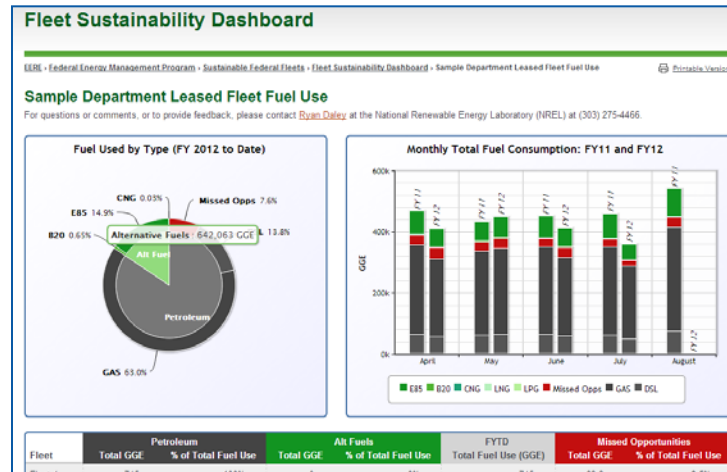
OpenCarto Geospatial Analysis Tool



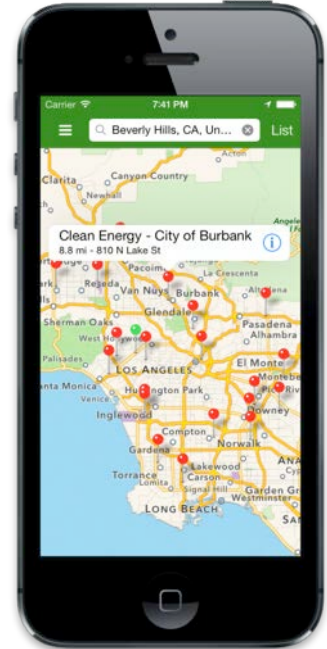
# Examples: Market Enabling Applications



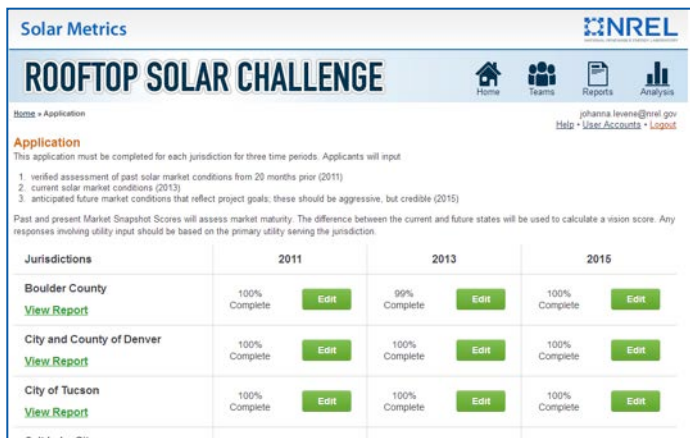
DOE's Alternative Fuels Data Center



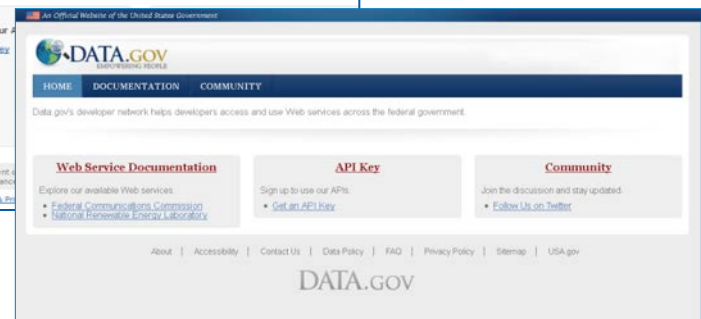
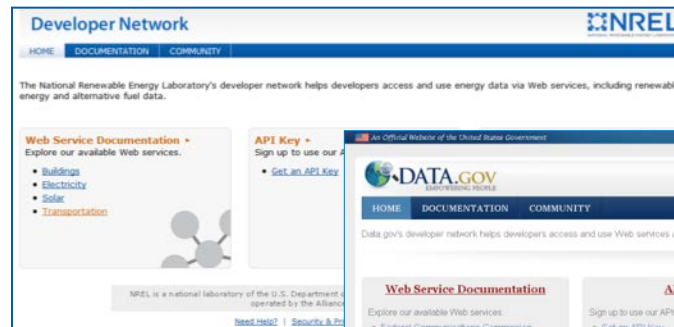
Decision Tools for Key Groups



Mobile Apps

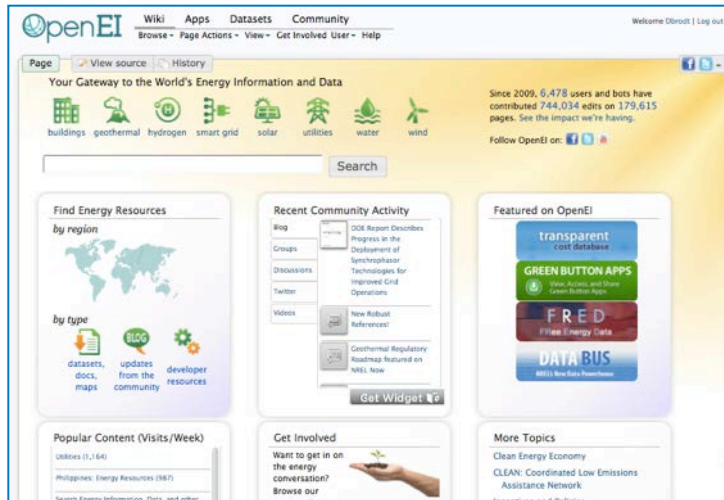


Program Reporting & Metrics

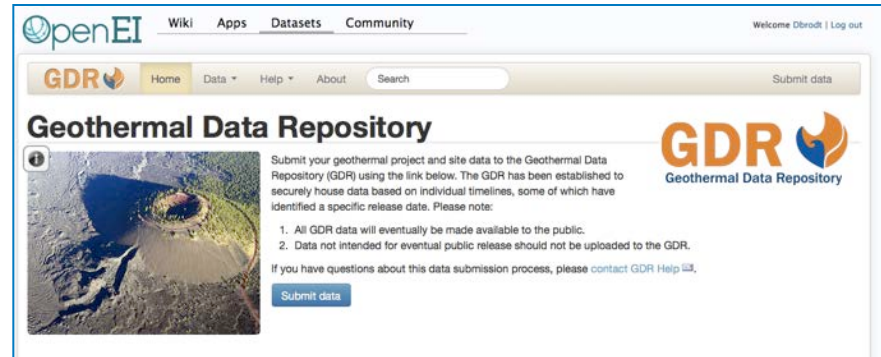


Data Services for NREL & data.gov

# Examples: Digital Assets



DOE/EERE Open Data Platform



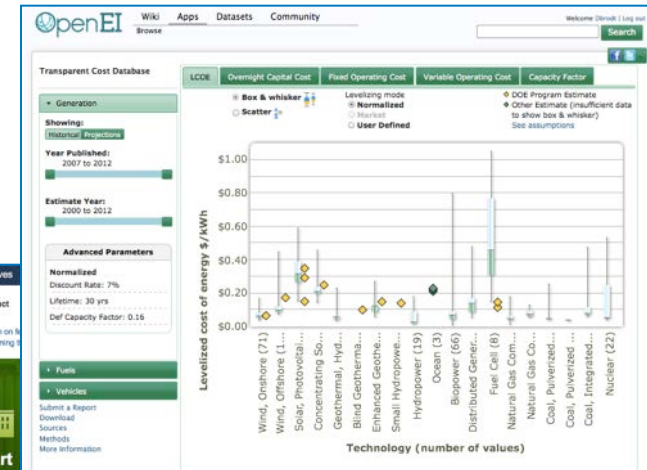
Geothermal Project Data Repository



NREL Campus Energy Data



ARRA Smart Grid Project Data



Technology Cost Database

# Why the Cloud?

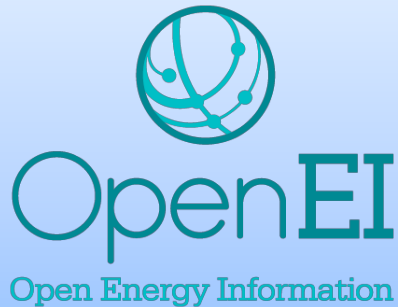
- **Fast**
- **Reliable**
- **Scalable**
- **Controllable**
- **Easy to monitor**
- **Redundant**
- **Accessible**
- **Easy to implement**
- **High availability**
- **Energy efficiency savings**
- **Cost effective**
- **Continually upgraded**



# What goes on the cloud?

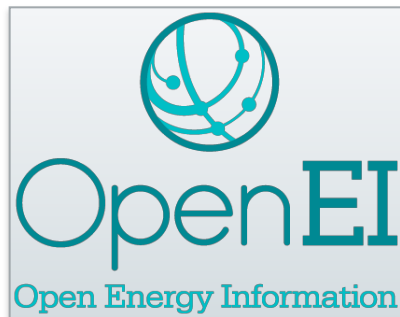
*Potentially anything!*

## But what we have there now is:



“.org” sites





- Wiki-based open energy data sharing platform for the world
- DOE's Energy Efficiency and Renewable Energy (EERE) platform for providing open data to the public



Linked Open Data for  
Improved access to energy-  
related information



Easy, legal, & scalable  
data sharing and ratings



Community support for  
contributions and  
collaboration



Assessments of  
information quality &  
provenance

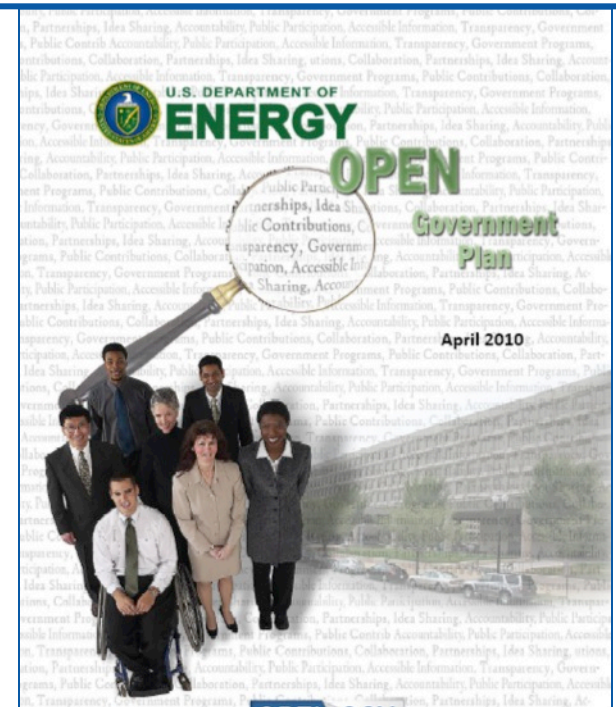


Services for application  
development & derived  
data knowledge



Crowdsourced  
Dataset Generation

Open Government and Energy Data Initiatives	Date
DOE issued <b>press release</b> to launch OpenEI as its Open Government Initiative	12/09
DOE releases <b>Open Government Plan</b> , which highlights OpenEI	4/10
OpenEI recognized by the White House as a <b>Flagship Open Government Initiative</b>	4/10
OpenEI featured on <b>White House Innovations Gallery</b>	1/11
White House Announces <b>Energy Data Initiative</b>	5/12
OpenEI included in <b>OMB Federal Digital Strategy</b>	8/12
<b>OSTP Open Access Memo</b> Issued to Federal Agencies	2/13



the WHITE HOUSE PRESIDENT BARACK OBAMA

BLOG PHOTOS & VIDEO BRIEFING ROOM ISSUES the ADMINISTRATION

Home • The Administration • Open Government Initiative

## Open Government Initiative

TRANSPARENCY • PARTICIPATION • COLLABORATION

About Open Government | Open Gov Blog | Around the Government | Innovations Gallery

**INNOVATIONS GALLERY**

- Aristotle
- Blue Button
- Business.gov
- Challenge.gov
- Community Health Data Initiative
- Data.gov
- Development 2.0
- Challenge
- DoD Techpedia
- Federal Register 2.0
- Flu Prevention PSA Contest
- Healthreform.gov
- IT Dashboard
- MedEasyst

### Open Energy Information

U.S. Department of Energy

Facilitating access, use and contribution of worldwide energy data & information

[Launch OpenEI.org](#)

**OpenEI video**

United States - Annual Average Wind Speed at 80 m



the WHITE HOUSE PRESIDENT BARACK OBAMA

BLOG PHOTOS & VIDEO BRIEFING ROOM ISSUES the ADMINISTRATION

Home • The Administration • Open Government Initiative

## Open Government Initiative

TRANSPARENCY • PARTICIPATION • COLLABORATION

About Open Government | Open Gov Blog | Around the Government | Innovations Gallery

### Fact Sheet: Open Government Flagship Initiatives

Today, Federal departments and agencies are putting forward concrete plans for making operations transparent, and expanding opportunities for citizen participation, collaboration, and oversight. To strengthen our democracy and promote efficiency and effectiveness across the government.

Open government is not the work of any single office. The entire Obama Administration is moving to translate the values of openness into lasting improvements in the way government makes decisions, problems, and addresses national challenges.

Below are summaries of selected open government flagship initiatives that Federal departments are undertaking to make the government more transparent, participatory, and collaborative. These are each agency's open government plan, and will result in lasting change in the way that the Federal works for and – equally important – with the American people.

the WHITE HOUSE PRESIDENT BARACK OBAMA

BLOG PHOTOS & VIDEO BRIEFING ROOM ISSUES the ADMINISTRATION the WHITE HOUSE our GOVERNMENT

Home • The Administration • Office of Science and Technology Policy

Get Email Updates | Contact Us

Search Whitehouse.gov

## Office of Science and Technology Policy

About OSTP | OSTP Blog | Pressroom | Divisions | R&D Budgets | Resource Library | NSTC | PCAST | Contact Us

### Unlocking the Power of Energy Data

Posted by Todd Park, Jason Bordoff, and Dave Danielson on May 22, 2012 at 08:00 PM EDT

E-Mail | Tweet | Share

The U.S. Government, as well as the private sector, is sitting on a vast – and in many cases, untapped – supply of energy data. Sets of data aren't what most people think of when we talk about safely and responsibly developing American energy resources such as wind, solar, oil, and gas. But data are also essential components of the President's all-of-the-above energy strategy. To help harness the power of these data through a combination of technology and ingenuity, the Obama Administration has launched the Energy Data Initiative (EDI). The goal of EDI is to drive entrepreneurs to use data to create tools that can help Americans save money on utility bills and at the pump – by, for example, virtually identifying cost-effective retrofits or delivering route- and vehicle-optimization tips to improve fuel efficiency. In doing so, this will generate a rising tide of innovation that can help grow the economy and create jobs.

**GIVE FEEDBACK ABOUT THIS PAGE**

**YOUR FEDERAL TAXPAYER RECEIPT**

Launch the Receipt

# Example LOD Functionality

Basic state info; semantically linked to external resources

Energy Data with source info

Tools/models/resources relevant to the U.S.

Access to hundreds of RE resource maps for the U.S.

REEGLE Policy and Regulatory Overview

## United States: Energy Resources



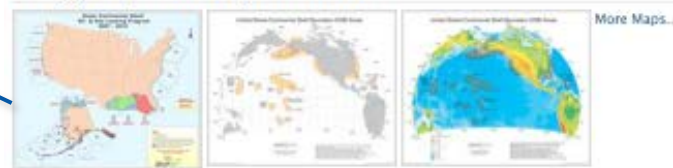
Click on a state to view that state's page.

The United States of America (USA or U.S.A.), commonly referred to as the United States (US or U.S.) or America, is a federal republic consisting of 50 states and a federal district. The 48 contiguous states and the federal district of Washington, D.C. are in central North America between Canada and Mexico.

### Energy Resources

Resource	Value	Units	Rank	Period	Source
Wind Potential	2,237,435	Area(km <sup>2</sup> ) Class 3-7 Wind at 50m	3	1990	NREL <a href="#">@</a>
Solar Potential	24,557,081,451	MWh/year	6	2008	NREL <a href="#">@</a>
Coal Reserves	260,551.00	Million Short Tons	1	2008	EIA <a href="#">@</a>
Natural Gas Reserves	8,978,000,000,000	Cubic Meters (cu m)	6	2010	CIA World Factbook <a href="#">@</a>
Oil Reserves	19,120,000,000	Barrels (bbl)	14	2010	CIA World Factbook <a href="#">@</a>

### Energy Maps featuring United States



### reegle Policy and Regulatory Overview <sup>[1]</sup>

No Policy and Regulatory Overview Available



View the States Solar and Wind Energy Resource Atlas for United States [@](#).

Country Profile	
Name	<a href="#">United States</a>
Population	Unavailable
GDP	Unavailable
Energy Consumption	99.53 Quadrillion Btu
2-letter ISO code	US
3-letter ISO code	USA
Numeric ISO code	840
UN Region <sup>[1]</sup>	Northern America
OpenEI Resources	
Energy Maps	1143 <a href="#">view @</a>
Tools	94 <a href="#">view @</a>
Programs	25 <a href="#">view @</a>
Energy Organizations	9019 <a href="#">view @</a>
Research Institutions	128 <a href="#">view @</a>
References	
CIA World Factbook, Appendix D <sup>[2]</sup>	

### 25 Programs

- NREL State Clean Energy Policies Analysis Project (SCEPA)
- Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) Program
- Climate Technology Initiative Private Financing Advisory Network (CTI PFAN)
- Sustainable Communities Leadership Academy (SCLA)
- US DOE Federal Energy Management Program (FEMP)
- [view all @](#)
- [Add a Program](#)

### 94 Tools

- Interruption Cost Estimate Calculator
- BITES
- Energy Storage Computational Tool
- River Hydrokinetic Resource Atlas
- Smart Grid Computational Tool
- [view all @](#)
- [Add a Tool](#)

### 9,019 Energy Organizations

- BLM
- A1 Sun, Inc.
- Resolute Marine Energy Inc
- SolarAMP LLC
- SolarAire LLC
- [view all @](#)
- [Add an Organization](#)

### 4,478 Clean Energy Companies

- A1 Sun, Inc.
- Resolute Marine Energy Inc



## Utility Portal

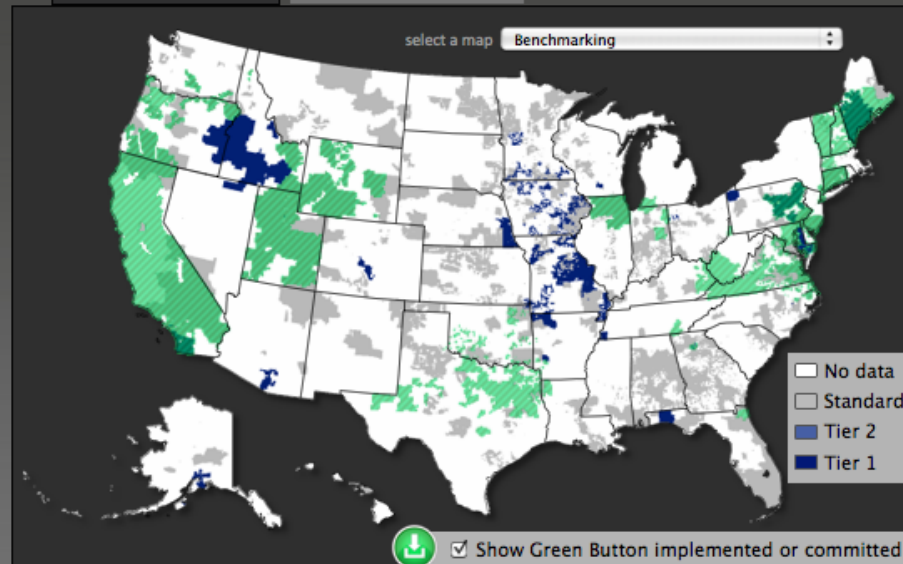
- U.S. Utility Rate Database
- Utility Access Map – Surveying utility connections to consumers and data access
- Green Button Data Collection

### Utility Data Access Map

Having access to your electricity use data is a very important step in understanding your overall energy usage. Comparing historical data to your current usage is one way to see trends and determine ways for reducing electricity costs and improving overall efficiency. We asked all U.S. electric utility companies to tell us how accessible their electricity use data is for both residential and commercial customers. The results are updated live based on the responses we have to date. As more utilities provide information, the utility boundaries will be automatically colored and the overall map will become more complete. Try searching for your utility company to see your electricity data access options. [Read more...](#)

Residential Customers

Commercial Customers



### State summary information

California

Green Button implemented or committed

- ☐ PacifiCorp
- ☐ Pacific Gas & Electric Co
- ☒ San Diego Gas & Electric Co
- ☐ Southern California Edison Co
- ☒ City of Anaheim, California (California)
- ☐ City of Banning, California
- ☐ City of Burbank Water and Power, California

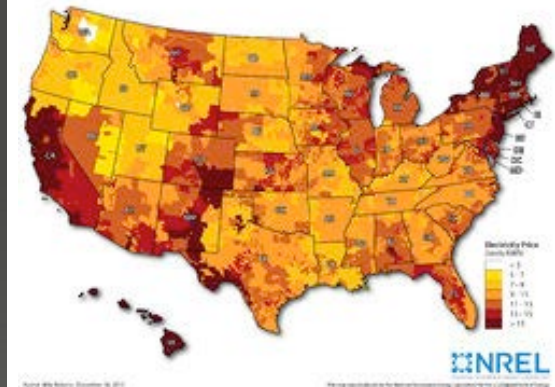
### What do these colors represent?

#### Residential benchmarking

Benchmarking is the practice of comparing how efficiently a building is using energy, compared to its own previous use, to similar buildings, or to both. This data must be available going back 13 months in an electronic format, and in the case of multi-meter buildings, aggregated building data must be available.

Standard Access ☐

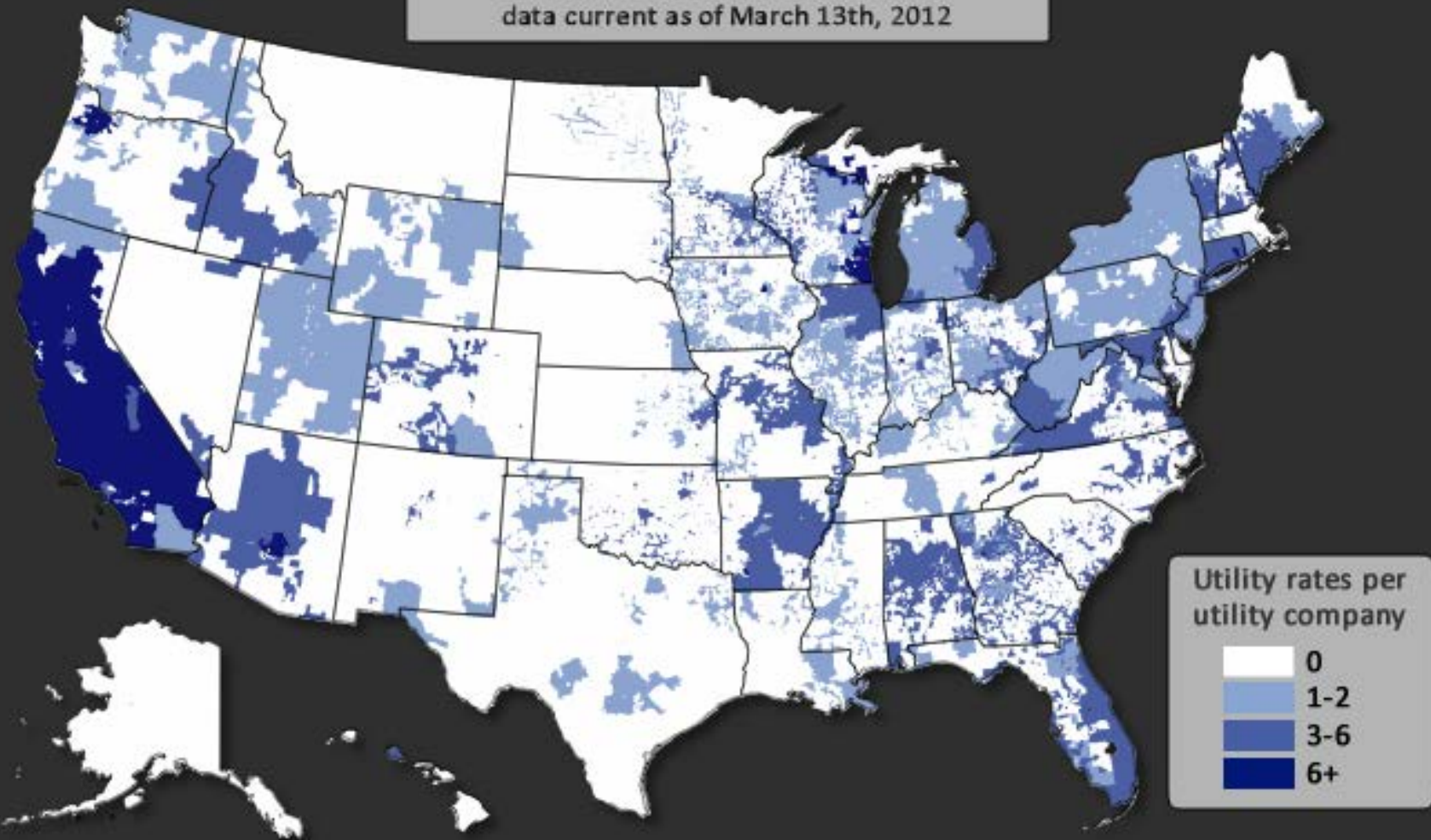
Customers have account-level access to their monthly data.



**Green Button  
Download  
My Data®**

## Utility rate coverage on OpenEI

data current as of March 13th, 2012



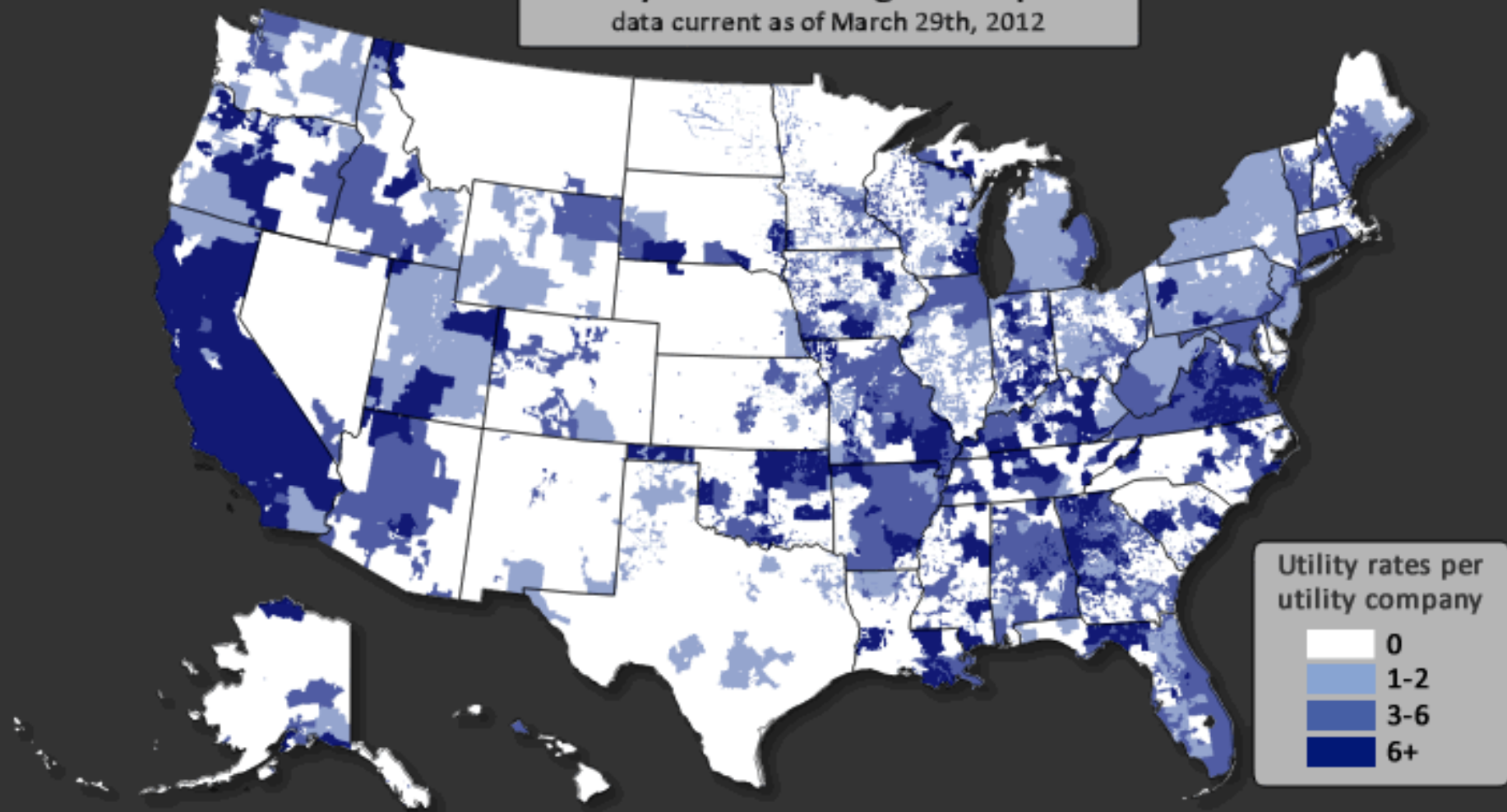
OpenEI | OPENENERGYINFO

Utility service territory boundaries sourced by Ventyx Energy Velocity Suite, © 2012.

Source: <http://en.openei.org/wiki/Gateway:Utilities>

## Utility rate coverage on OpenEI

data current as of March 29th, 2012



OpenEI | OPENENERGYINFO

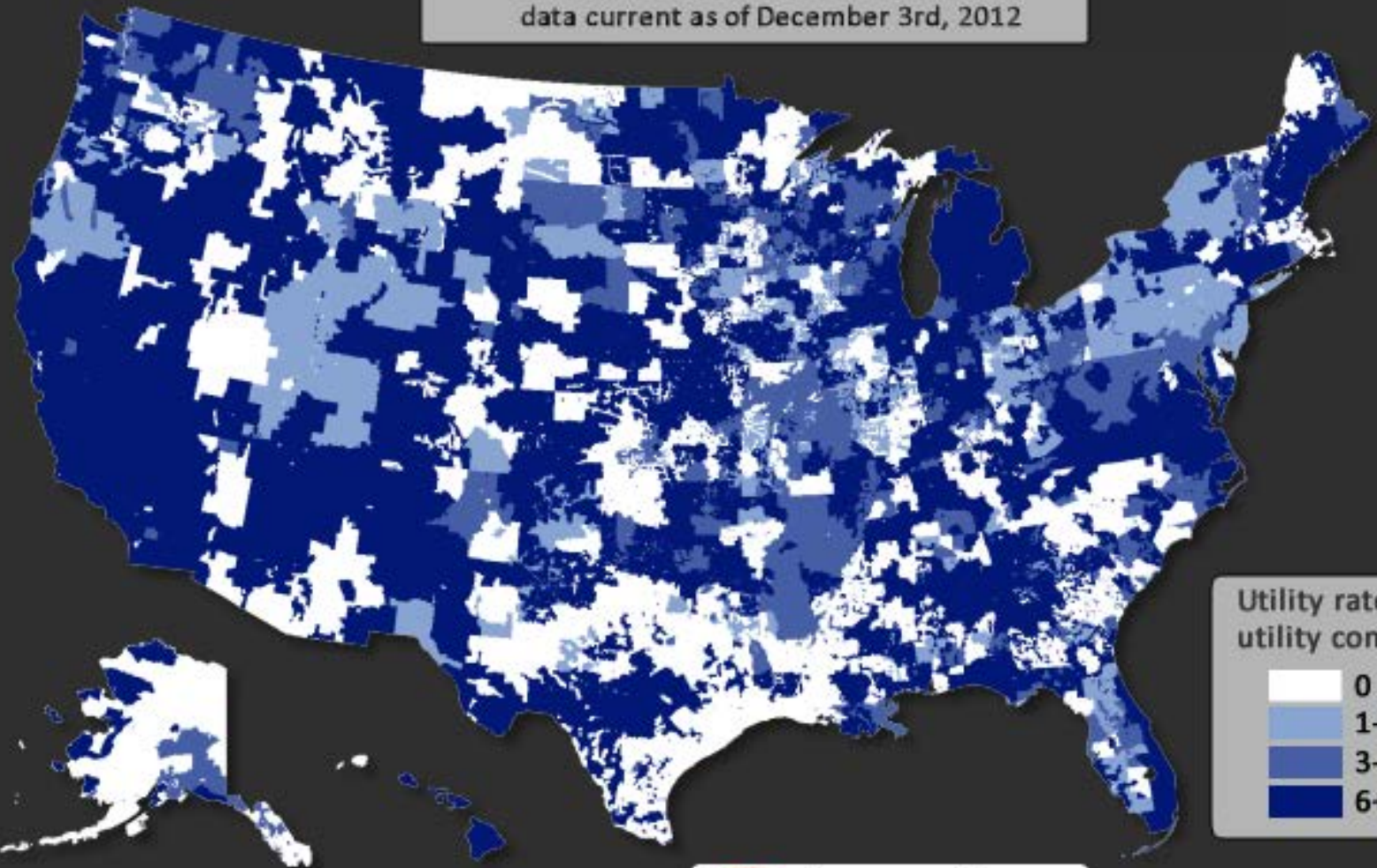
Utility service territory boundaries sourced by Ventyx Energy Velocity Suite, © 2012.

Source: <http://en.openei.org/wiki/Gateway:Utilities>



## Utility rate coverage on OpenEI

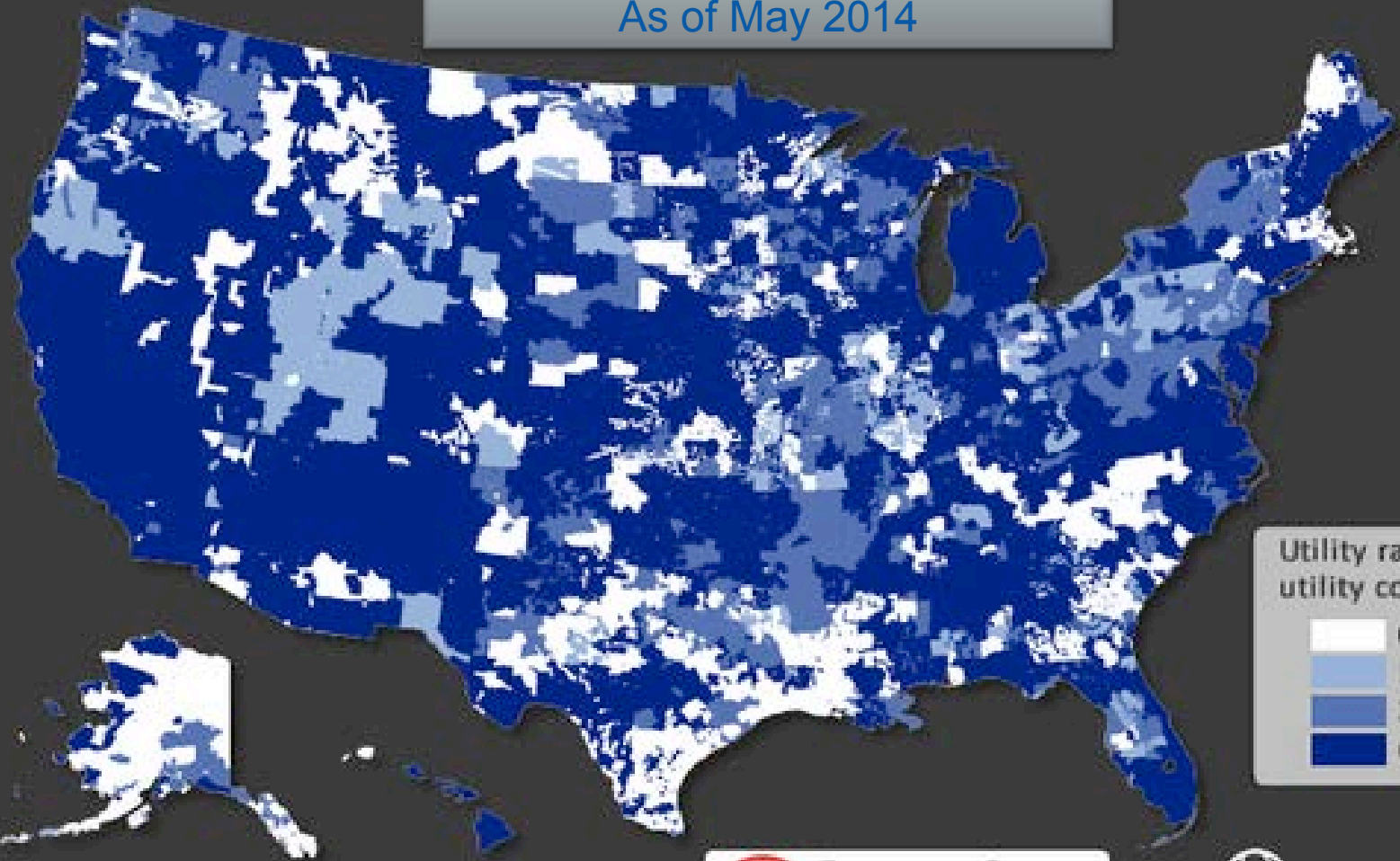
data current as of December 3rd, 2012



OpenEI | OPENENERGYINFO

Source: <http://en.openei.org/wiki/Gateway:Utilities>

Utility Rate Database Coverage  
As of May 2014



As of May 2014, over 43,000 utility rates

Source: <http://en.openei.org/wiki/Gateway:Utilities>

# SmartGrid.gov Portal Page

[What is the Smart Grid?](#)[Recovery Act Smart Grid Programs](#)[Federal Smart Grid Initiatives](#)[Smart Grid Resource Center](#)



[Home](#) | [About](#) | [News](#) | [Glossary](#) | [Contact](#)

SmartGrid.gov is the gateway to information on federal initiatives that support the development of the technologies, policies and projects transforming the electric power industry.



## What is the Smart Grid?

Information for Consumers



## Recovery Act Smart Grid Programs

Program Progress and Results



## Federal Smart Grid Initiatives

Policies and Programs



## Smart Grid Resource Center

Reports and Documents

### BUILDING THE 21ST CENTURY GRID



#### Smart Grid Savings and Grid Integration of Renewables in Idaho

Idaho Power Company (IPC) serves customers in southern Idaho and eastern Oregon. IPC is vertically-integrated, manages power generation, transmission, distribution, and demand-side resources. Faced with grid modernization challenges from new wind power capacity, rising summer peak demands, and aging electricity delivery infrastructure, IPC's SGIG project covers all aspects of its electric operations.

[GO TO STORY >](#)[SEE MORE >](#)



### NEWS

**April 15, 2014**  
Cybersecurity for Energy Delivery Systems (CEDS) Research Call

**January 16, 2014**  
Energy Department Launches Competition to Spur Creation of Innovative Energy Apps Built with Open Data

**November 5, 2013**  
NIST Seeks Public Input on Updated Smart Grid Cybersecurity Guidelines

**October 24, 2013**  
FTC to Hold Free Workshop: Internet of Things – Privacy and Security in a Connected World

[SEE MORE >](#)

[Sign up for SmartGrid.gov email updates >>](#)



### Green Button Gives Millions of Consumers Access to Electricity Usage Information



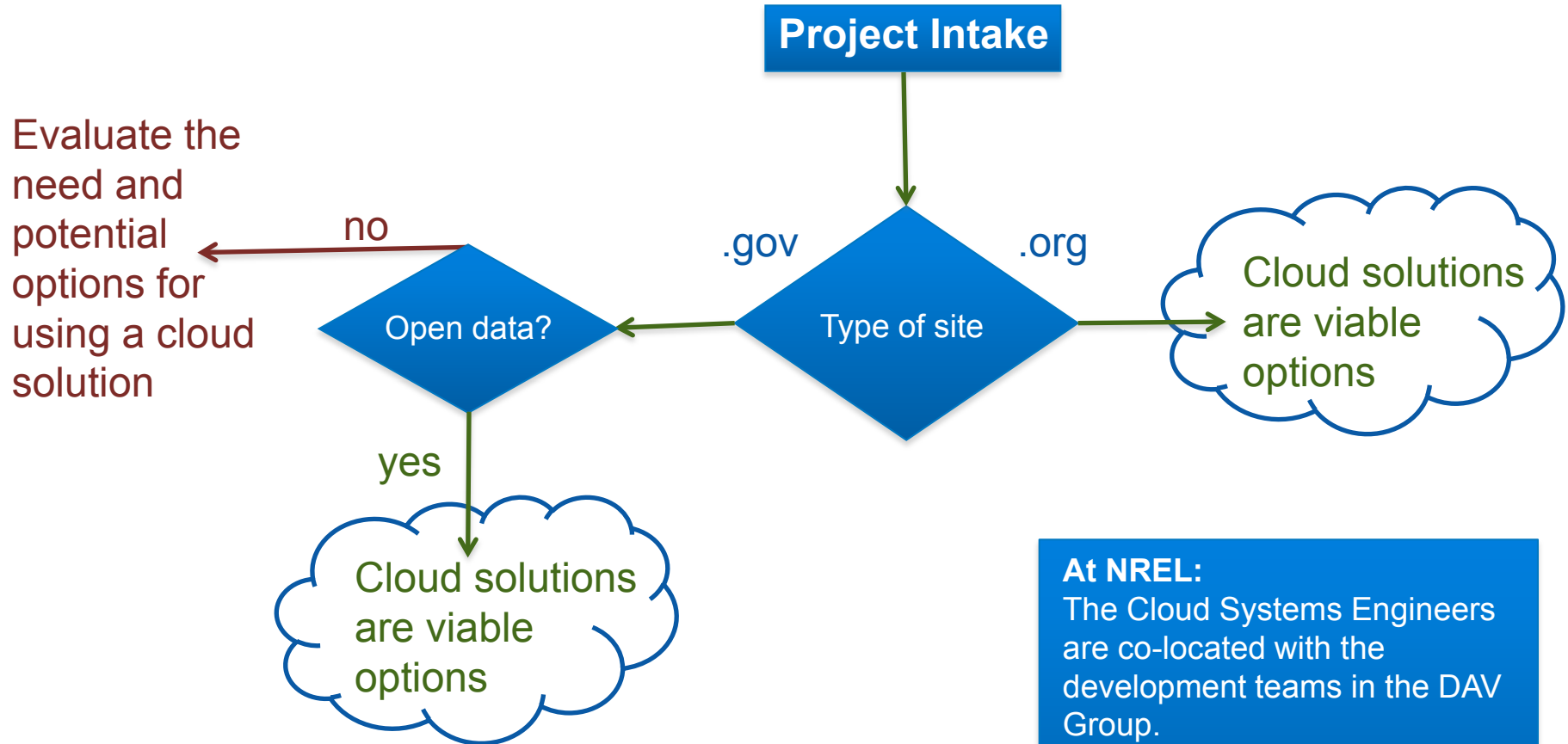
# Smart Grid ARRA Project Investments and Impacts



# Lessons Learned

- Think on the cutting edge and embrace new technologies and tools
- Create an organizational strategy
- Cloud solutions must be viewed as critical to the success of .org and .gov web platforms
- Utilize the external cloud for what it is good for and don't over complicate the integration with internal architecture
- Leverage investments in cloud solutions when possible (FedRAMP, AWS Products)
- ATO requirements add complexity
- Enable DevOps partnerships between developers and cloud system engineers
- Moderate-level data access solutions are needed

# Cloud Solution Process



## At NREL:

The Cloud Systems Engineers are co-located with the development teams in the DAV Group.

OCIO is a separate organization, but we work closely with them



# Strategy and Next Steps

Utilize the key benefits of the cloud to build scalable and accessible data solutions and platforms to enable open data sharing, API data connections, collaboration, and 24/7 uptime. Leverage the tools and inherent strengths that the cloud provides, while maintaining reliable, secure, scalable, and cost-effective government solutions.

## Next Steps:

Complete automation and monitoring tasks for the current ATO environment

Based on a DOE program need – Develop an ATO environment to house moderate data and provide access to DOE and other National Labs in an easy to access format

Enable a “turn key” process for getting other web sites and platforms on the cloud

Create an organization-approved cloud strategy

Tackle the big/complex data issues – affordable storage with quick access for analysis