Energy Informatics Panel

May 17, 2012

World Renewable Energy Forum

Moderator: Bobi Garrett
National Renewable Energy Laboratory
Sr. Vice President – Outreach Planning and Analysis

NREL/PR-6A20-54678
Consumer Empowerment with Information

World Renewable Energy Forum
May 17, 2012
The Cloud Computing platform for Energy Internet

• Backed by leading European and US Venture Capital
• 35+ utility and ‘smart’ product providers (in regulated and competitive markets)
• 200+ Employees
• Headquartered in Boulder, Colorado (with offices in Boston, Melbourne, Australia, and San Francisco)

Multiple awards and recognitions, including:
Connecting Four Communities

One Platform. Every Connection.

- A cloud based platform for open, secure and scalable consumer engagement
- An integrated series of connected devices, applications and services for all users of the Energy Internet
- Agnostics to network, device and application
Tendril and The Green Button

Three commitments:

1. **Utilities**: Green Button functionality native within the Connect Platform

2. **Developers**: Green Button API’s for third-party applications

3. **Consumers**: A strong first experience through GreenButtonConnect.com
Start developing for the Energy Internet with Tendril Connect™ APIs
Create unique applications that monitor and control user data and devices

Get Started

Reasons to use Tendril Connect™ APIs

Connect with the Energy Internet.
Gain first-time access to the Energy Internet, the world’s largest marketplace. We’ve innovated an industry, so you can innovate the world.

Documentation
Access API documentation; test API calls with sample data

Community
Join discussions about our API, ask questions, and get answers

Blog
Follow the latest news, learn about upcoming events, and find out about new releases

Applications
Manage your Tendril applications
Interval Data

/connect/greenbutton

Returns historical cost and consumption metering data in the Green Button format.

This API is subject to change. The specification is still in DRAFT state. The goal: Enable consumers to download their detailed energy usage with the simple click of a “Green Button.” The concept: Inspired by successes in getting Americans their own health care data, but developed by the energy industry in a consensus process that may be adopted voluntarily. Builds on policy objectives in the Obama Administration’s Blueprint For a Secure Energy Future and Policy Framework for the 21st Century Grid to ensure that consumers have timely access to their own energy data in consumer-friendly and computer-friendly formats.

Note: Values listed in the Response descriptions are subject to change and may not be available in the final Green Button specification.

GET

Returns to the consumer their home's energy cost and consumption.

Request


GET  Reset  andrew.wood@tendril.com:password  JSON
Smarter ways to use your energy.

Understanding your energy data is one upload away.

It's your energy information. Get the most from it with a visit to the Green Button App Gallery.

Green Button apps help you understand how you're using energy today, find new ways to save, and participate in your energy community.

Get Started

Upload your energy information.
Easily upload information about your energy usage and costs. Get your Green Button file from your utility, then drag and drop it here.

Find valuable applications.
Once you've uploaded your information, get the most from it by visiting the Green Button App Gallery.

Live smarter, lowering your energy cost.
Get in the habit of using energy efficiently, and save money. There are several simple practices that can make a big difference.

A powerful platform for developers.
Create game-changing applications powered by energy and device data. Learn More

©2012 Tendril. All rights reserved.
www.GreenButtonConnect.com
dev.tendrilinc.com
Geospatial Energy Informatics

Dan Getman
WREF 2012
Geospatial Energy Informatics

- **Resource Information**
  - Generation and acquisition of spatial datasets that describe energy resources

- **Geospatial Analysis**
  - The process of deriving actionable information from energy resource datasets

- **Information Technology**
  - Providing access to data and analysis through visualization and data services

- **Decision Making**
  - Development of applications that utilize these data, visualizations, and services to empower decision making
Resource Data Estimation and Visualization
Resource Data Access
Decision Making: Residential PV
Decision Making: Residential PV
Decision Making: Residential PV

In My Backyard - National Renewable Energy Laboratory (NREL)

Solar Simulation Results

Reduced Load Profile

- System Output
- Load Profile

Load

Now compare your estimated solar electricity production with your electricity consumption.

Step 1. Select a load profile.

You may select a sample profile or upload your own custom load profile.

(A) Use a sample load profile.

Choose a city from the drop-down box below.

Sample Profile: Denver

or

(B) Upload a load profile.

Click the Upload File button below. Then browse to locate your load profile document.

For help click here.

Step 2. Run load profile

Using sample load for Denver

Step 3. Estimate your production.

Additional Options

View Duration Curve

Export Results Close
Decision Making: PV Performance
Decision Making: PV Performance
Decision Making: PV Adoption
Data and Analysis Services

The analysis available in IMBY, PVDAQ, OpenPV, Biopower Atlas and other applications is also available as API based services that provide the same data and analytical results.

Industry is actively using these to develop their own applications

All of these services are being made available through developer.nrel.gov
Data and Analysis Services

The analysis available in IMBY, PVDAQ, OpenPV, Biopower Atlas and other applications is also available as API based services that provide the same data and analytical results.

Industry is actively using these to develop their own applications.

All of these services are being made available through developer.nrel.gov.
Data and Analysis Services

Visualizations in applications are based on data obtained from service responses
Data and Analysis Services

It is just as easy to access these data and analysis services through Excel and scripting.
World Renewable Energy Forum
May 17, 2012

Debbie Brodt-Giles

Turning Data into Energy Informatics
Importance of Data

• Data is driving our innovation and our future
• Global, Regional, Local, Campus data – all are important!

My Goal:
– Provide a brief overview of NREL’s Energy Data and Informatics Activities
– Spark your interest to learn more!
Energy datasets on OpenEI

Openei.org

Energy Information, Data, and other Resources

Energy Expenditures and Renewable Energy Consumption in the US: Visualizing Trends with a Motion Chart

Renewable energy trends per state

Total renewable energy trends per state

Colorado: Energy Resources

Energy Production by Technology in Colorado

News Articles

- OpenEI News Feature on NREL News
- U.S. Secretary General tells NREL Clean Energy a Top Priority
- Vice President Joe Biden’s visit to NREL
- Explore what’s new on OpenEI
- Running the numbers: OpenEI can help you weigh the costs versus the benefits of making your home green

70 Energy Incentives (Active)

- Colorado incentives for both residential and commercial energy efficiency and renewable energy projects
- 0 Energy Incentives (Inactive)

11 News Articles

- National Solar Radiation Data Base
- National Solar Radiation Data Base (NSRDB)
- The NSRDB is the most comprehensive collection of solar radiation data available
- The 1991–2005 NSRDB contains hourly solar radiation data

National Solar Radiation Data Base

The National Solar Radiation Data Base (NSRDB) is the most comprehensive collection of solar radiation data available. The 1991–2005 NSRDB contains hourly solar radiation data.

Energy Technology Cost and Performance Data

This data indicates the range of recent cost estimates for renewable energy and cost estimates are shown in dollars per installed kilowatts of generating capacity.

Commercial Building Profiles

This dataset includes simulation results from a national-scale study of the commercial buildings sector. Electric load profiles contain the hour-by-hour demand for electricity.

Electric Power Monthly – Monthly Data Tables

Monthly electricity generation figures (and the fuel consumed to produce it). Source information available at EIA.

Low temperature Direct Use Geothermal Facilities

Contains generating capacity information for low temperature direct use geothermal facilities by state.

NOAA Borehole Data


National Biorefineries Database

This phase of the project began with the development of a geodatabase with the focus predominantly on ethanol. The task involved collection of data on ethanol production locations.

Energy Production by Technology in Colorado

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Value (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Power</td>
<td>16,530</td>
</tr>
<tr>
<td>Wind Power</td>
<td>2,042,133</td>
</tr>
<tr>
<td>Geothermal Power</td>
<td>0</td>
</tr>
<tr>
<td>Biomass Power</td>
<td>50,528</td>
</tr>
<tr>
<td>Total Energy Production from Non-Hydro Renewables</td>
<td>3,059,191 MWh</td>
</tr>
<tr>
<td>Hydro Power</td>
<td>2,058,215</td>
</tr>
<tr>
<td>IPP Power</td>
<td>101,818</td>
</tr>
<tr>
<td>Total Energy Production from Renewables</td>
<td>3,073,900 MWh</td>
</tr>
</tbody>
</table>

13 News Articles

- OpenEI News Feature on NREL News
- U.S. Secretary General tells NREL Clean Energy a Top Priority
- Vice President Joe Biden’s visit to NREL
- Explore what’s new on OpenEI
- Running the numbers: OpenEI can help you weigh the costs versus the benefits of making your home green

70 Energy Incentives (Active)

- Colorado incentives for both residential and commercial energy efficiency and renewable energy projects
- 0 Energy Incentives (Inactive)
Crowdsourcing Success

More than 3,000 Utility Rates Covering 80+% of the country!
Utility Access Map Highlighting Data Connectivity

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...

What do these colors represent?

Time period

This map shows customers' access to 13 months worth of historical data. Color coding indicates varying levels of access to historical data.

- Light gray signifies that only the previous month's data is available.
- Medium blue indicates that data for the past 13 months is available.
- Dark blue indicates that data since the last bill is available, as well as data for the past 13 months.
Green Button Apps – Providing Energy Use Data to Consumers
Connecting to the World and Federating with Data.gov
• Smart Grid Data Hub manages data from the 132 ARRA funded Smart Grid Projects
  – Equipment and Expenses
  – Impacts and Benefits
  – Consumer Behavior Study Data
• Consumer Behavior Data will be coming October 2012
• Live data updates, analyses, tabular complete data views – all focusing on accessibility and transparency!
Breakdown of Technologies Installed

Customer Systems Installed To-Date

- Programmable Thermostats: 180,375
- Direct Load Control Devices: 215,610
- Energy Management Systems: 455
- In Home Displays: 6,736
- Other Customer Systems*: 4,591
- Smart Appliances: 153

Enrollments vs Access Over Time 1

Customer Systems - Web Portals

<table>
<thead>
<tr>
<th></th>
<th>September 2010</th>
<th>December 2010</th>
<th>March 2011</th>
<th>June 2011</th>
<th>September 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Count</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrolled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Other Customer Systems include premises with multiple customer systems, electric vehicle supply equipment, and commercial and industrial controllable air conditioning systems.
NREL’s Campus Energy Informatics Initiative

- Campus energy meters
  - 80 meters at 1-5 second interval readings
  - PV, Plugs, Mechanical, Elevators, Data Center sub-meters
  - Real/Apparent/Reactive Power in all three phases + Energy
- Primary weather sensors (12 streams at 3 second interval readings)
  - Temp, Humidity, Irradiance, Wind speed/direction
- Building Automation System (~1000 Variable interval readings)
  - Temp, Humidity, CO2, Lighting, HVAC, Heating/Cooling
Client Application – BuildingAgent

• Provide user with:
  – Messages from building
  – Ability to report comfort
  – LEED Survey

• User logs in with NREL credentials

• Majority of application functionality is through web API (i.e. questions, plots, etc)
BuildingAgent Local Data Collection

- Client software pushes occupant feedback and local measurements to server
- Temperature, Humidity, and Lighting Levels

Credit: Marj Schott / NREL
Web Application

- Manages users, meters, data, and APIs for client application data
Whole Campus View
Single Building Views and End Use Views
Heat Maps
3D Orbit of Buildings and Walkthrus with Energy Data