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Knowledge is (less) Power: Exploring the Google PowerMeter API

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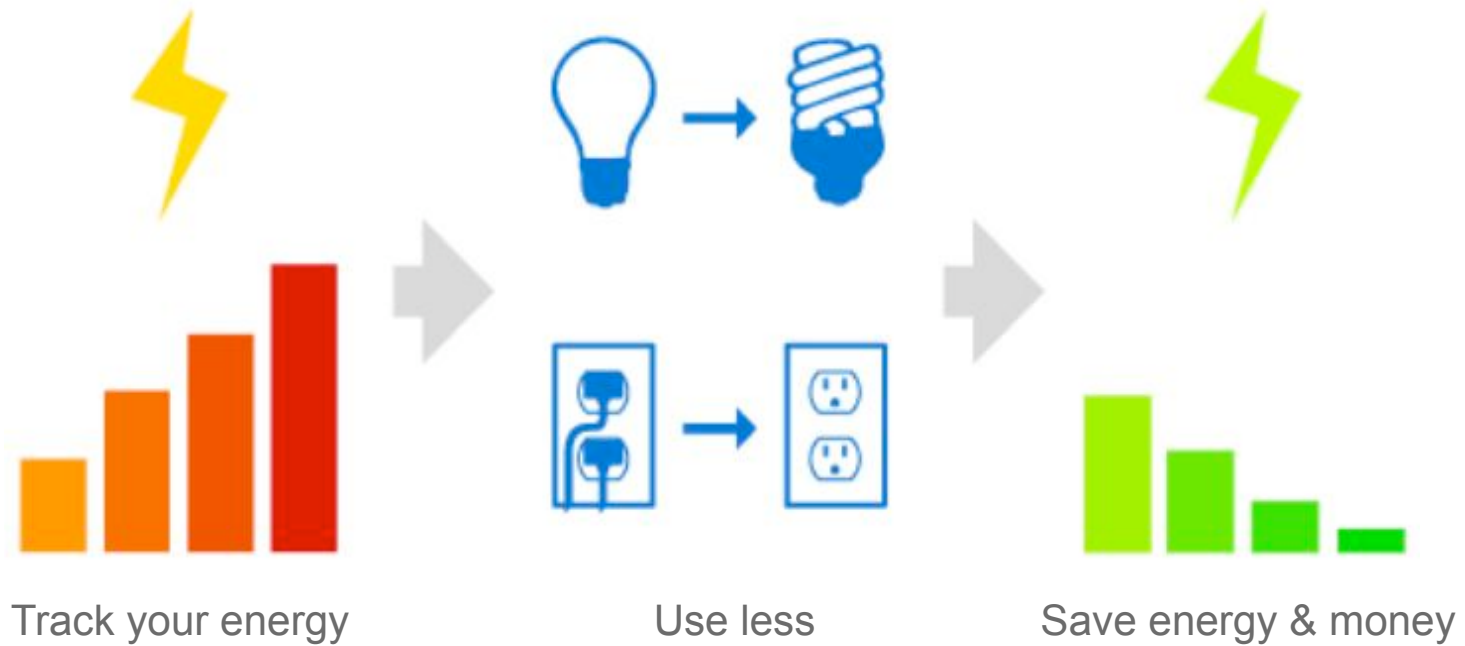
Agenda

- What is Google PowerMeter
- Design Concepts
- Using the API
- Q&A

What is Google PowerMeter?

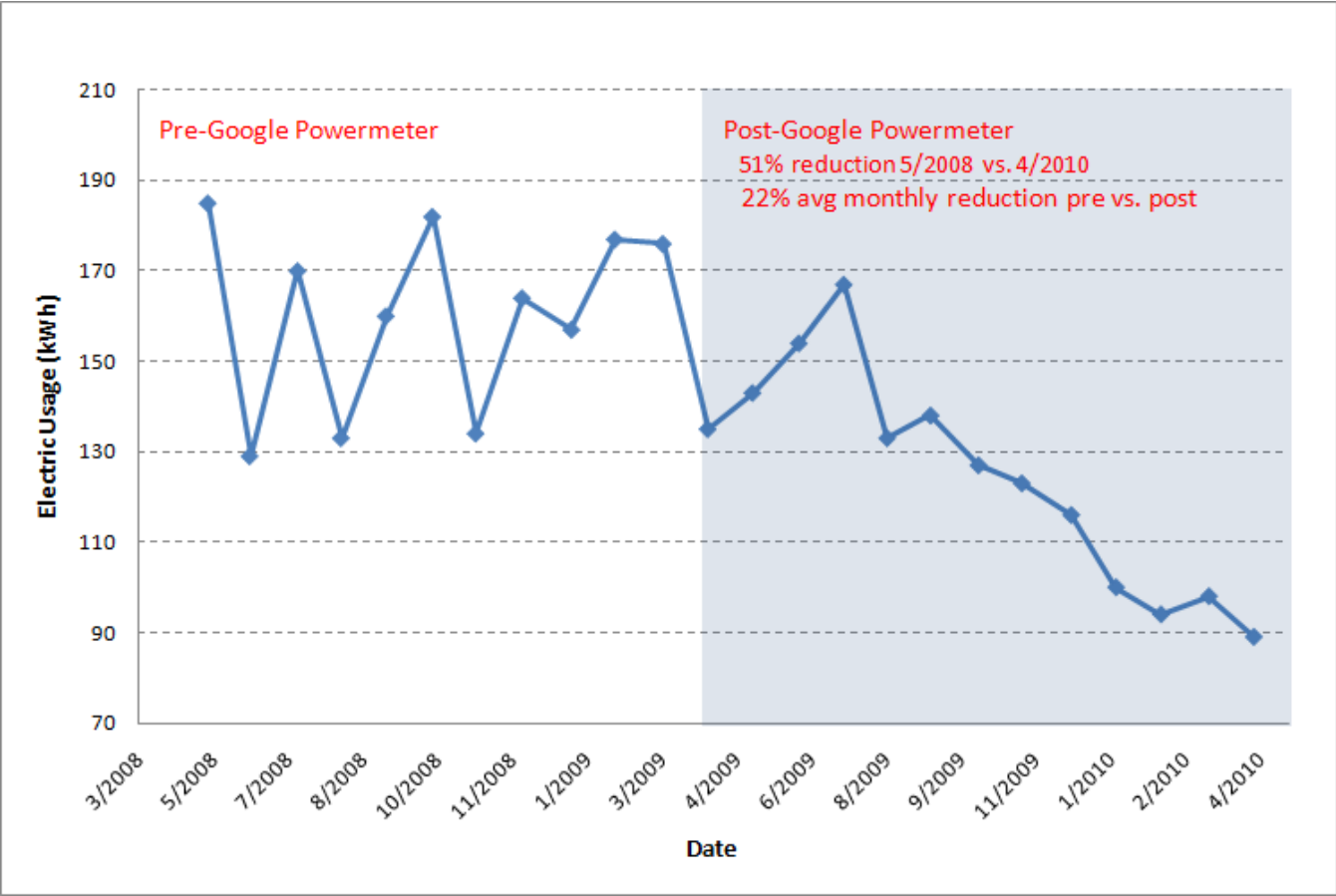


What is Google PowerMeter?

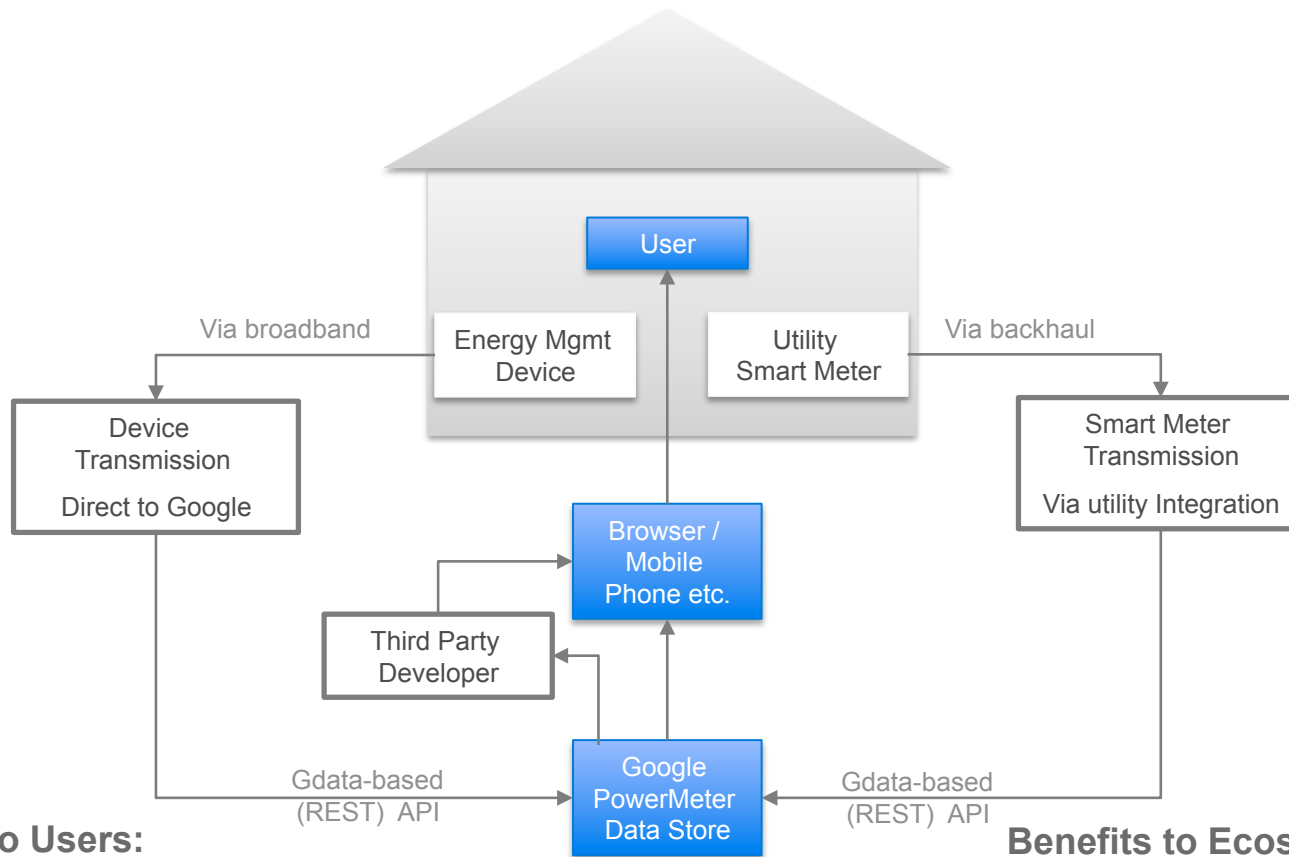


- See your home's energy consumption anywhere online
- A project of Google.org

Google PowerMeter – Awareness drives Action



How Google PowerMeter Works



Benefits to Users:

- Near real-time feedback
- Understand your impact
- Lower electricity bills

Benefits to Ecosystem:

- Accelerate smartgrid deployment
- Platform to expose devices
- Drive innovation towards active management

Making Users Aware

Track energy over time
See how much energy you have used by the day, week or month.

Always on power
The darker shaded portion of the graph shows power that is always on, such as any appliance that goes on standby mode. Many appliances are always on; you just don't know it. Discovering these is one of the easiest and fastest ways to reduce energy use and save money.

Customize your experience
Add your estimated cost per kWh, sign up for weekly emails, and share your usage with family and friends.

Join the community
Get tips on how to save from other Google PowerMeter users and share what has worked for you.

Have a question?
Learn more about Google PowerMeter from our online help center.

Predict your costs
Google PowerMeter helps you predict your annual energy bill that you can start making changes and saving early.

Budget Tracker
Set an energy savings goal for yourself and track your progress.

Google PowerMeter: Energy User's Home

Electricity used Sep 30-Oct 1

Day [Week](#) [Month](#)

electricity in KW

12a 6a 12p 6p 12a 6a 12p 6p 12a

← Previous day

Wednesday Sep 30 7.4 kWh used Approx. \$485/year ? Always on: 3.9 kWh used	Thursday Oct 1 3.2 kWh used Approx. \$223/year ? Always on: 1.8 kWh used
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Compared to past usage

6% under Thursday's energy budget ?

night	morning	3.2 kWh used	8.6 kWh expected
night	morning	afternoon	evening

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Design Concepts



Design Principles

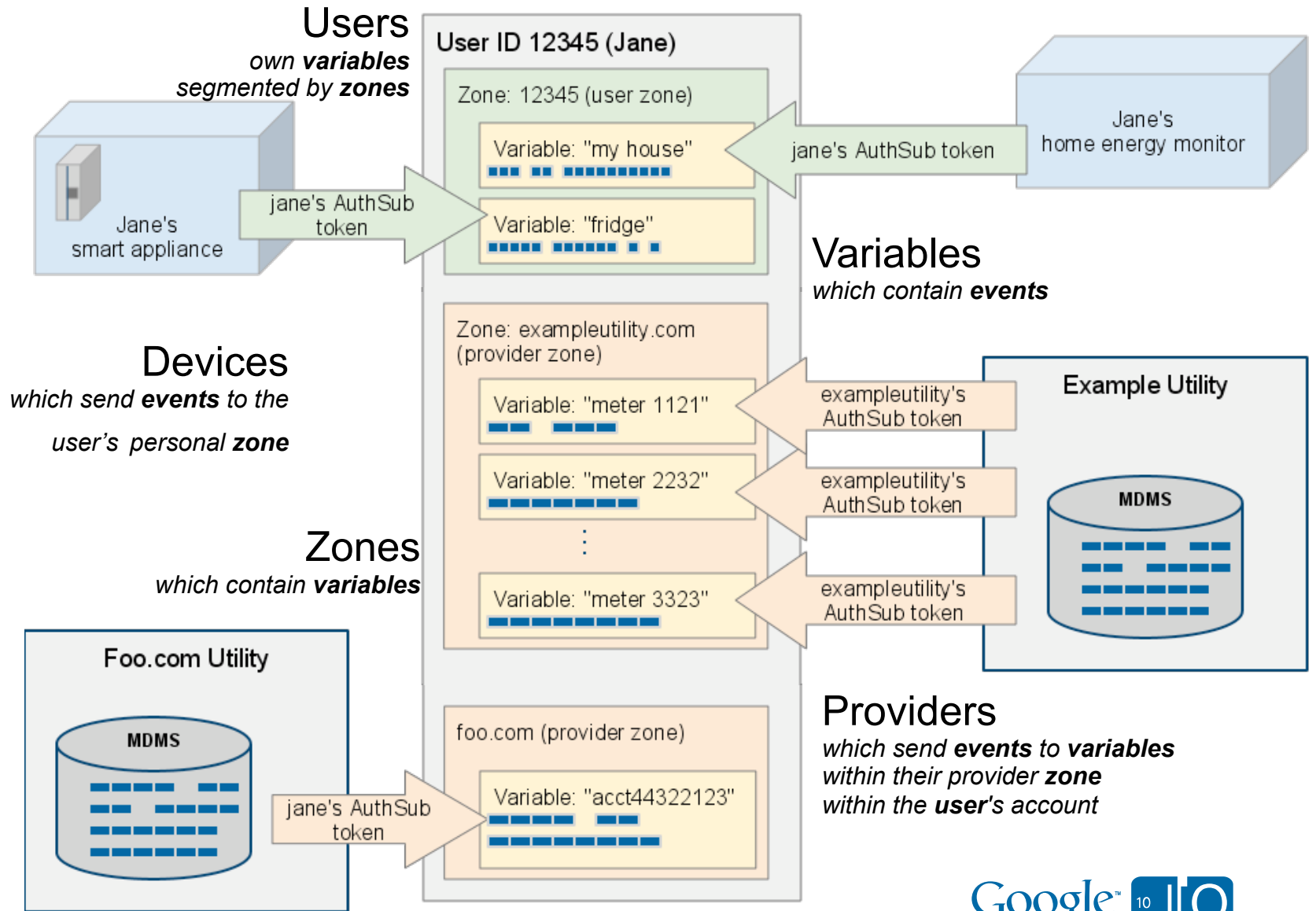
- Flexibility
 - Many variables, many sources
 - Random access too all measurements and metadata
 - Highly available service
- Privacy and Data Ownership
 - Explicit consent / full control on data (dataliberation.org)
 - Authentication and auditing
 - Data isolation

You can always get back anything you put in.

Design Principles

- Security
 - API is secured with AuthSub, no exceptions
 - Providers and users have Google accounts
 - Clients use permanent (revocable) AuthSub tokens
 - OAuth support on roadmap
- Personally identifying information
 - Users have an anonymized PowerMeter-specific obfuscated ID
 - Providers receives only obfuscated ID for user on authorization
 - No real names, account numbers, street addresses, etc.

PowerMeter Storage Model



Using the Google PowerMeter API



Google PowerMeter API: Overview

API for users & devices (zone is user ID)

URI Purpose	URI (after https://www.google.com/powermeter/feeds)
user entry	<i>/user/12345</i>
variable feed	<i>/user/12345/12345/variable</i>
variable entry	<i>/user/12345/12345/variable/v1</i>
instantaneous measurement feed	<i>/user/12345/12345/variable/v1/instMeasurement/2009-01-01T15:13:00.000Z</i>
variable entry	<i>/user/12345/12345/variable/v2</i>
durational measurement feed	<i>/user/12345/12345/variable/v2/durMeasurement/2009-01-01T15:13:00.000Z</i>

API for providers (zone is provider domain)

URI Purpose	URI (after https://www.google.com/powermeter/feeds)
user entry	<i>/user/12345</i>
variable feed	<i>/user/12345/exampleutility.com/variable</i>
variable entry	<i>/user/12345/exampleutility.com/variable/v1</i>
instantaneous measurement feed	<i>/user/12345/exampleutility.com/variable/v1/instMeasurement/2009-01-01T15:13:00.000Z</i>
variable entry	<i>/user/12345/exampleutility.com/variable/v2</i>
durational measurement feed	<i>/user/12345/exampleutility.com/variable/v2/durMeasurement/2009-01-01T15:13:00.000Z</i>

Activation

- Activation / Authorization
 - Secure activation handshake to transfer AuthToken
 - Explicit user opt-in necessary for activation
 - Separate handshakes for:
 - Provider enrollment
 - Device activation
 - App delegation (coming soon)

Abuse

- Throttling
 - Providers and devices must stay under our maximum resolution and frequency (6 measurements per hour)
 - Applications (coming soon) must make reasonable efforts to defer computation
- Storage quota
 - Years of data per user

We want to handle all legitimate energy usage data



Sending Data into PowerMeter

- Types of Feeds

- Accumulator reads (instMeasurement):

- ```
<entry><occurTime><value><isInitial></entry>
<entry><occurTime><value></entry>
<entry><occurTime><value></entry>
```

- Interval reads (durMeasurement):

- ```
<entry><startTime><endTime><value><entry>  
<entry><startTime><endTime><value><entry>  
<entry><startTime><endTime><value><entry>
```

- Batch upload

- Meta-data (user feed, provider feed, variable feed)

- Coming soon: computations



Reading Data from PowerMeter

Read-only tokens

Allow users to authorize third party apps without giving away the farm

Token scopes

Restrict devices to only a subset of users' data

Data feeds

Offer access to the same raw data that the API received

Sample code

Reference code includes Python programs that demonstrate reading from the API

More to come

Future APIs will offer much more--- smoothing, analysis, charting, etc.



Examples and references

Check out

<http://code.google.com/apis/powermeter>

<http://www.google.org/powermeter/partners.html>

for more

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