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WattDepot: Open Source Software for Energy Data Collection and Analysis

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About Sensors

Software to collect data

- Interface to specific meters
- Store data in server via HTTP

Designed for flexibility

- Encapsulates vendor-specific code
- Any platform or language
- Just needs to output XML over HTTP

Current implementations

- TED 5000 home energy meter
- Veris power meters
- Modbus/TCP meters

About Servers

Central data repository

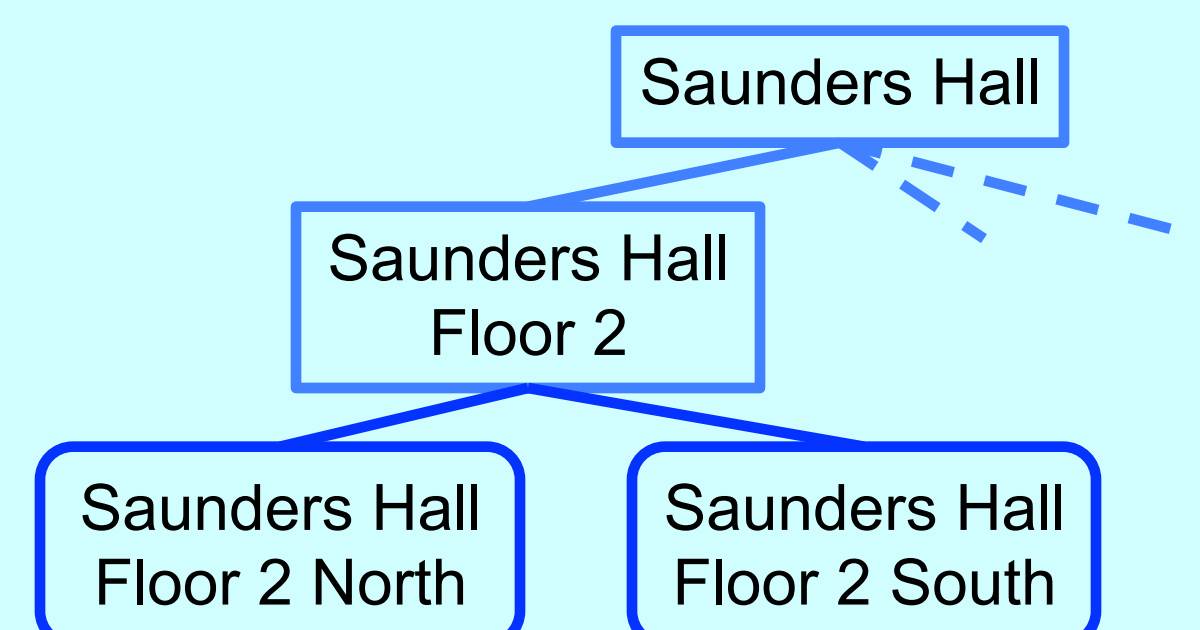
- RESTful HTTP API
- Pluggable back-end database
- Data represented as XML or JSON
- Devices represented as Sources

Server-side capabilities

- Simple carbon emission calculation
- Aggregation of sources (virtual sources)
- Data interpolation

Virtual sources and the timestamp problem

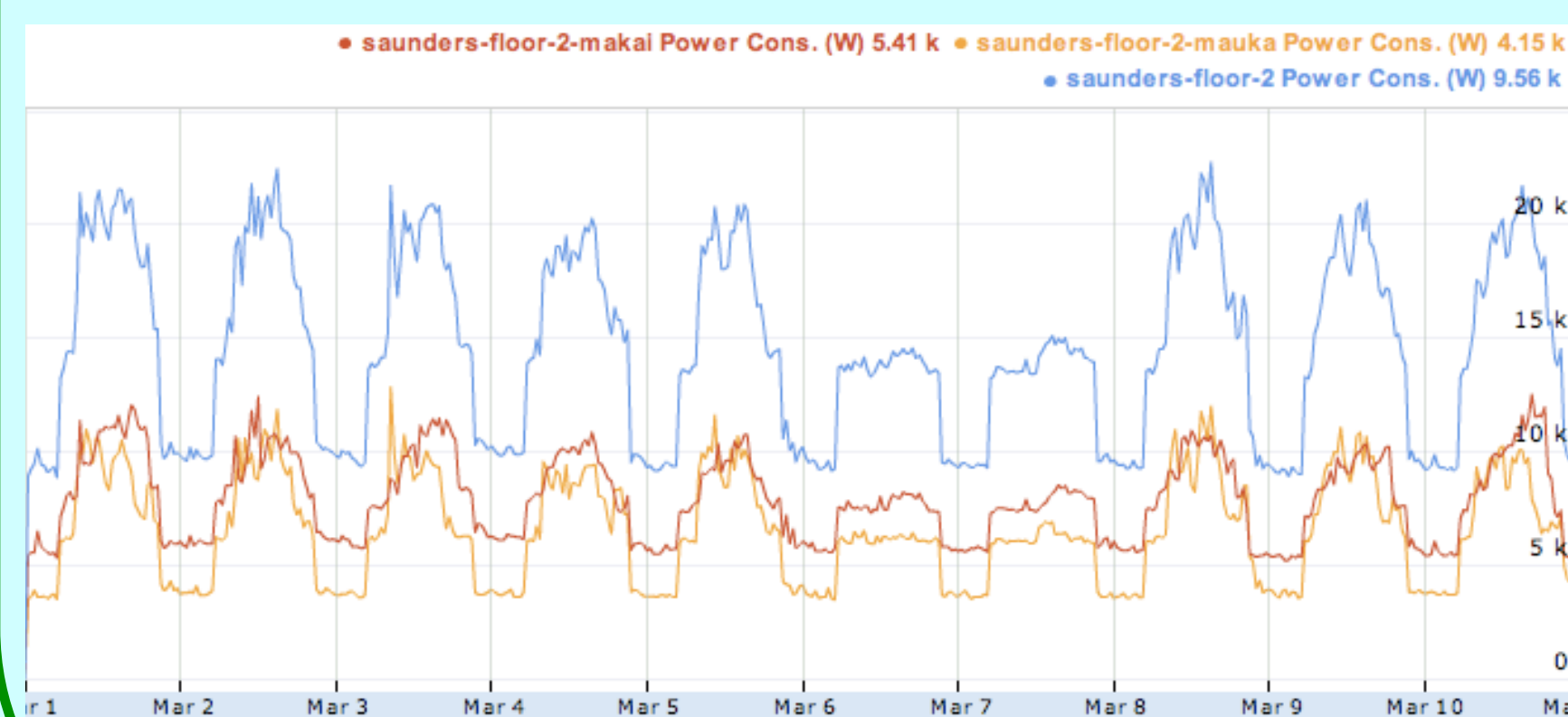
Virtual sources combine sub-sources



But meter clocks may not be synchronized

Date & Time	Saunders Floor 2 N	Saunders Floor 2 S
Mar 1, 2010 12:01:00 AM	5453 W	
Mar 1, 2010 12:01:02 AM		3562 W
Mar 1, 2010 12:15:00 AM	5500 W	
Mar 1, 2010 12:15:02 AM		3547 W

WattDepot performs linear interpolation between data points, solving timestamp problem



Motivation and Goals

WattDepot was created to collect & analyze energy data for the study of change in energy use behaviors

WattDepot Requirements

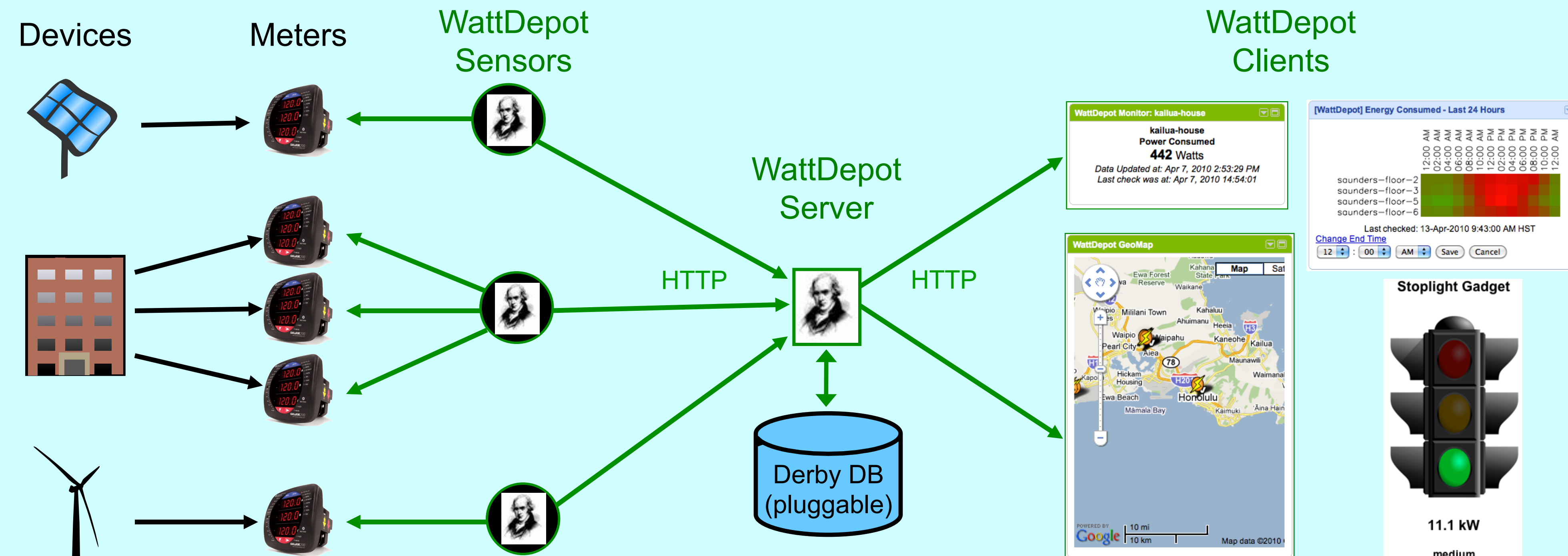
- Data collection from many meters ($1 < x < 100$)
- Sub-minute data collection
- Easy to simulate sensor data
- Internet-accessible repository
- Visualization variety & flexibility
- Open source

Need for WattDepot: Existing solutions did not meet requirements

Existing systems:

- TED 5000
Single household, software & hardware
- Google PowerMeter
Hosted, 15 minute intervals, single household
- PI 2010
Commercial, utility-grade, non-open source

Architecture



Applications

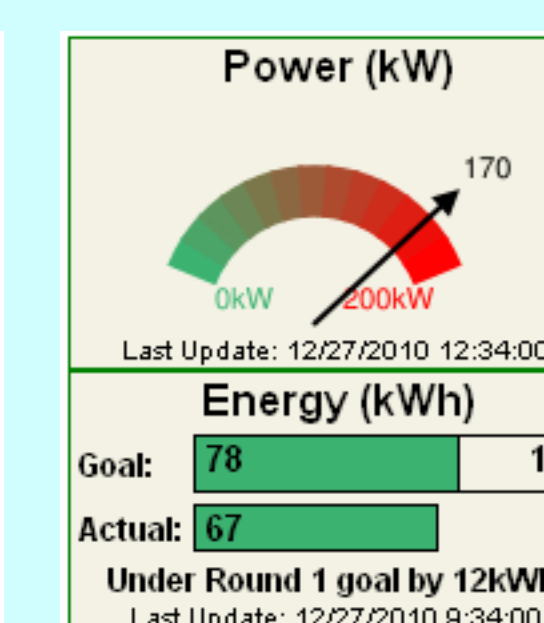
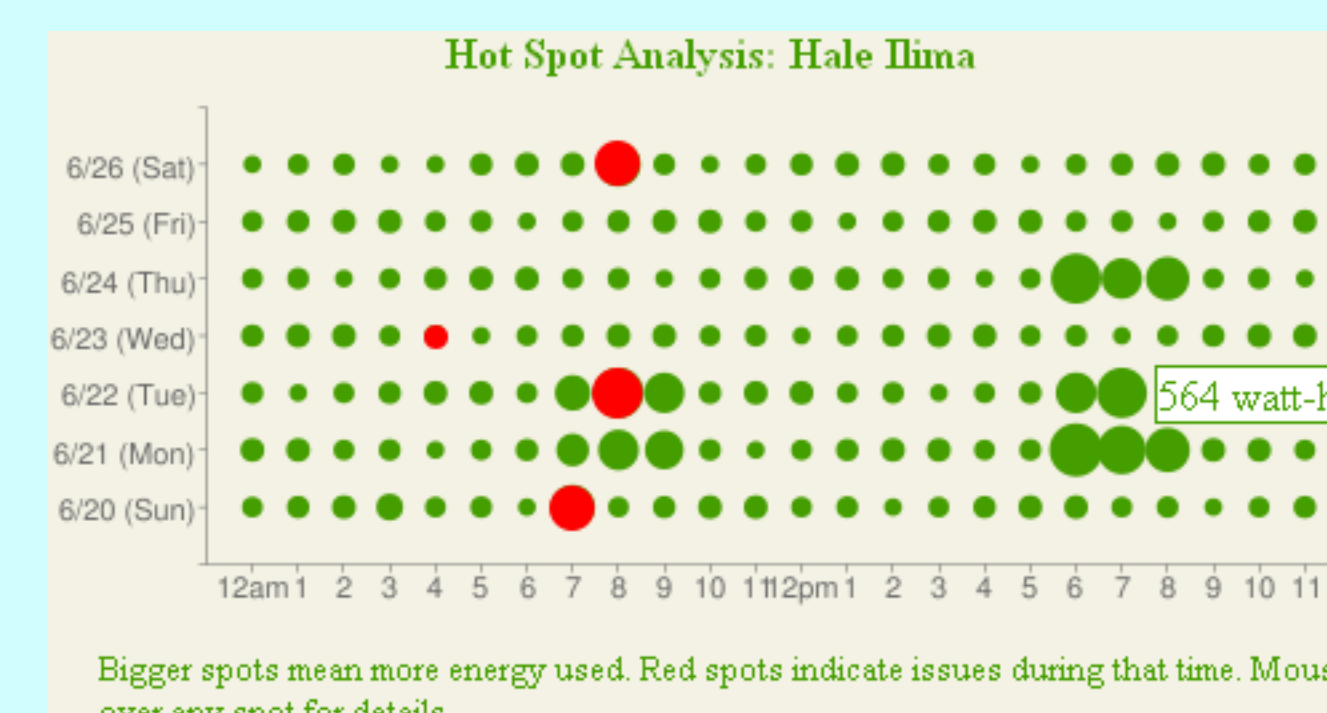
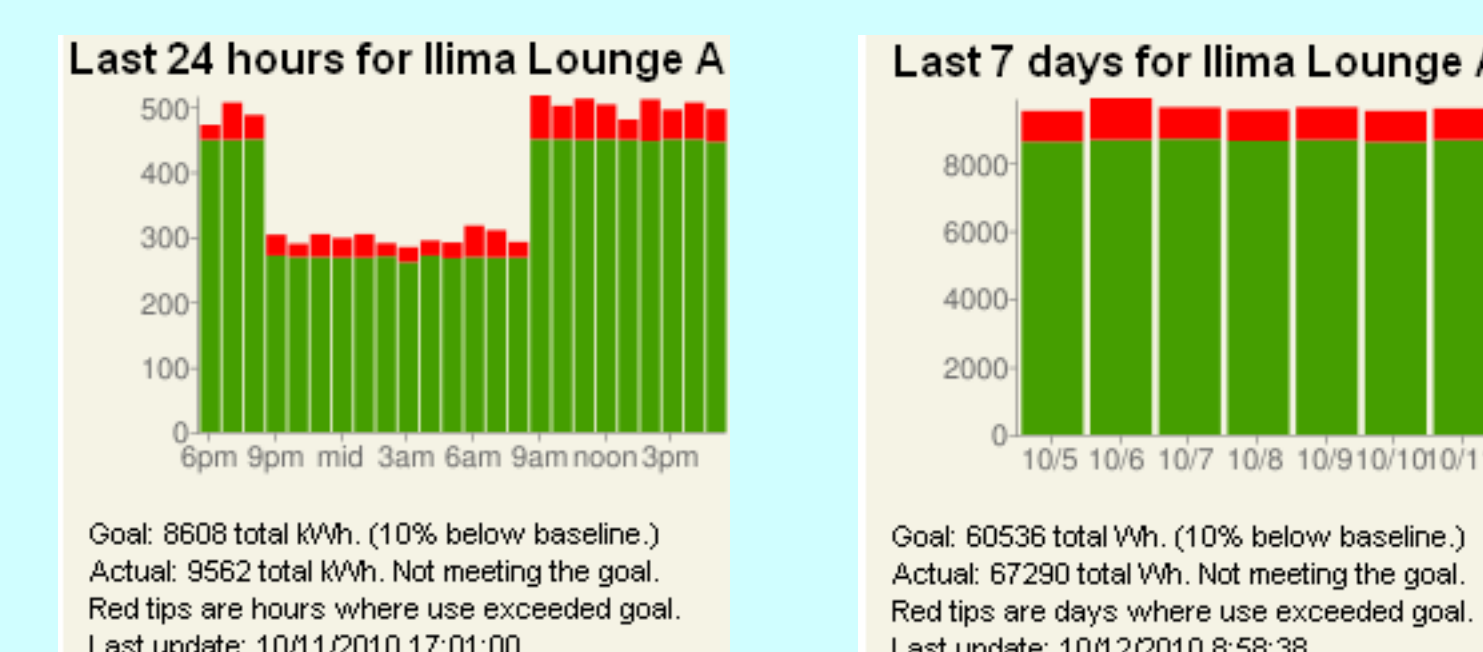
Kukui Cup Dorm Energy Competition

- Study of sustainable behavioral changes in energy use among college freshmen
- UH Mānoa campus in Fall 2011
- 30 floor-level energy meters
- Near-realtime data collection (10-15 s)
- ~780 participating residents
- Website provides variety of goal-based energy visualizations to participants
- Website hosts energy-related activities designed to improve energy literacy
- Participants earn Kukui Nut points

Other applications

- Tracking PV production on UHM campus
- Tracking 7000 utility customer's usage (University of Skövde)

Kukui Cup Visualizations

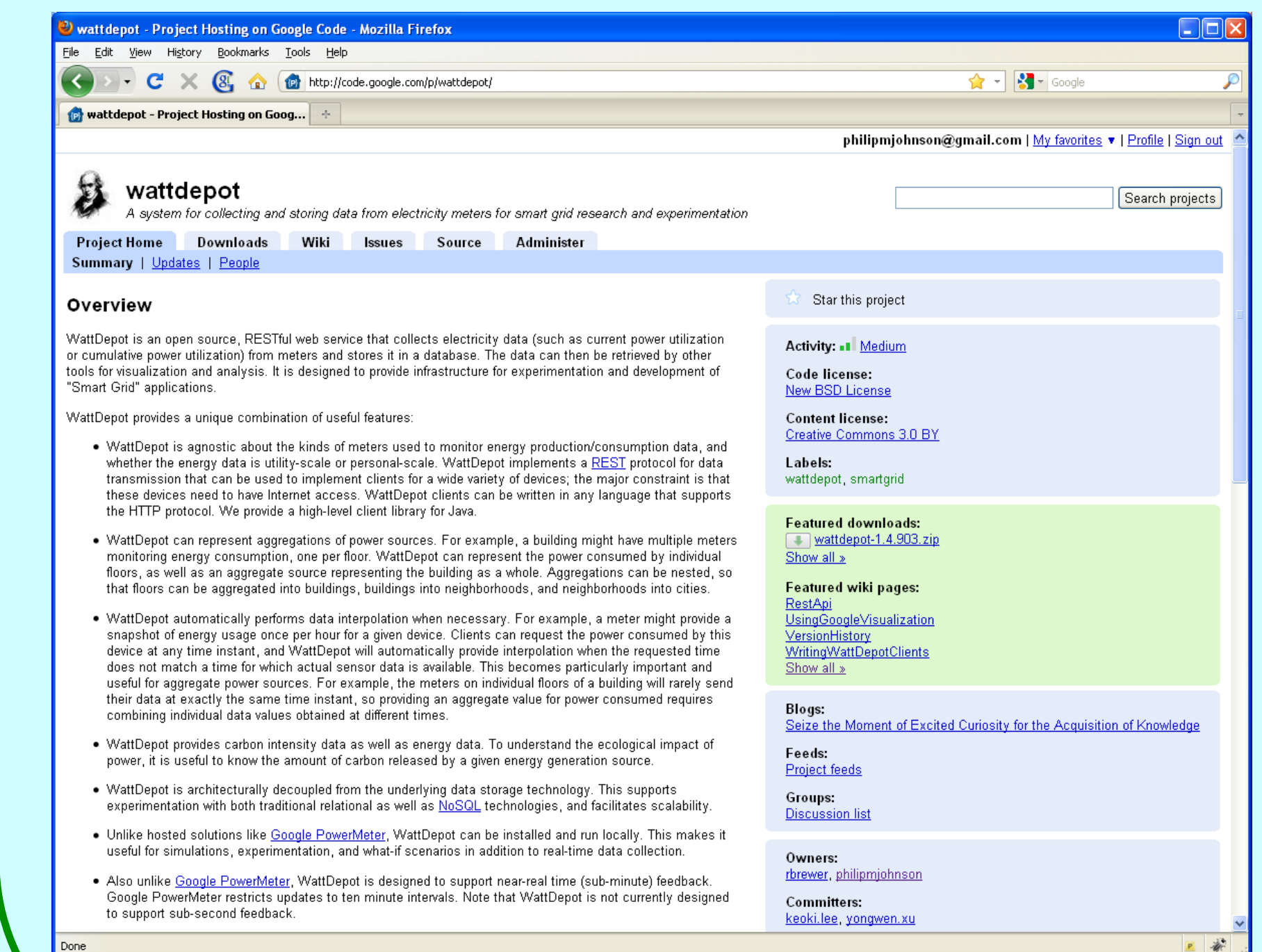


Getting the system

WattDepot is hosted at Google Code, available for download and modification:



<http://code.google.com/p/wattdepot/>



Future Directions

Privacy

- Sources are currently public or private
- Limited authentication support
- All current applications use public data
- Essential for single household data

Data aggregation

- Combining data from multiple sources
- Needed when comparing private data
- Can be performed in server

Sensors

- Support additional meters
- Particularly for renewable energy

Scalability

- High data rates untested in real-world
- Support for thousands of meters

Support

- Renewable Energy and Island Sustainability (REIS) Center, University of Hawai'i at Mānoa
- National Science Foundation grant IIS-1017126
- University of Hawai'i Office of Facilities Management