

Smart Meter Data Analytics

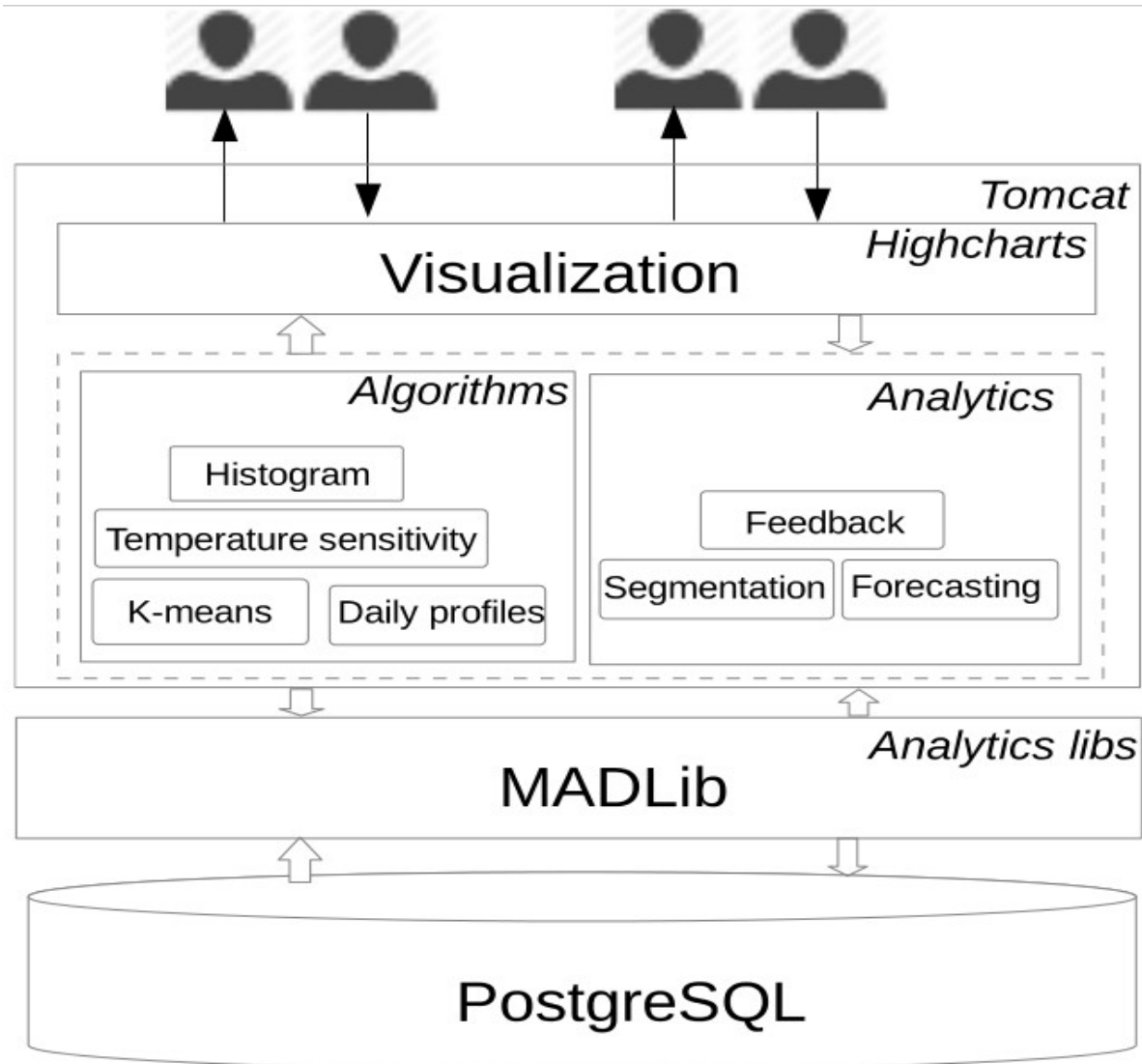
Xiufeng Liu

xiufeng.liu@uwaterloo.ca

University of Waterloo, Canada

The Smart Meter Data Analytics Project

System Architecture



Roles of the use

1. Utilities
2. Energy consultant
3. Energy consumers

Functionalities

- Energy consumption time series analytics
 - Time and location dimensions
 - Different angularities
- Segmentation analytics
 - Cluster customers with similar consumption patterns
 - Show on Google map

Functionalities

- Energy demand forecasting
- Pattern discovery
 - Load profiling
 - Load distribution
 - Load disaggregation
- Customer feedback
- Consumption comparison

Build Smart Meter Data Analytics System

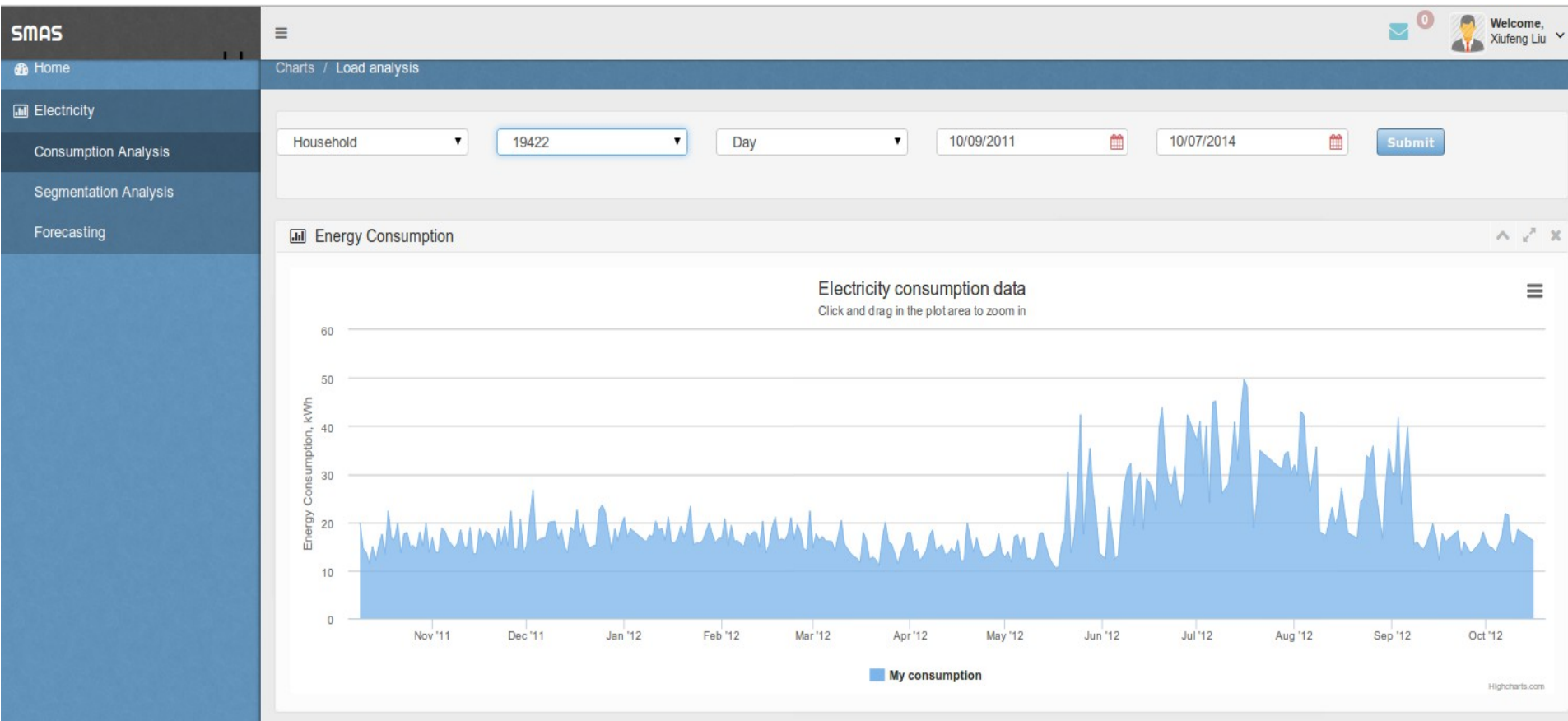
- The Prototype System – SMAS:
 - Roles of users: Utilities, energy consultants, and energy consumers
 - Integration with different analytic models
 - Functionalities: consumption time-series analysis, pattern discovery, customer segmentation, forecasting and customer feedback
 - Open source

Uses the System to Solve Real Problems

- Have 27,000 electricity time series from Essex Energy
- Have 25,000 water time series from Abbotsford, BC
- Have fine-grained data from 12 buildings on Waterloo University campus
- Refine the system based on real-life case studies

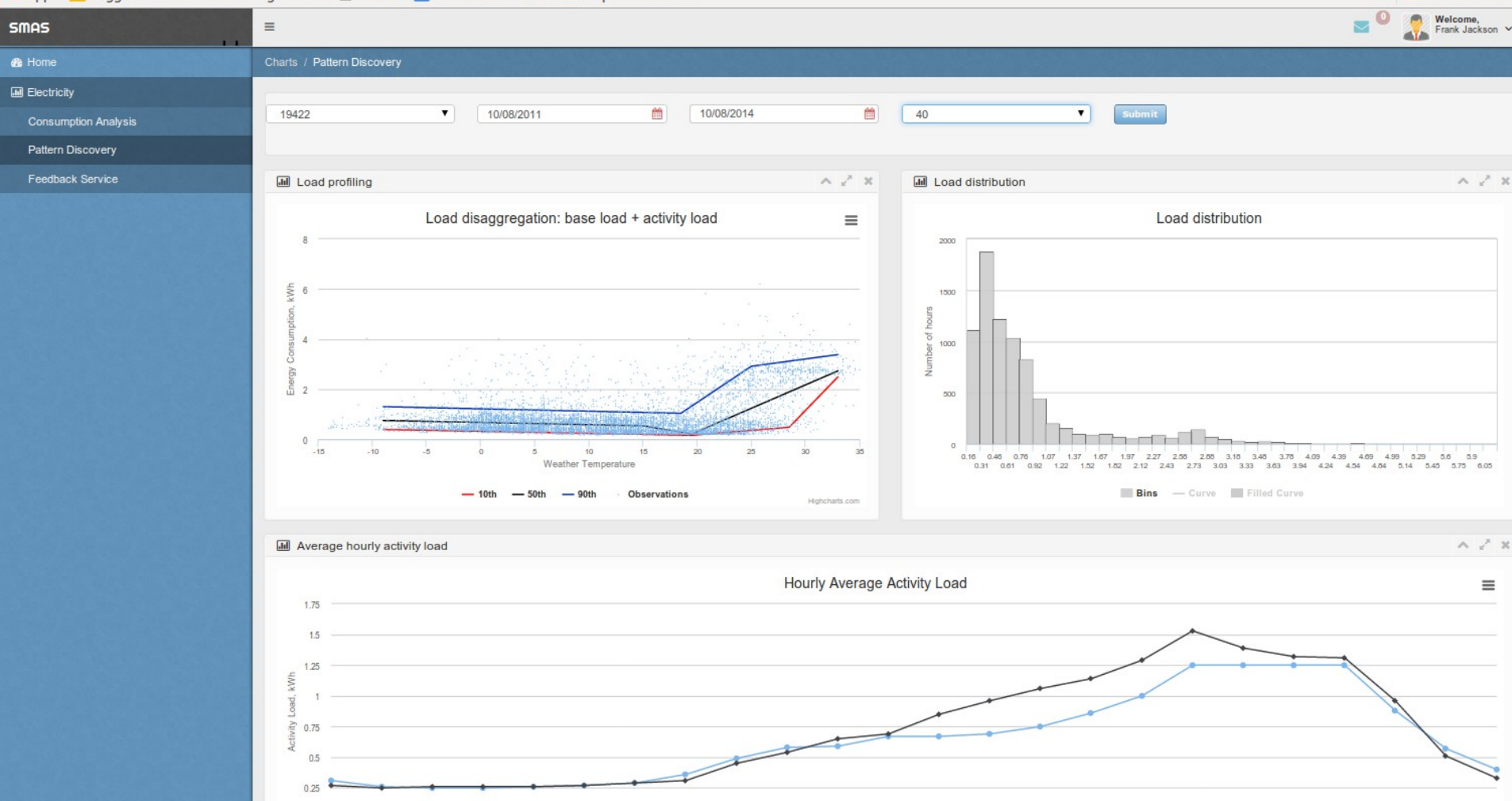
Smart Meter Data Analysis System (SMAS)

Consumption time-series analysis



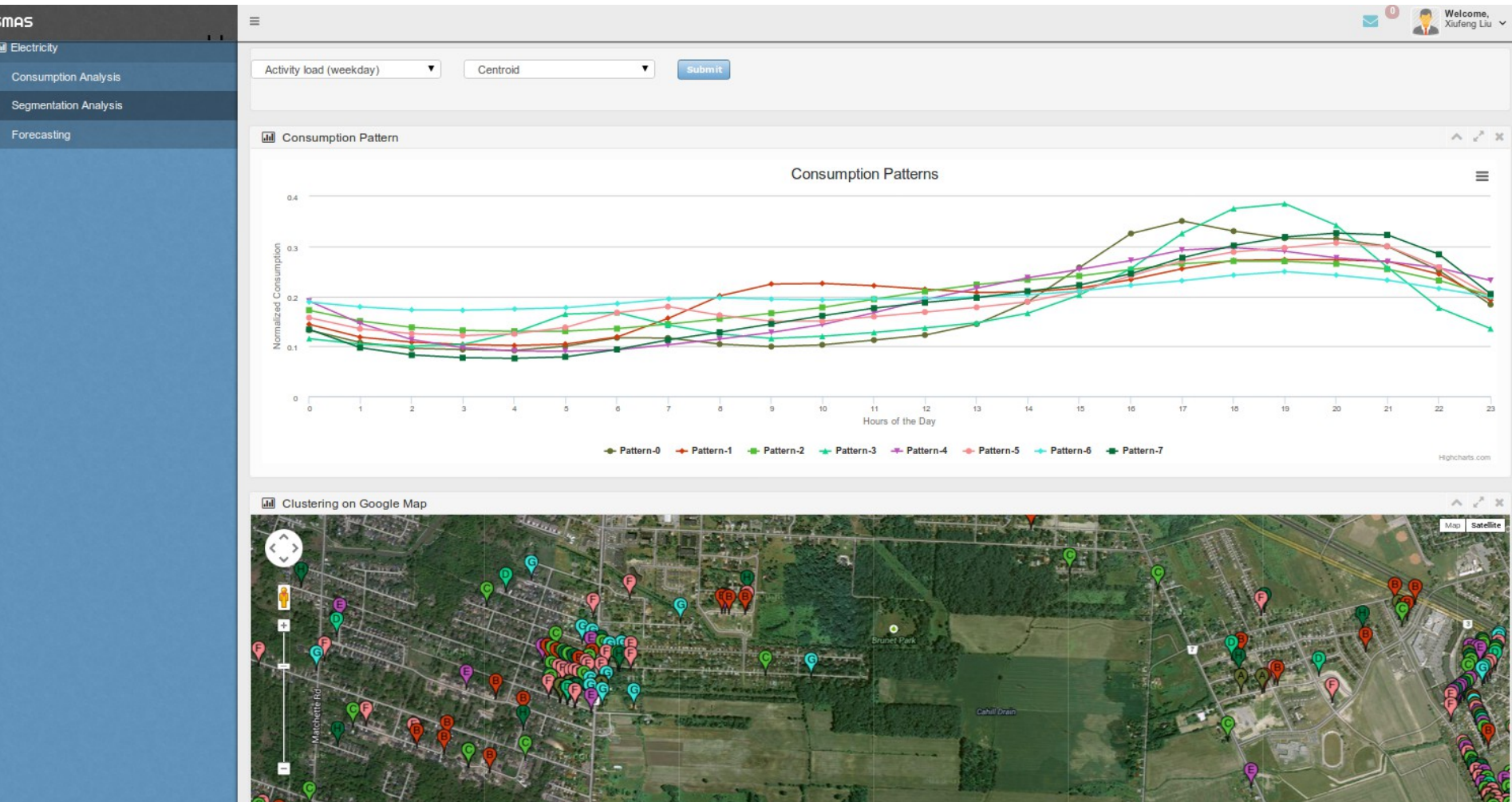
Smart Meter Data Analysis System (SMAS)

Consumption profiling



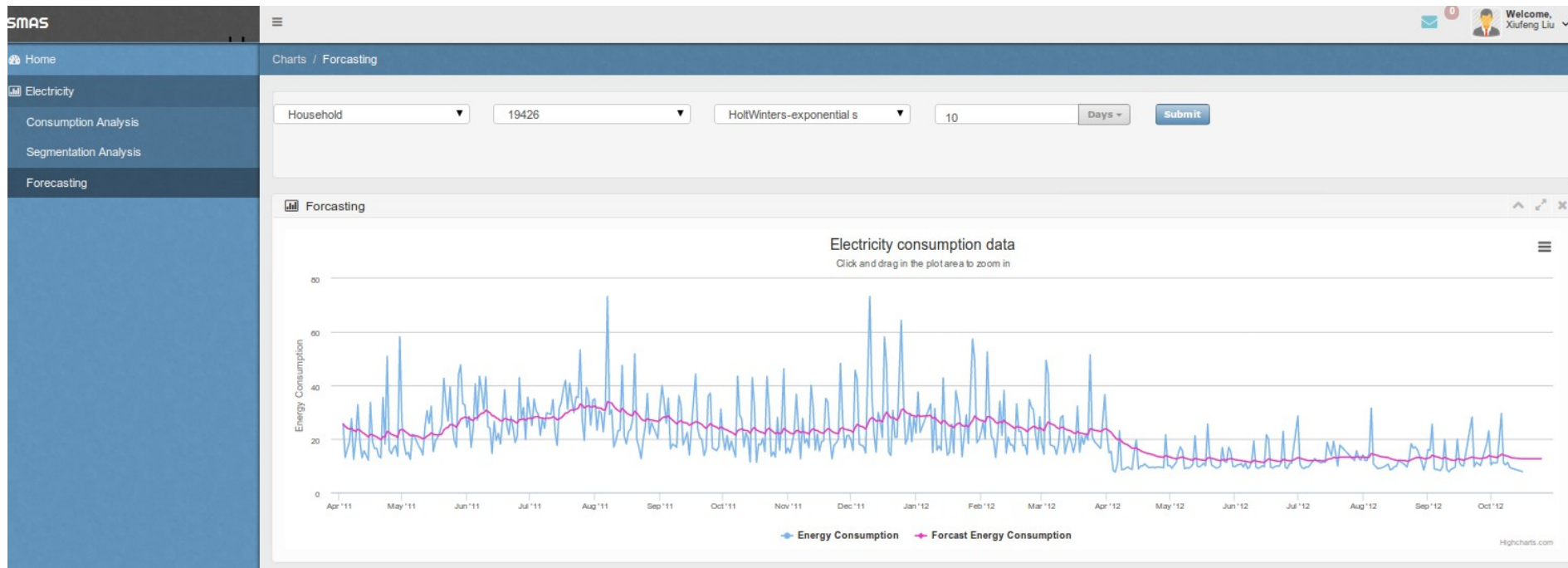
Smart Meter Data Analysis System (SMAS)

Consumption pattern discovery and customer segmentation



Smart Meter Data Analysis System (SMAS)

Demand forecasting



Smart Meter Data Analysis System (SMAS)

Customer feedback

SMAS

Home

Electricity

Consumption Analysis

Pattern Discovery

Feedback Service

Home / Charts / Feedback Service

Name: You nightly consumption is 20% higher than your neighbors

Feedback: When customer's consumption is ___% higher than the neighbors within ___ km during the hours between ___ and ___ o'clock

Param1: 20

Param2: 10

Param3: 18

Param4: 6

Receivers: None selected

Message: You are probably using a low efficient air condition, and please consider a replacement!

Schedule Start Time: Effective start time

Repeat Interval: Repeat interval (hours)

Save

Feedback services


#	Title	Rule	Receivers	Next start time	Repeat interval (hour)	Enable?	Action
219	You nightly consumption is 20% higher than your neighbors	When customer's consumption is 20% higher than the neighbors within 10 km during the hours between 18 and 6 o'clock	cust1,cust2,cust3,cust4	2014-09-27 07:00:00	23	ON <input checked="" type="checkbox"/>	Delete

Home / Feedback

Inbox (86)

Sent (0)

Trash (0)



Frank Jackson

Time: 2012-04-30 18:00:00.0 -- 2012-05-01 06:00:00.0
Your consumption: 15.07 kWh
The average consumption of your neighbors (within 10.0km): 11.53 kWh
Rank the 135th highest in 627 neighbours
The overall average consumption: 11.16 kWh
Rank the 175th highest in 909 customers

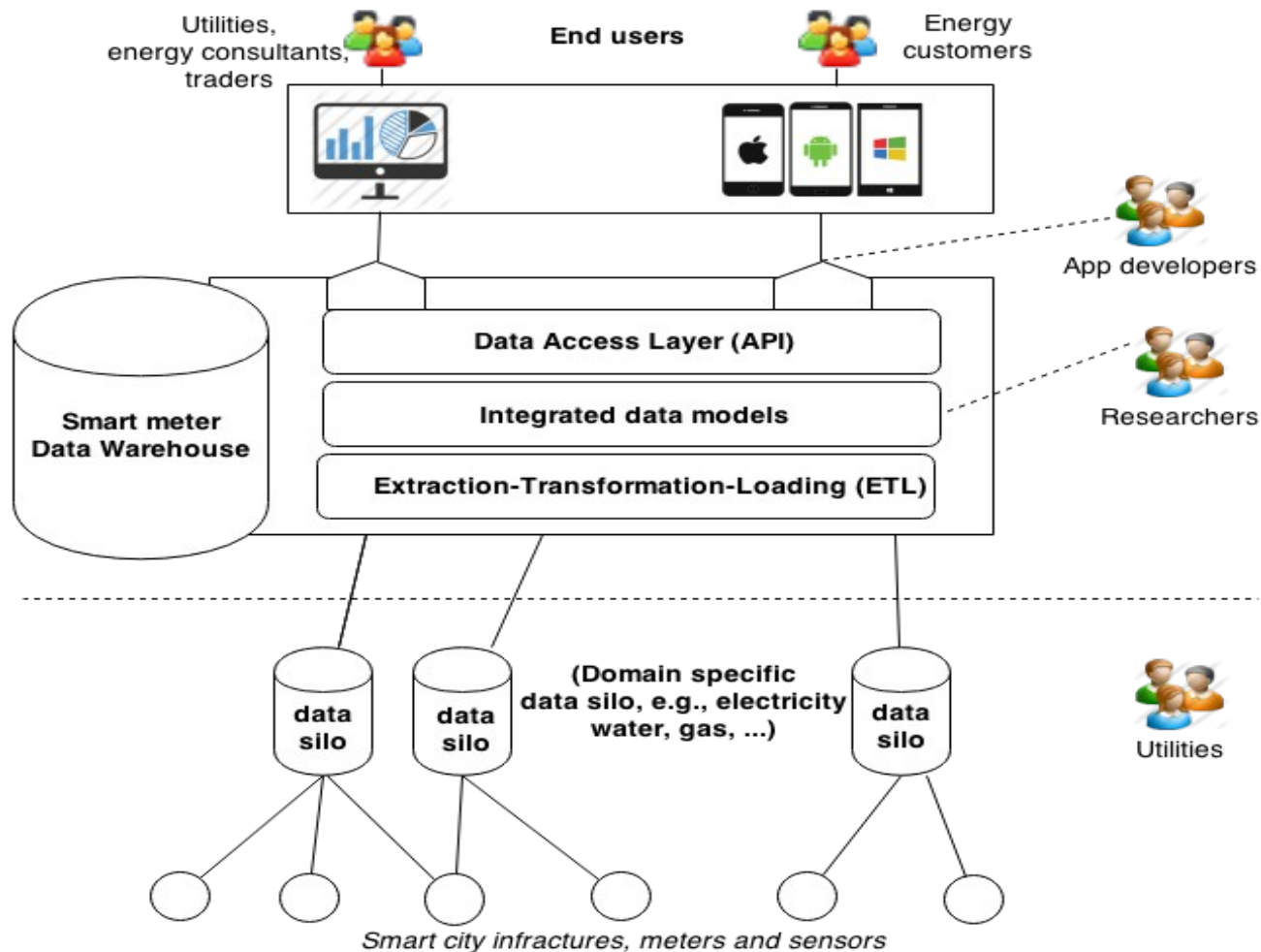
Message:
Your household appears to have an unusually high nightly consumption. Consider replacing your refrigerator or another appliance that is always on with a more energy-efficient one

Big Data Platforms

- Use Canada cloud computing platform: *Sharcnet*, for performance experiments
- Run MapReduce jobs in cloud environment to update the analytics views

What I can contribute

- Build an ambitious smart energy system for production and research



What I can contribute

- Data Modeling for the energy prosumption:
 - Districts
 - Cities
 - Buildings
- With the metrics, such as:
 - Climate
 - Building-related characteristics
 - Building occupants' behavior and activities,
 - User-related characteristics
 - Social and economic factors (e.g., degree of education, energy cost, etc.)
 - Indoor environmental quality required.
 - ...

What I can contribute

- Big data integration and analysis
 - Big data ecosystem for analytics
 - Near real-time analytic results
- Data quality issue & data cleansing:
 - Missing data
 - Erroneous data
- Research management activities

Questions?