RSM Master Thesis Projects at Center for FEB:

Topic Block 1. Behavioral IS.

Methods:

- qualitative studies (interviews, observations, focus groups)
- surveys
- objective data extraction and analysis
- lab experiments

Topics:

1. Prosumer Motivations, Preferences, and Segmentation.
   Nowadays consumers of energy also become the producers as they use their solar panels and electric cars and can thus provide the energy back to the grid when it is needed. As such, they might have specific motivations and preferences. These, in turn, might differ depending on specific user segments.

   a. Perceptions of energy as a resource.
      - What is the impact of intangibility on energy-related behaviors?
      - How to make energy more “tangible”?

   b. Motivations for using sustainable energy resources (electric vehicles, solar panels, etc.) / switching to a more sustainable provider / sharing energy resources
      - How can the consumers be incentivized to use sustainable energy?
      - Are consumers motivated by cost-benefit or rather social welfare considerations?
      - What is the role of reputation/image?

   c. Exploring the preferences of electric Vehicle owners
      - how much time in advance do they need their vehicle to be available to them?
      - what are the incentives that can compensate their comfort against making

their EV available to the Smart Grid?

2. Behavioral aspects of prosumer decision-making: bounded rationality.
   Using cognitive psychology, prospect theory, epistemic motivation theory, the aim of this research stream is to analyze the behavioral aspects of prosumer decision making. As prosumers are not able to take into account all of the incoming information to make their decisions, framing of the problem and different cognitive biases might have an impact on energy-related behaviors. Possible topics include:

   a. Cognitive biases and the impact of framing in energy tariff selection.

   b. Behavioral aspects of using scheduling devices in smart homes.

   c. Risk attitudes of electric vehicle users.

3. Network Structure and Network Effects on the Energy Market.
   Network structure and the positions of the actors in a network have been found to affect a myriad of social and organizational phenomena, ranging from individual creativity to corporate profitability. Network effects are also expected on the energy market, as the motivation of prosumers is often social in nature. The behavior of other members of social network is expected to influence tariff choice, energy conservation as well as adoption of sustainable energy resources. Possible topics include:

   a. Social Influence in choosing Green Energy tariffs.
      Extending the existing project on Tariff Choice.

   b. Global and local network effects in energy conservation.
      Extending the existing project on the impact of social network consumption behavior on the intentions to save energy.

4. Demand side management and Demand Response.
   In order to be able to predict the demand for energy and leverage it in the times when it is most needed, demand management can be adopted. XXX

   a. Demand side for Electric Vehicles

      - What are the incentives that lead the EV owners to shift their consumption?

      - How are those incentives related to the Smart Grid's balance?

      - What are the adoption rates for those incentives?

   b. Adoption rates for various Demand Response programs

      - how easily do the consumers adopt particular demand response

programs?

- what are the rewards that are effective?
- which groups react to particular incentives?

5. Sharing energy resources: stated preferences vs. actual behavior.
   Most prosumers state that they prefer using the sustainable energy resources, as this is beneficial for social welfare. However, when the time comes to share their resources with others or feed the energy back to the grid, they might act opportunistically. Using the social exchange theory determine whether the people would be willing to share their energy resources with others. For this, an experiment is designed where users are required to use their battery instead of the power adapter on their laptops. Possible questions to address are:

   a. Altruism and social welfare preferences in sharing resources.

   b. Identification of factors that lead users to share their resources.

   c. Opt-in vs. opt-out models of sharing energy.

6. Consumer Social Networks.
   Main objective of this project is to examine the impact of energy customers social networks on the energy demand. By identifying the segments of customers and their energy use patterns, one can better predict the energy demand. The data from the existing project Cassandra can be utilized, such as the information about the consumer characteristics and their interactions with each other. Topics include but are not limited to:

   a. Analyzing networks of users and relating to outcomes
      - What are the common features within the networks?
      - What keeps the customers in the same network?
      - What are the structural properties of these networks?

   b. User segmentation and preferences
      - How can the networks be distinguished based on their networks?
      - What are the preferences of different segments?

   c. Network formation and network dynamics
      - How are the networks formed over time?

        - What are the dynamics in the CSN? How does the adoption spread?

Block 2. Design Science

Methods:

- Analysis
- design
- implementation

Topics:

1. Tariff development and selection
    a. New business models and tariff development for electric vehicles and smart homes (Virtual Power Plants -- VPP)
    b. Tariff recommender system (possibly agent-based)
    c. User interface design for tariff selection (relates to behavioral IS)
    d. Portfolio management for brokers (energy finance)
2. Retail Electricity Markets
    a. Analysis of “Big Data” on Retail Electricity Markets
        - Goal: Perform analyses of participants’ behavior in retail electricity markets; derive IS design theories for electricity brokers
        - Prerequisites (MUST): Candidate needs solid working knowledge of SQL, and database concepts such as indexing schemes; statistical analysis and visualization tools such as R/ggplot2, SPSS, or Python/matplotlib.
        - Prerequisites (SHOULD): deal candidate will have working knowledge of UNIX operating system and shell scripting, Electricity Trading / Smart Grid domain knowledge, or bring a strong desire to learn them autonomously
    b. Trading strategies and opponent modeling for the wholesale and retails markets
    c. CO2 trading and emission reduction
3. Power TAC.
    a. Developing a reporting/analysis system for the evaluation of Power TAC data
        - Goal: Develop an interactive reporting environment for the ex-post analysis

of Power TAC game logs. Database structures are in place; what we would like to create is a reporting layer on top of them, most likely using commercial or open source BI tools.

- Prerequisites (MUST): Candidate needs solid working knowledge of SQL, and database concepts such as indexing schemes; UNIX operating system and shell scripting
- Prerequisites (SHOULD): Ideal candidate will have working knowledge of BI tools such as Cognos, SAP Business Objects, Pentaho, or Jasper Reports, or bring a strong desire to learn them autonomously; Java, MDX, and LDAPv3 are a plus.

b. Extending the LARGE Power TAC broker into a fully reusable broker development framework and implementing a trading strategy on top of it

- Goal: We have a basic framework for creating Power TAC brokers for the LARGE group in place. Candidate will extend the framework into a COTS-quality building block for other broker developers and develop an own trading strategy on top of this.
- Prerequisites (MUST): Candidate needs strong working knowledge of the Java Programming Language, and documentation systems such as Javadoc and Doxygen.
- Prerequisites (SHOULD): Knowledge of one or more of the following is a plus: Maven, UNIX operating system and shell scripting, Swing or other Java GUI toolkits, Electricity Trading / Smart Grid domain knowledge.

4. Smart Grid Infrastructure.
    a. Design and incentives for energy cooperatives and smart energy neighborhoods
    b. Energy storage capacity and economics for refrigerated warehouses
    c. Privacy and policy challenges of the smart grid (e.g. intruders through smart meter readings, etc.)
    d. The social smart grid: designing a network infrastructure to include consumers, their relationships and interactions so that they can coordinate their energy resources consumption themselves.
5. Electric Vehicles
    a. Repast broker agent for Power TAC (graphical programming)

b. stomer modeling for Electric Vehicle owners. Expected outcome is the creation of customer models that approximate reality and can create large populations of EV owners.
    - individual energy consumption
    - charging schedules
    - discharging availability
    - distance driven per day for various activities
    - response rates to various tariffs
c. Charging models for electric vehicles
d. Coordination strategies for Electric Vehicle charging. Uncoordinated charging for EVs leads to peaks to the energy prices. Main objective of this project is to design a coordination strategy for charging that will ensure customer's comfort in terms of EV availability.

Block 3. Economics of IS (Model building)

1. Develop coordinated datasets of weather and wholesale supplier bids. Study correlation of prices and weather conditions.
2. Model the influence of Smart Meters given a real-world dataset