Green Machine: Mobile Decision Displays to Promote Eco-Action

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Meter Design: The Past

- Fixed hardware designs, limited data

- Viewed by utility technicians: headquarters and meter readers

Meter Design: The Future

- Variable, detailed, contents, probably **massive** data

- Viewed by utility, but also: home/business customers/users, interested groups, the public

- Mixed contexts
  - Desktop/mobile devices: at home, play, and on the way
  - Social media
  - Games, competition
  - Education, training, behavior modification, videos
  - Marketing of products, services, persuasion
  - Search engines, network visualization

Challenges

- Design useful info viz of new, massive data

- Means of social participation, scalable technology

- Develop appropriate metaphors, mental model, navigation, interaction, appearance
  - Desktop and mobile solutions
  - Interaction widgets and multiple window coordination Long time series (>10K time points), multiple variables, controlled precision

- Find good discovery process-model
  - Integrate statistics and visualization
  - Support annotation (tabbing) and collaboration
  - Preserve history, undo, macros, etc.
 - Example: Spotfire (e.g., Retinol discovery)
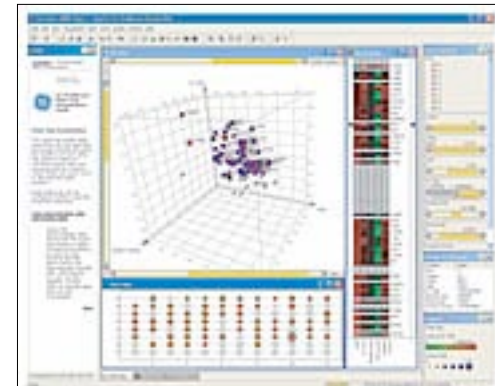
Social Media: Transforming Society

- **Communication:** Blogs, micro-blogging, social networking, soc net aggregation, event logs/tracking

- **Collaboration:** wikis, social bookmarking (social tagging),social news, opinions, Yelp

- **Multimedia:** photo/video sharing, livecasting, audio/music sharing

- **Reviews and Opinions:** product/business reviews, community Q+As

- **Entertainment:** platforms, virtual worlds, game sharing

Google's Power Meter

- Google's Power Meter technology separate from utilities and other channels
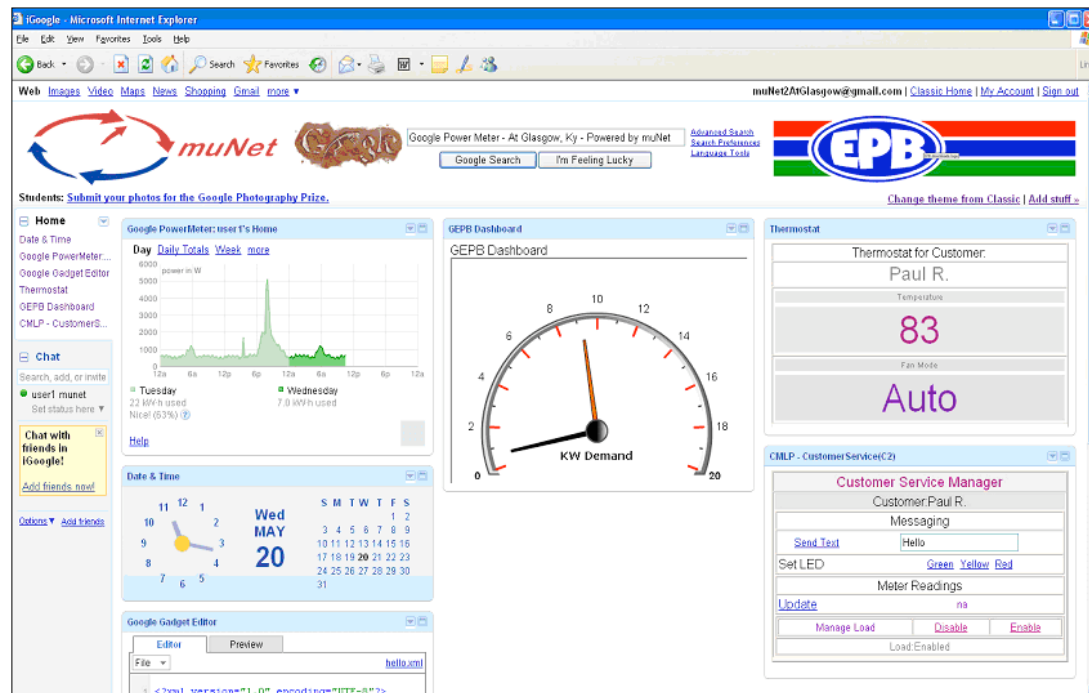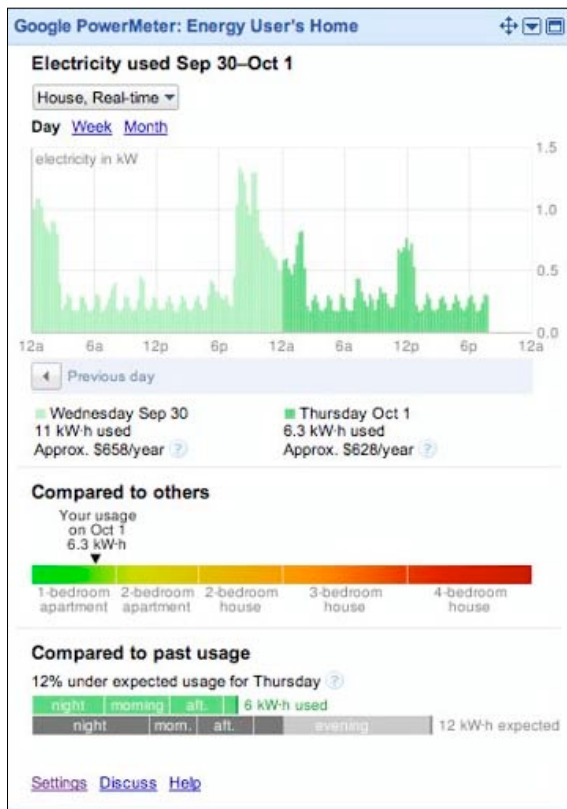
# Green Machine: Design Data Decision Displays to Promote Eco-Behavior

- How can information design/visualization present persuasive information to promote ecological, or sustainable, short-term eco-actions and long-term eco-behavior?

- How can mobile technology assist in presenting persuasive information and promote eco-behavior

Energy, Pollution: We've Known the Issues for More than 30 Years

- **Visualizing Global (Energy) Interdependence**
  - East-West Center VGI Project, Honolulu, 1978
  - Used information visualization using tables, charts, maps, diagrams, without words
  - Multidisciplinary, multi-cultural research and development team

- Published VGI articles, showed presentation worldwide
  - Marcus, Aaron (1979). "Visualizing New Perspectives," *EWC* Magazine, 1978, pp. 18-24
  - Recent showing at Tama Art University, Tokyo, Japan, 2008

VGI Presentation Examples
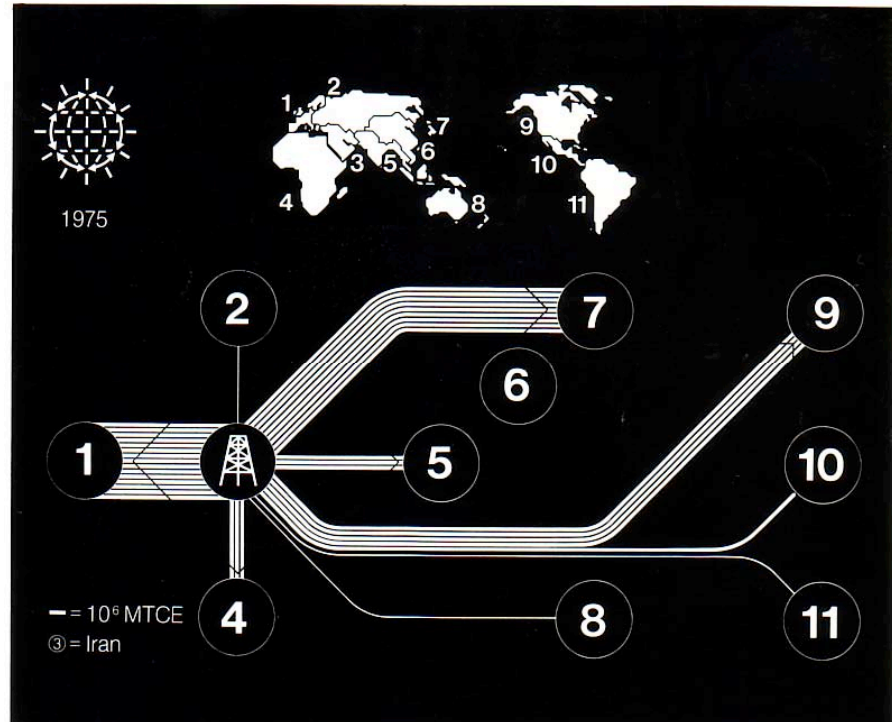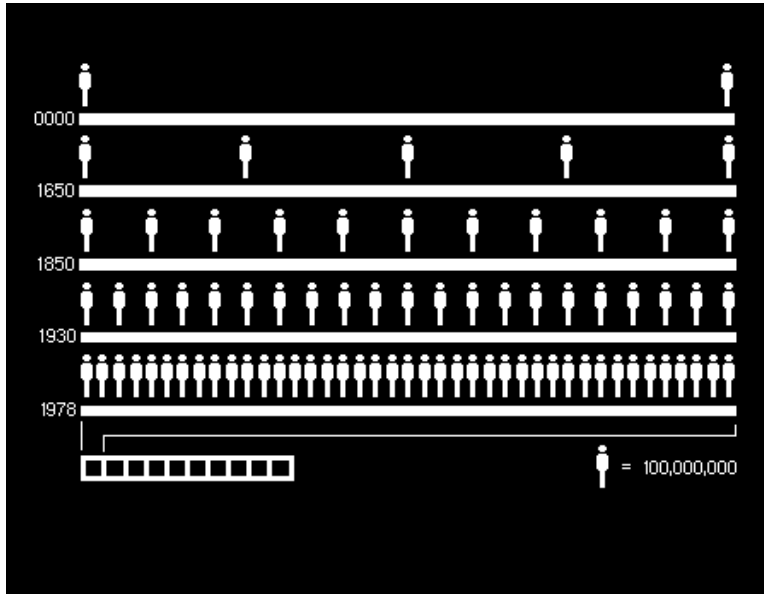
VGI Publication Examples

Visualizing Global Interdependencies

The earth, a home for more than four billion people, is a place of greatly increasing diversity and complexity.

Ideas, people, and goods are moving faster and faster and intermingling.

There are rising challenges in the changing world, caused by global situations of population, food, energy, and environmental pollution.
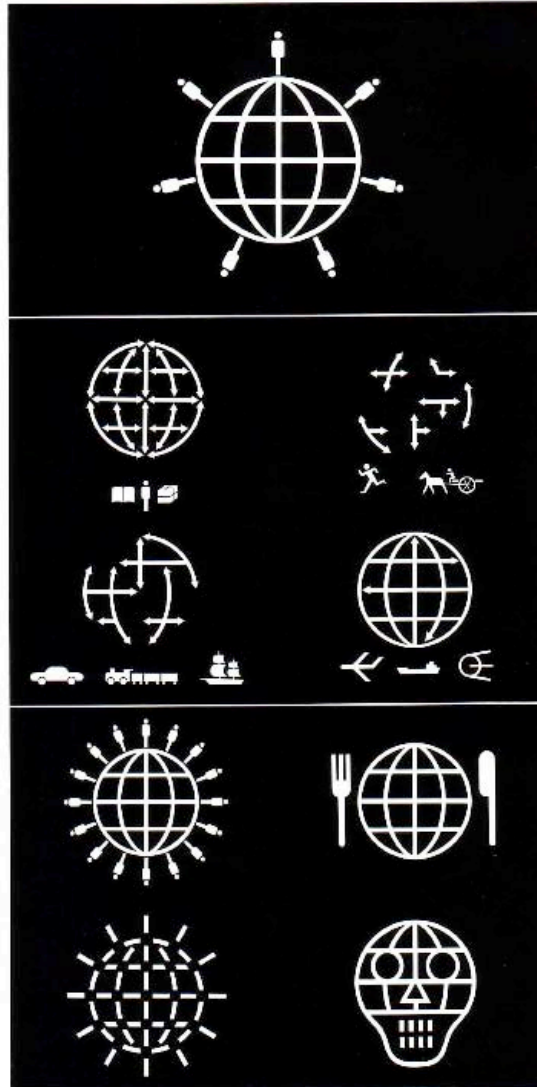

Global Interdependence From the Energy Perspective

Conventional sources of commercial energy include oil, coal, natural gas, hydroelectricity, and nuclear power.

The energy each person consumes is different in each region of the world. (See chart at near right.) Some regions consume more than they produce. Other regions export their excess production. (See chart at far right.)

With uneven consumption and production, energy cannot flow without global cooperation.

In the recent past, world energy consumption has been increasing rapidly. This is leading to the depletion of energy resources.
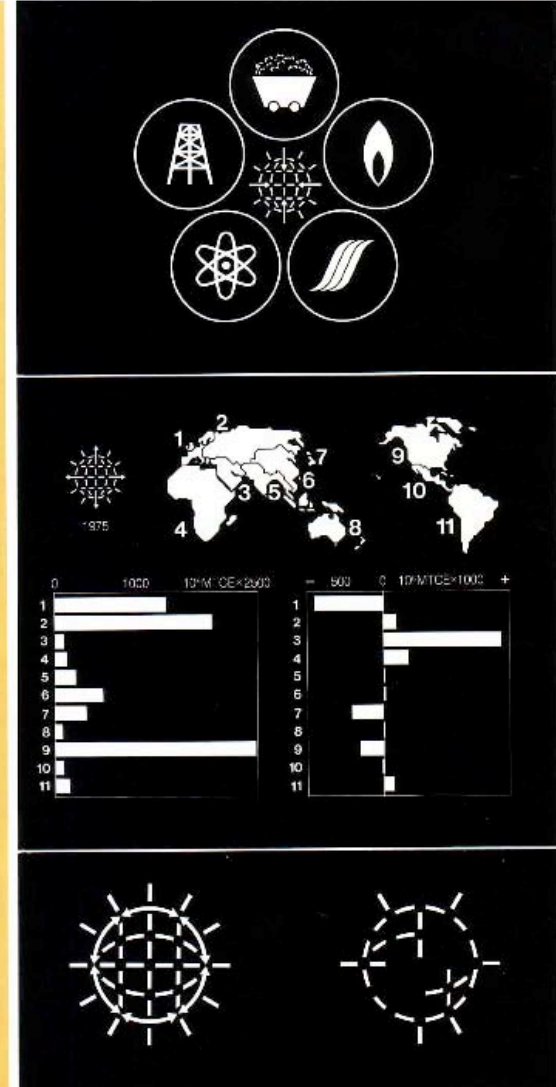
What Do We Need?

- Information design and information visualization good

- But not good enough!

- What we need:

- **Persuasive Information Design *and* Information Visualization**

Where Should we Show this Persuasive Information?

- **Mobile devices**: Most important, effective

- 3 billion people worldwide use them

- Smarter, faster, cheaper, better, with built-in social networking and video

- Primary communication and interaction platform now and in future

Essential Challenge for Sustainable Development

- People know **data** but do **not change behavior**
  - Global warming: Frightening threat to Earth's future
  - Examples: **Al Gore**'s "An Inconvenient Truth", VGI project

- **Challenge**: How to help people reduce carbon footprint?
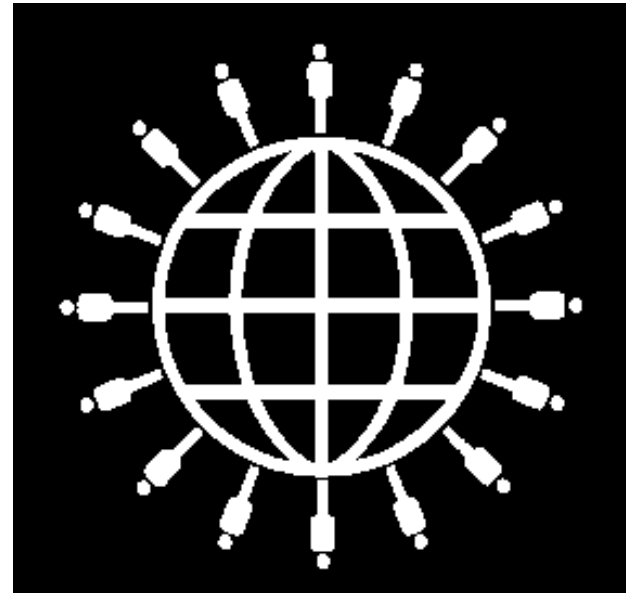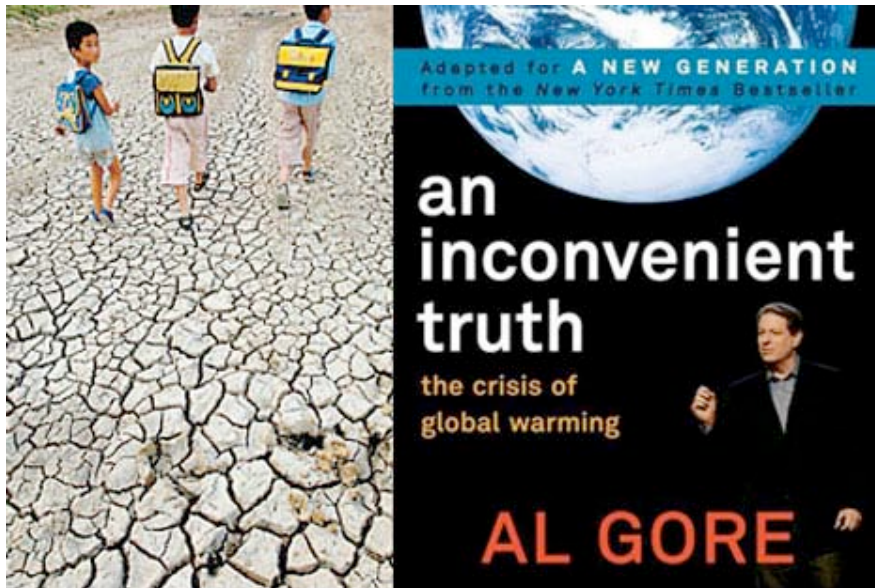
Household Energy Consumption: Some Background

- **With feedback, people can achieve 10% energy-consumption reduction without lifestyle change**

- 10% reduction in US: Total energy provided by US wind and solar, 113.9 billion kwh/year!

- US home consumption: 18% of CO_2 emission
  - Other sources: daily transportation, waste/recycling, eating/shopping

- US President Obama will invest $4.5 billion in **Smart Grid** to extend its use in US households

- Companies developing software using Smart Grid to help people monitor their energy consumption

Green Machine UI Analysis:
User Profiles or Personas

- Later: business use

- Now: home use, general context, wider use
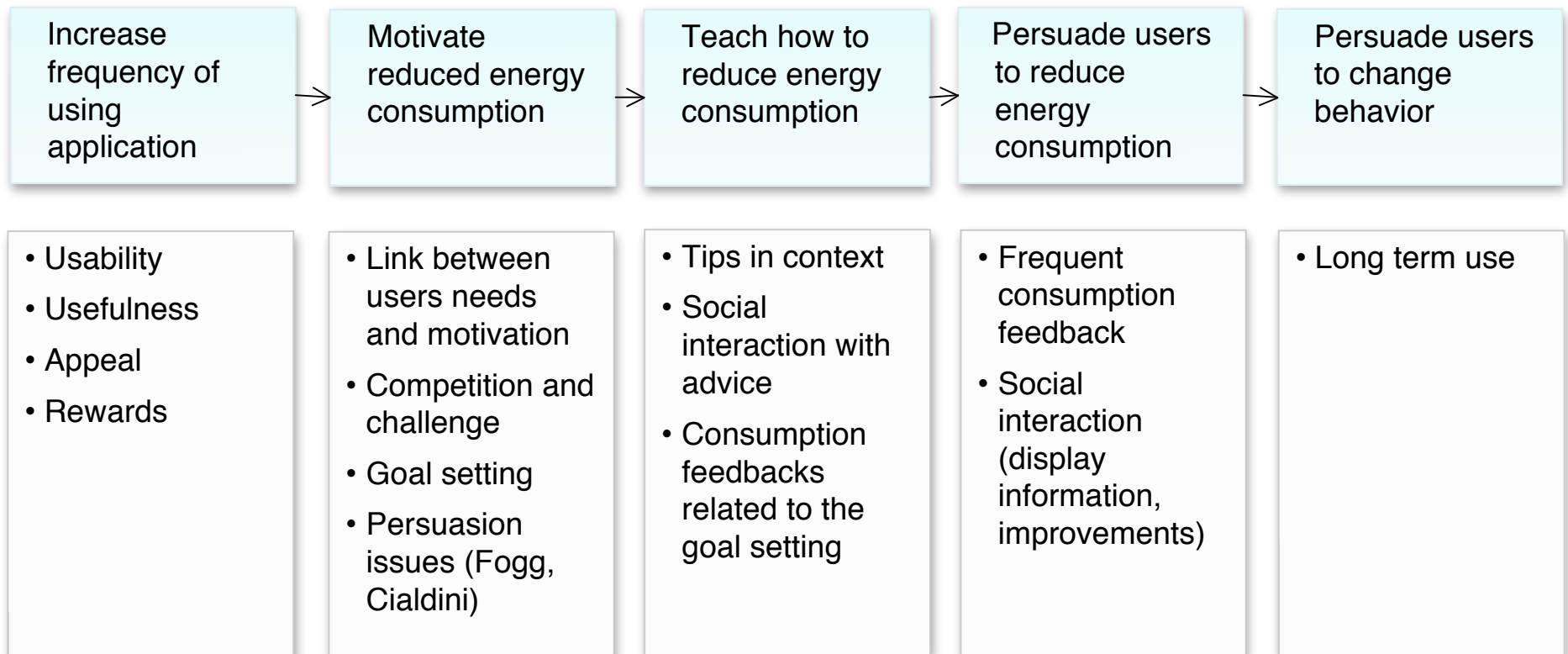
- Key users: Mom, Dad, Daughter, Son
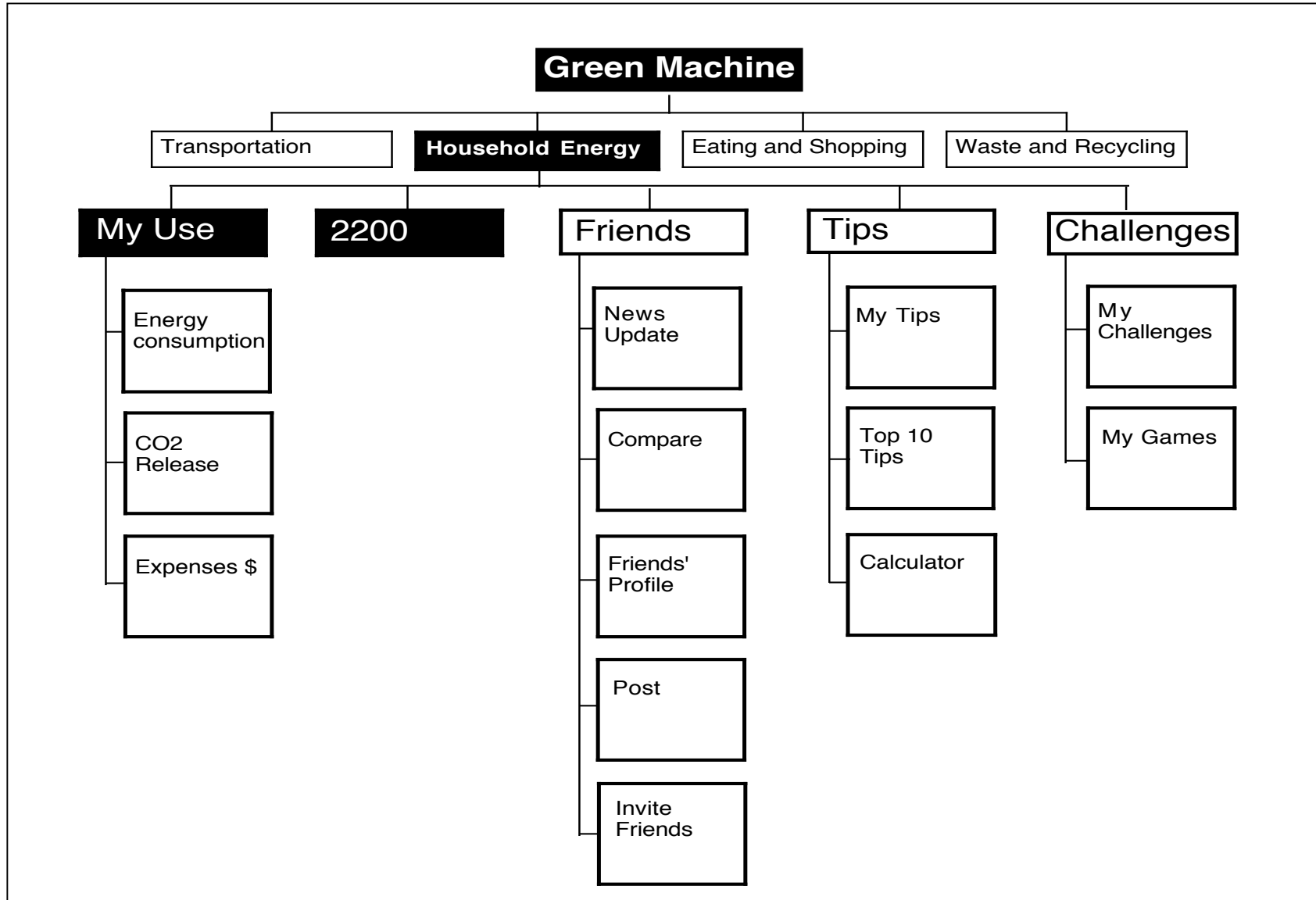
Green Machine UI Analysis:
Use Scenario

- Mom/Dad wants to check energy consumption before running major appliance. She/he uses mobile phone to check current household energy consumption to learn recent history and check tips on lowering usage

- By lowering usage, she/he gains higher status in friends' energy-saving group, earns some rewards points, and helps save the Earth

Behavior Analysis:
Behavior Changing Process

- 5 steps of users' behavior-changing process through **Green Machine** application

Increase frequency of using application	→	Motivate reduced energy consumption	→	Teach how to reduce energy consumption	→	Persuade users to reduce energy consumption	→	Persuade users to change behavior
• Usability • Usefulness • Appeal • Rewards		• Link between users needs and motivation • Competition and challenge • Goal setting • Persuasion issues (Fogg, Cialdini)		• Tips in context • Social interaction with advice • Consumption feedbacks related to the goal setting		• Frequent consumption feedback • Social interaction (display information, improvements)		• Long term use

Green Machine Info Architecture

Green Machine

- Transportation
- **Household Energy**
- Eating and Shopping
- Waste and Recycling

My Use
- Energy consumption
- CO2 Release
- Expenses $

2200

Friends
- News Update
- Compare
- Friends' Profile
- Post
- Invite Friends

Tips
- My Tips
- Top 10 Tips
- Calculator

Challenges
- My Challenges
- My Games

Initial Concept Sketch on i-Phone: User's Energy Consumption

- **Multiple tracks:** multiple formats of info

- **Large text:** Shows recent net total

- **Small text:** Comparison

- **Thermometer chart:** recent net total re goal

- **Line chart:** Last 24-hours

- **Adjustable comparisons:** What? When?

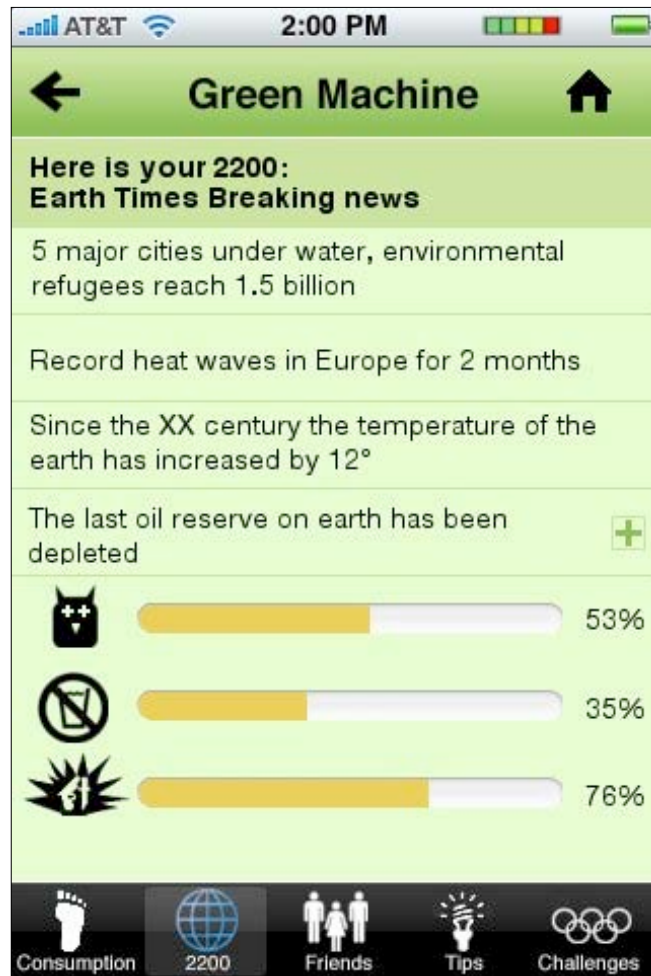# Initial Concept Sketch on i-Phone: Comparison, Competition
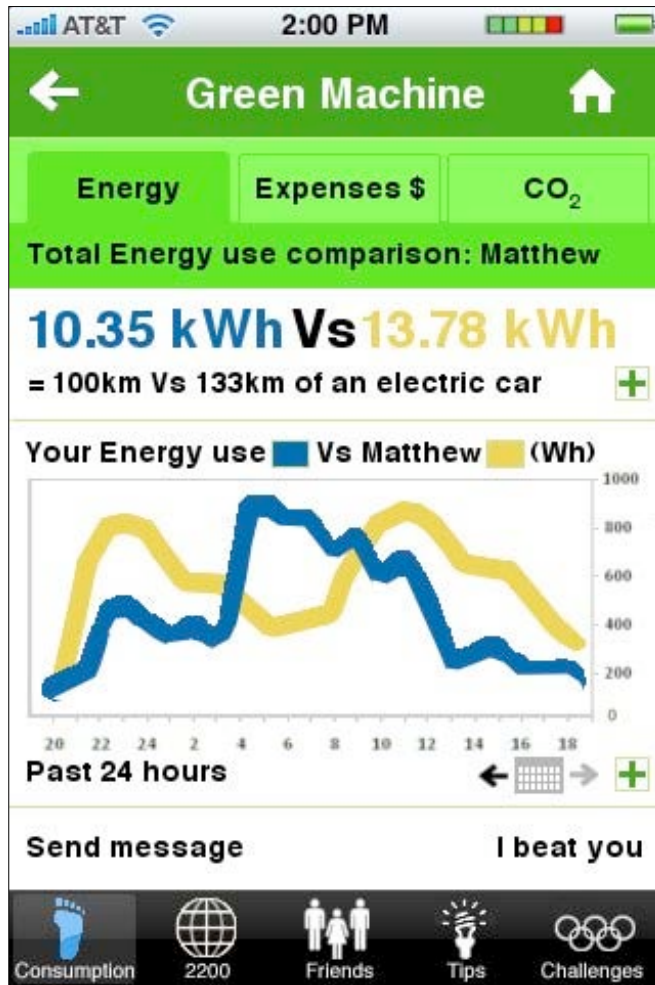
- **Send message**: User can send message to friend(s)

- **I beat you:** User can send friend short info of encourageement or triumph

Initial Concept Sketch on i-Phone: User's Calendar (for all 3 sub-tabs)


- **Custom date selection:** filtered by Day, Week, Month and Year

- **Green goal indicators:** 3 small dots show how much you consumed and how well you met your goals

- Selected dates highlighted

- Selected dates summary

Initial Concept Sketch on i-Phone: Year 2200 Preview

- **Year 2200:** Shows extrapolated impact of user's current consumption

- **News headlines:** Give impression of impact

- **Bar charts:** Show data of impact

# Initial Concept Sketch on i-Phone: Possible Friends Preview
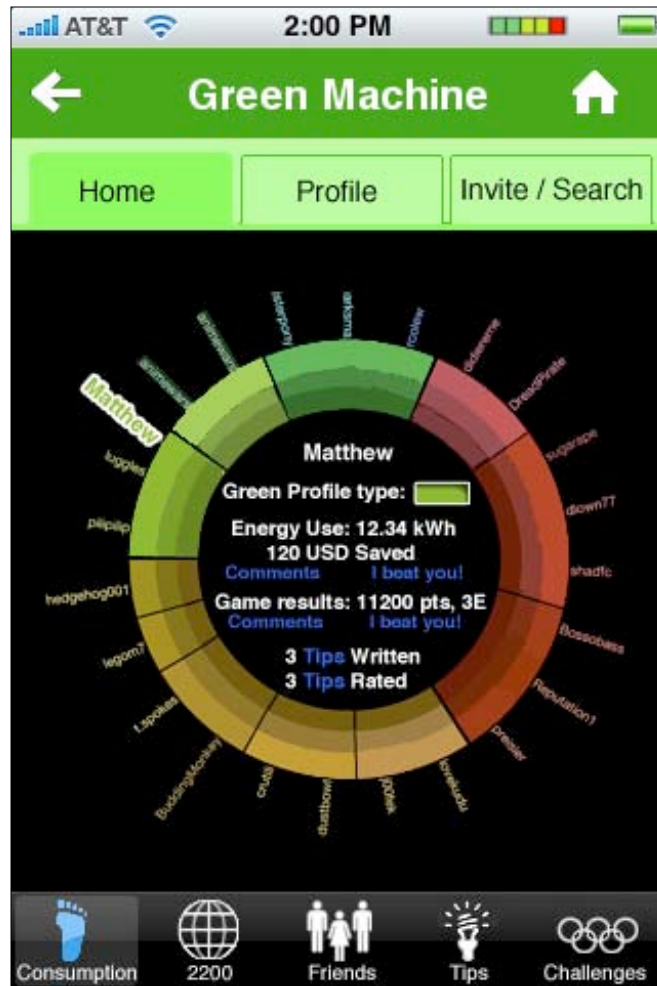
- **Touch-sensitive chart:** when user circles chart, his/her friends' name highlighted

- **User Highlights:** shows user or specific friend's quick profile

- **Color circular chart:** Shows how green your friends are based on their behavior
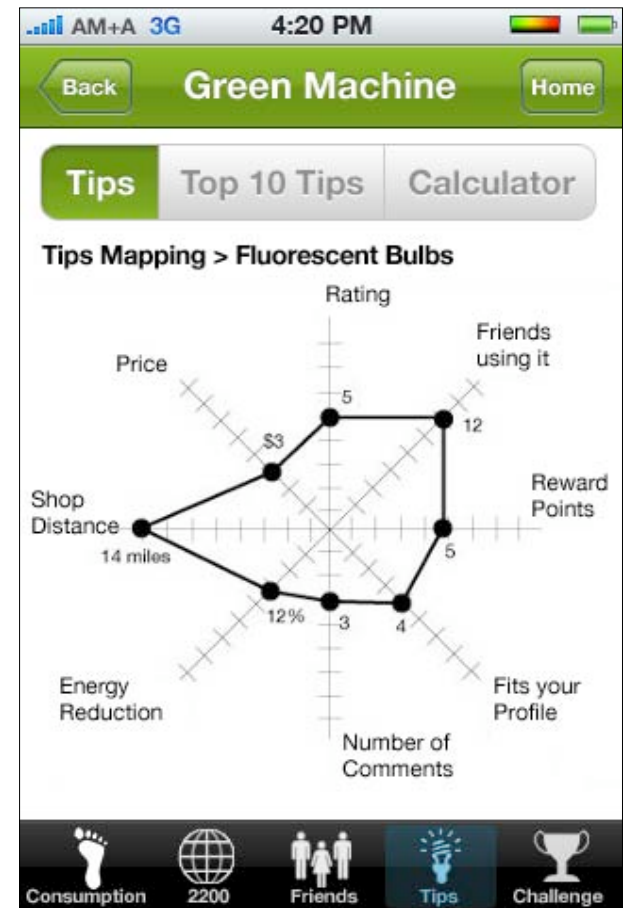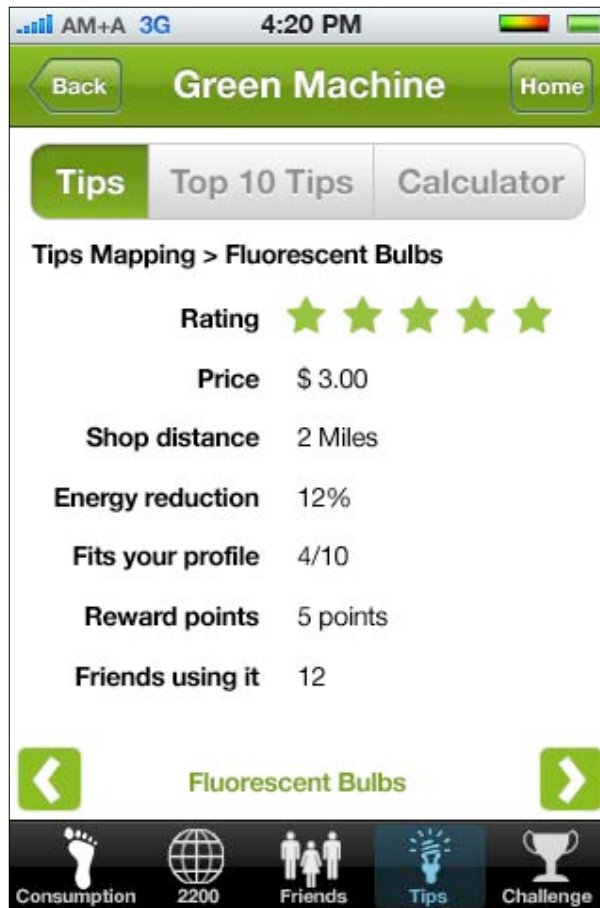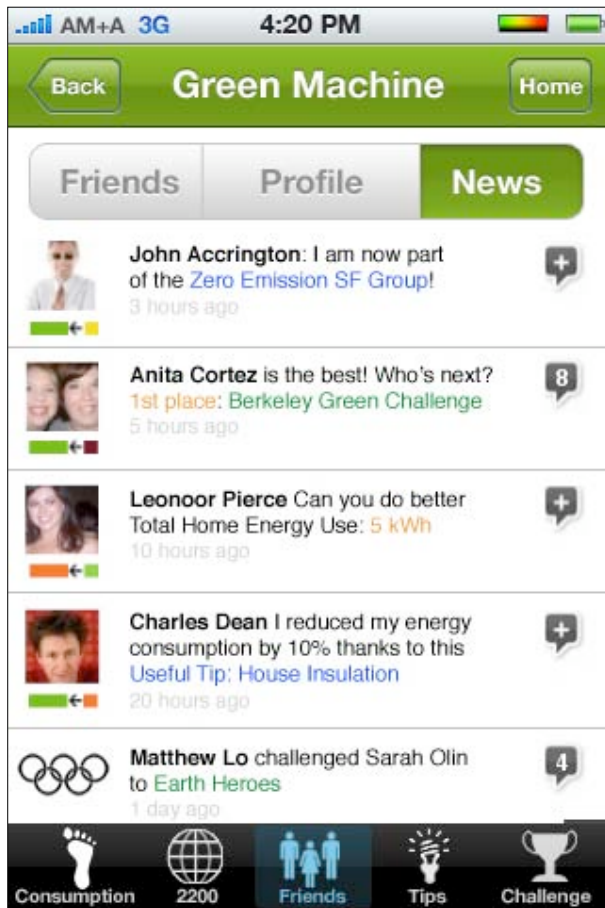
User-Test Analysis, 1/2

- 20 people, 18-65, men/women, students, adults

- Users positive re motivation, behavior change
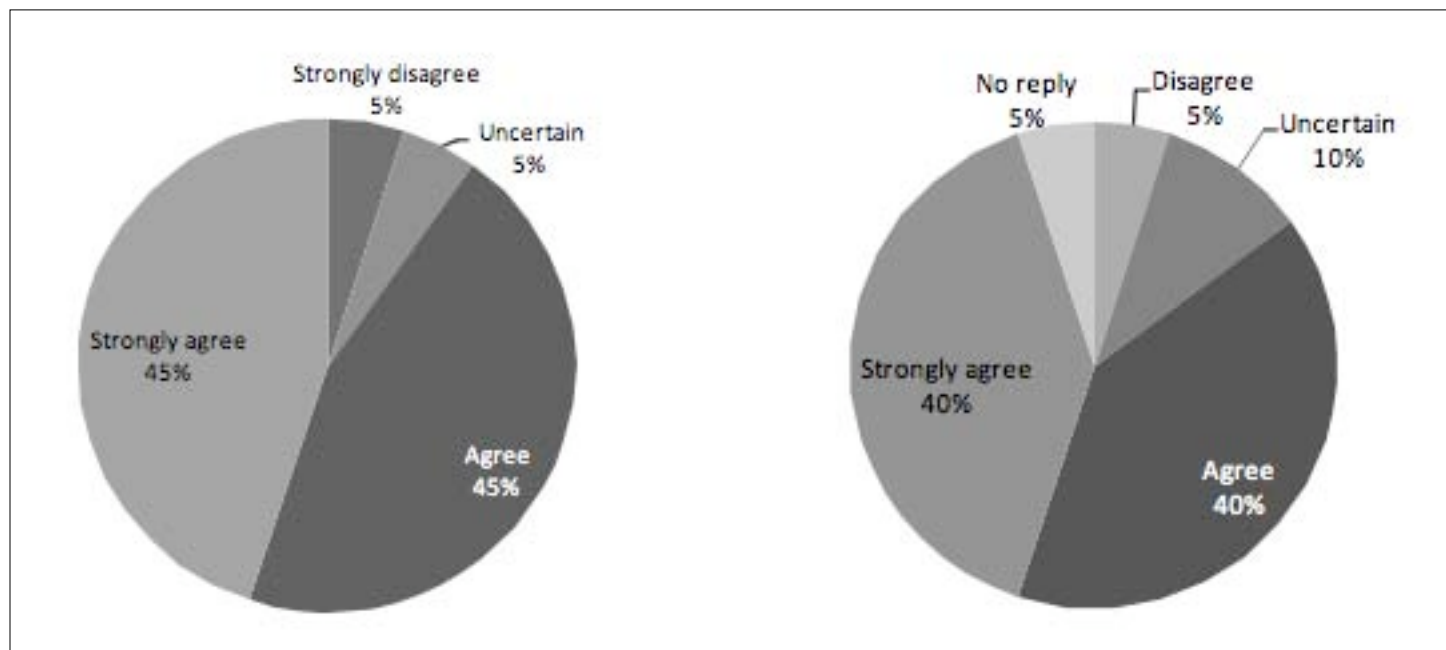
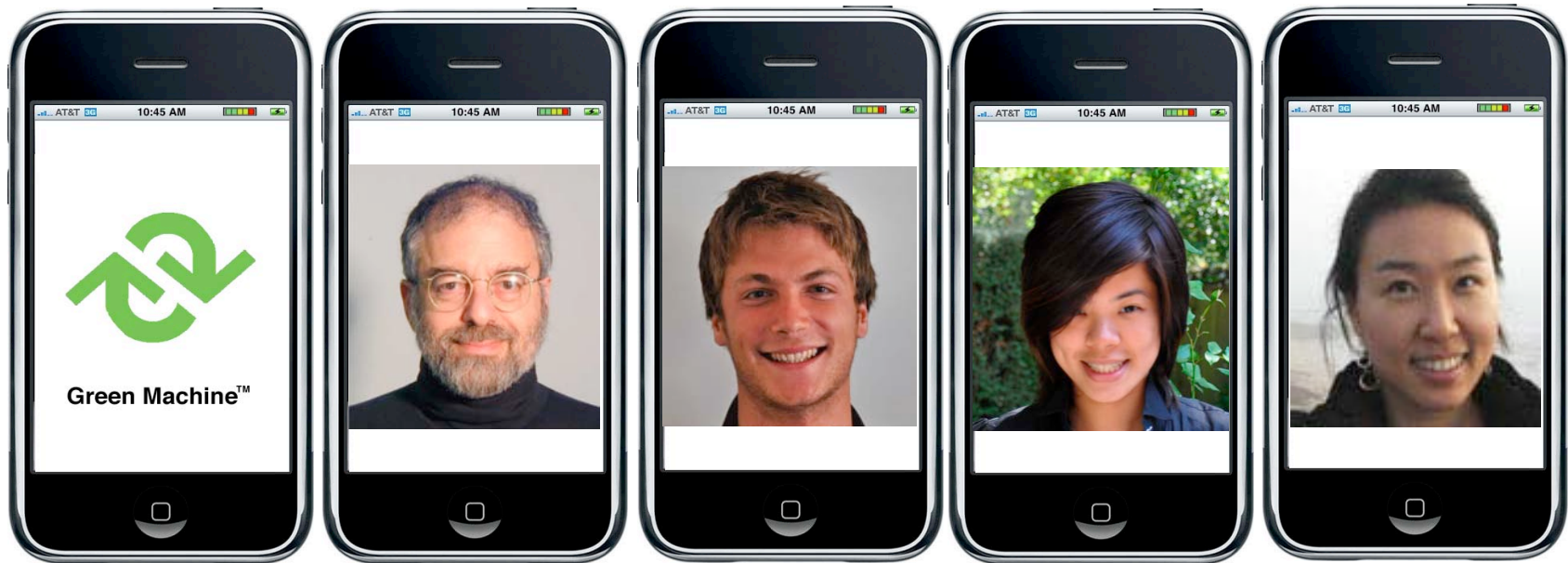# Design Changes, 1/2
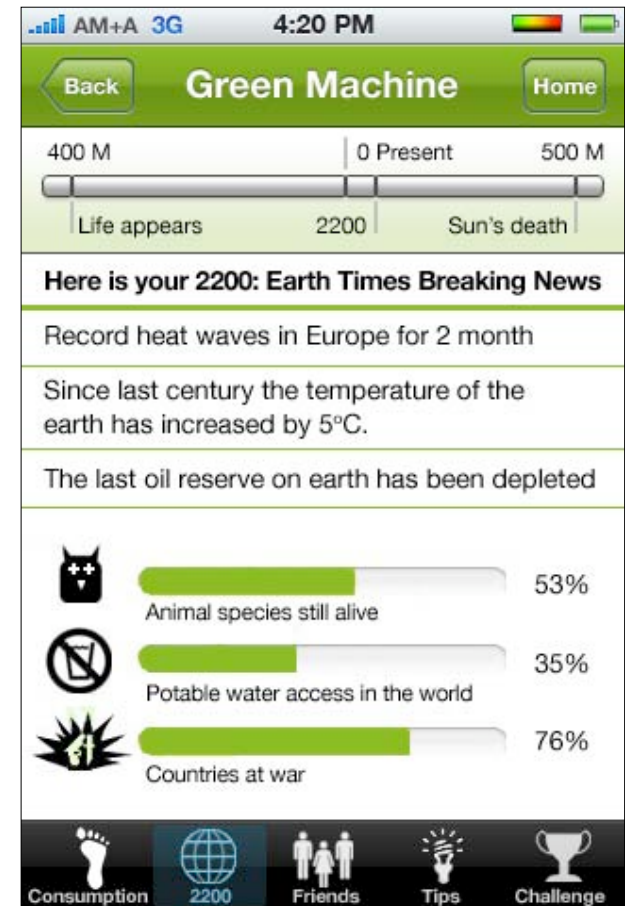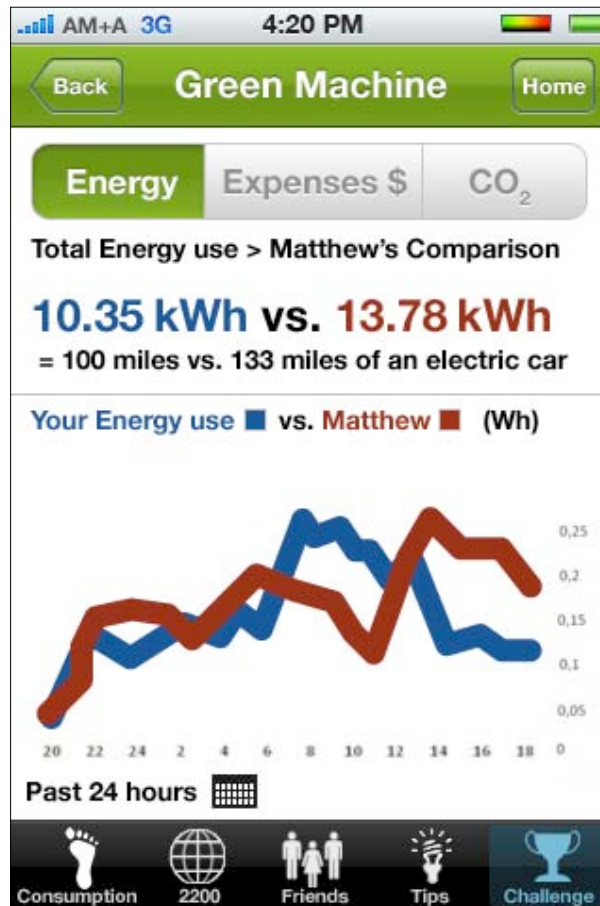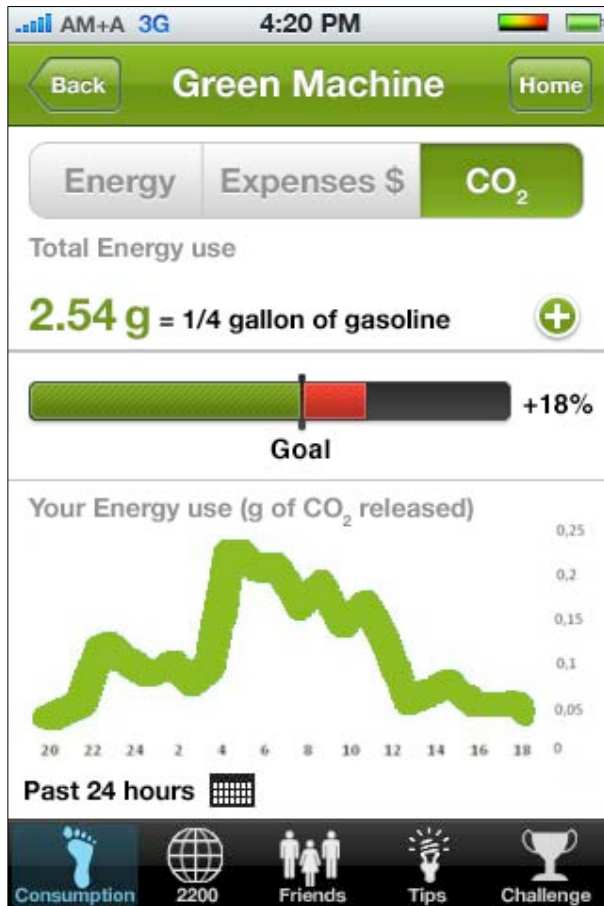
Design Changes, 2/3

Green Machine: Conclusions

- Green Machine: proven motivation and persuasion

- Further R+D needed to complete full mental model, navigation, interaction, and appearance details

- Need for rapid switch to home devices controller

- Project ready to turn over to implementation sponsor in preparation for availability of Smart Grid

- Green Machine approach can be applied to other content, other platforms, *e.g.*, business use and health

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