Plug Loads Advocacy:

A Look Ahead in the Plug-in Appliances and Their relationship to the Smart Grid and Homes

- Research in progress -

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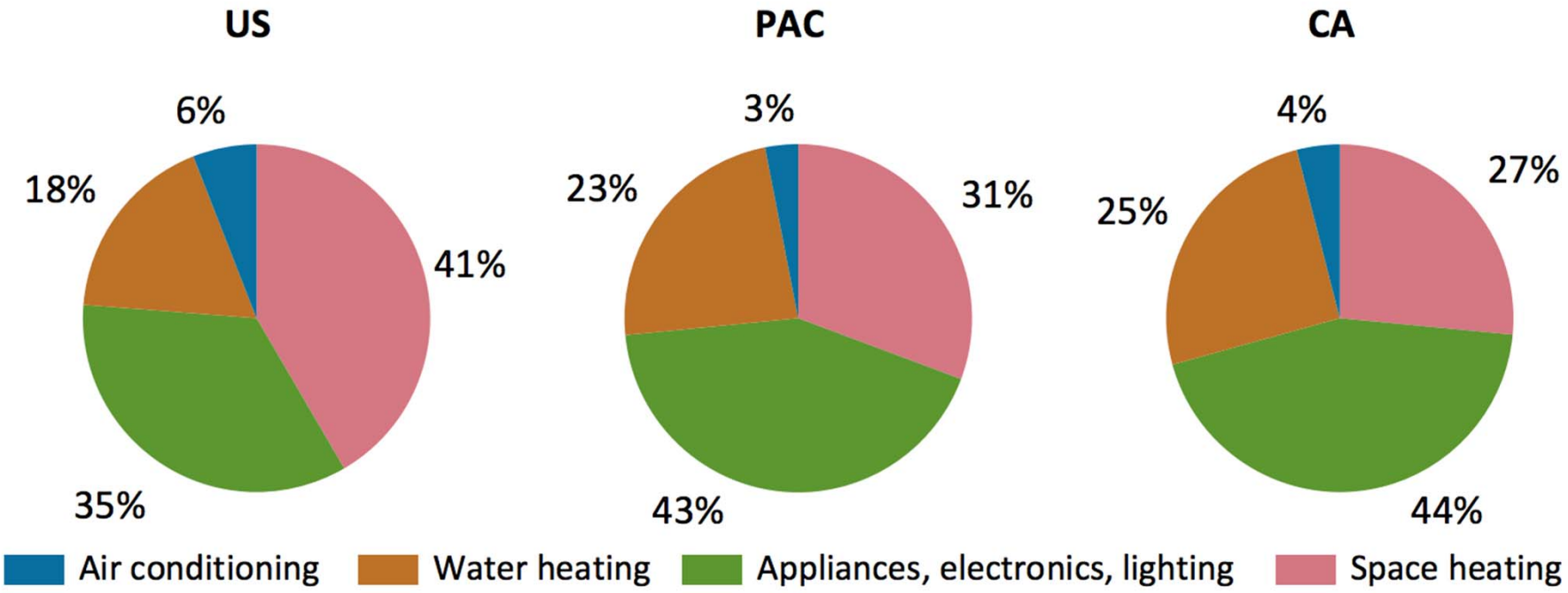
www.calplug.org

Creating Connections. Powering Innovation. Boosting Efficiency.

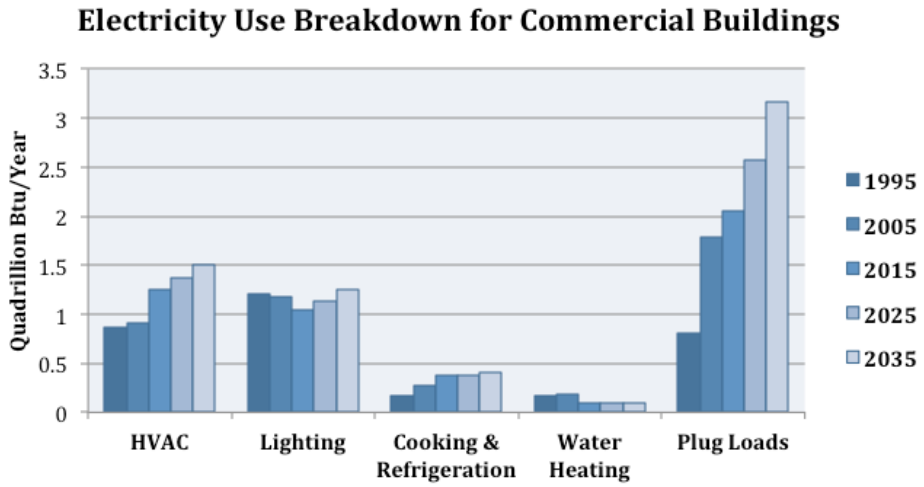
CalPlug
California Plug Load Research Center

Where did your money go?



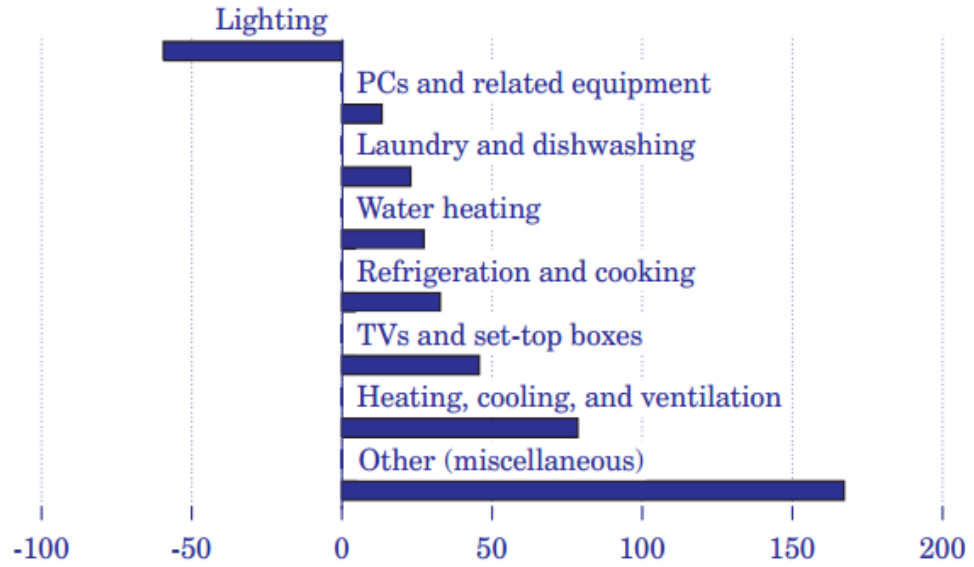
All data from 2009 EIA's Residential Energy Consumption Survey
California households use 62 MBTU per home, 31% less than national average
*PAC: Alaska, California, Hawaii, Washington

Future Outlook of Energy Demands



(Graph was created from Annual Energy Outlook data)

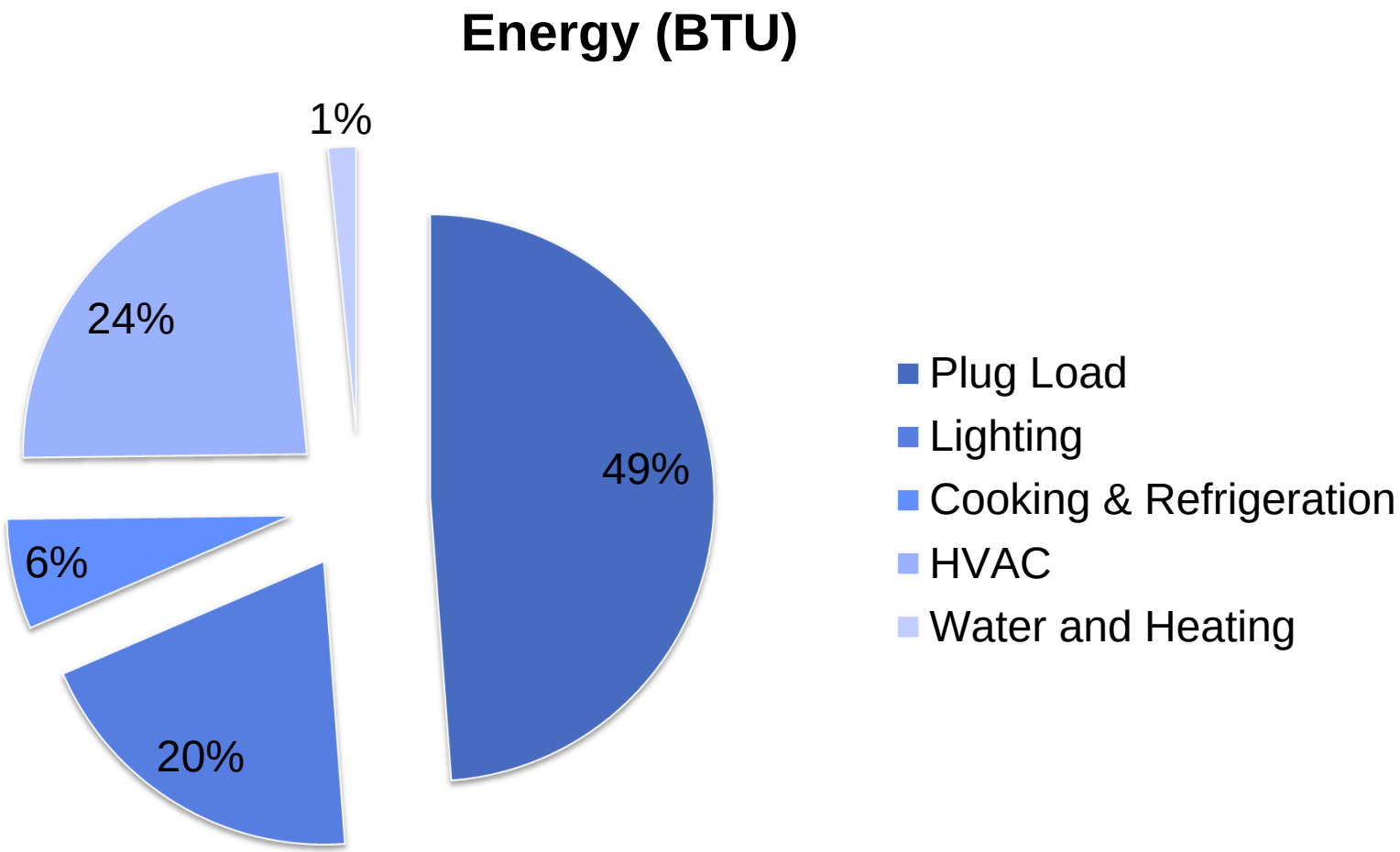
Change in commercial building energy consumption by Rocky Mountain Institute (left)
By 2035 plug load devices consumes up to 50% of the energy budget



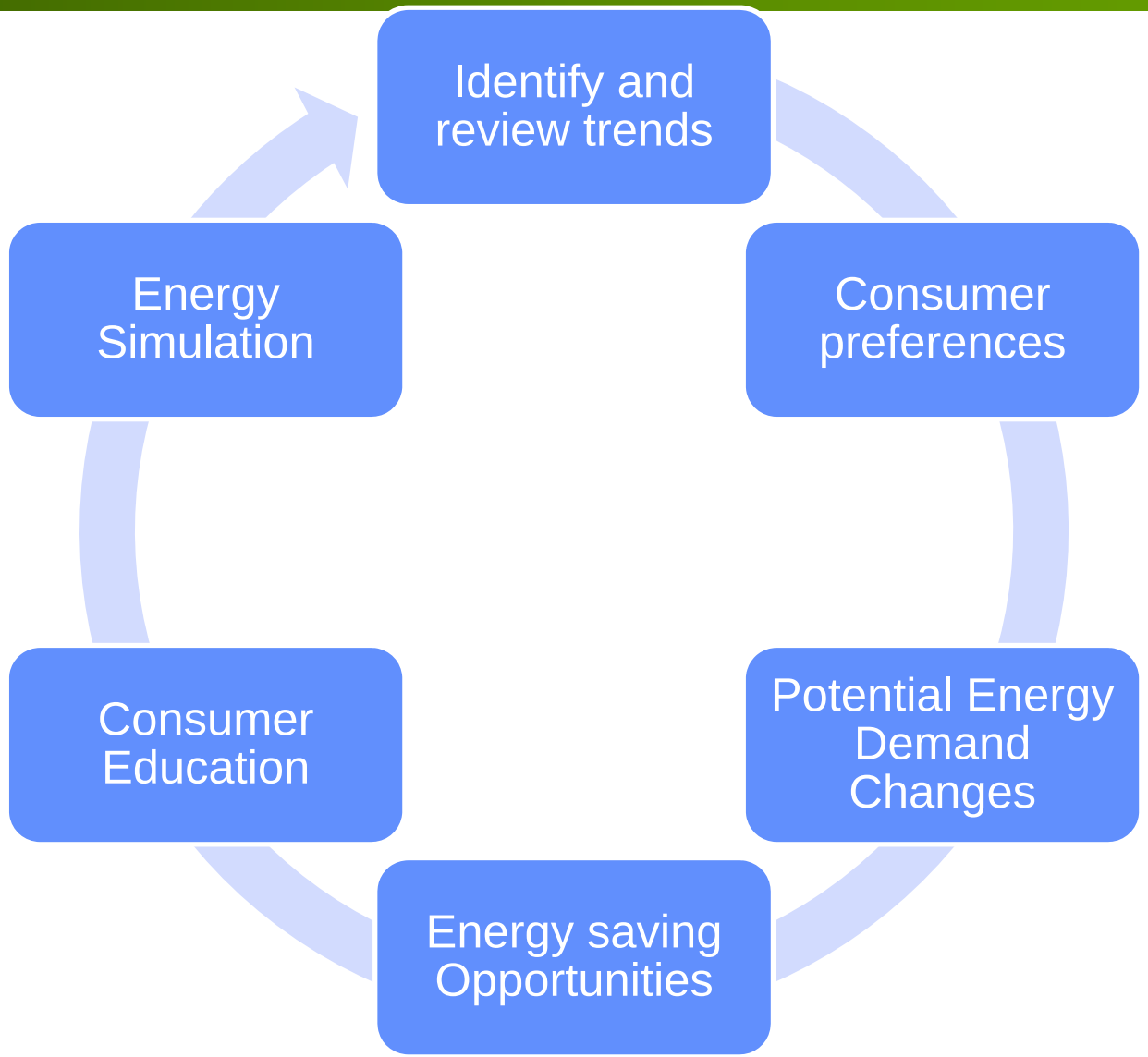
Change in residential electricity consumption for selected end uses in the Reference case, 2008-2035 (billion kilowatt hours) by EPA (right)

http://www.eia.gov/oiaf/archive/aeo10/pdf/0383(2010).pdf

A Further Breakdown of the Problem: Year 2035 Projection



Research Goals



Previous Work: Game Console and STB

- **Set-top-box:**
  - **Energy consumption passed beyond refrigeration in 2010.**
  - **CalPlug proposed and created 5W5S intelligent sleep solution with a 54% of energy saving.**
- **Game Console:**
  - **Identified as the biggest energy hog in the entertainment system on average.**
  - **Performed in house testing with various APS and other solutions to address the issue.**

Current Work Areas Overview

- **Personal Electronics:**
  - **Wearable electronics**
  - **Cell Phones**
  - **Companion robots**
  - **Telemedicine**
- **Robotics and 3D printing:**
  - **By 2017, 20% durable goods will be 3D printed**
  - **Organizations own 5.4 3D printers on average**
- **Entertainment:**
  - **Virtual reality for gaming and entertainment**
- **Water and Energy**
- **Data Centers**
- **Consumer Education**

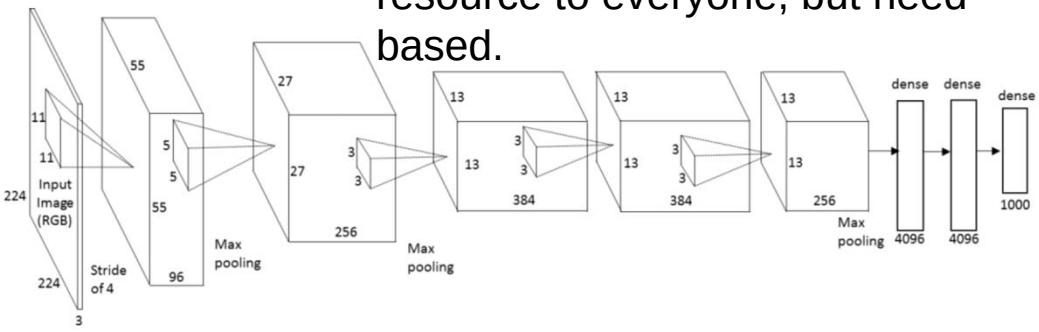
Current Work Areas: Wearable

- **Fitbit**
  - Claims 68% of market share
  - Sold 10.9 M devices
  - Active users 6.7M
  - It takes approximately 325MW Hr to charge up all the Fitbits each year only for the active users.

- **Others:**
  - Apple
  - Samsung
  - Google
  - Moto
  - Pebble
  - Cloths
  - Backpacks
  - Glasses
  - ……

Current Work Areas: Data Centers

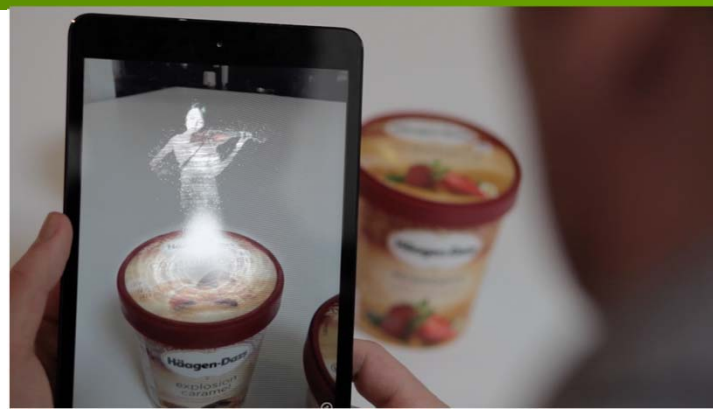
- **Software Efforts:**
  - **Dataset manipulation:**
    - **Microsoft:** Accelerating Deep Convolutional Neural Network (CNN) Using Specialized Hardware.
  - **Fair Allocation vs. Efficiency: (Princeton U.)**
    - not assigning same amount of resource to everyone, but need based.



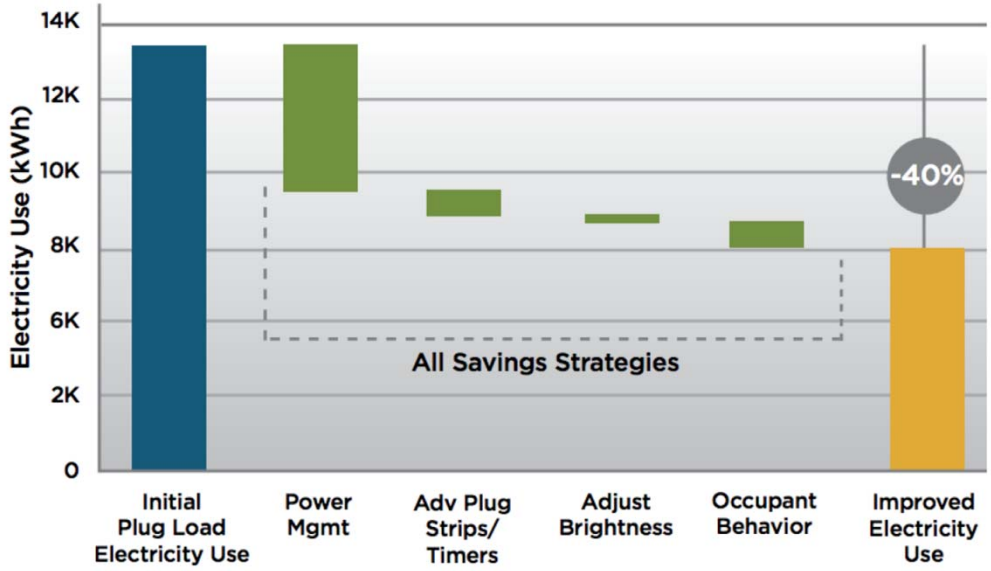
- **Hardware Efforts:**
  - **Facebook's Open Compute project:**
    - **Announced "Yosemite" SOC server.**
    - **Superior to traditional data server in terms of performance-per-watt.**
    - **Yosemite has a 65 Watt thermal design power (TDP) but can operate up to 95 Watts.**

Current Work Areas: Consumer Education

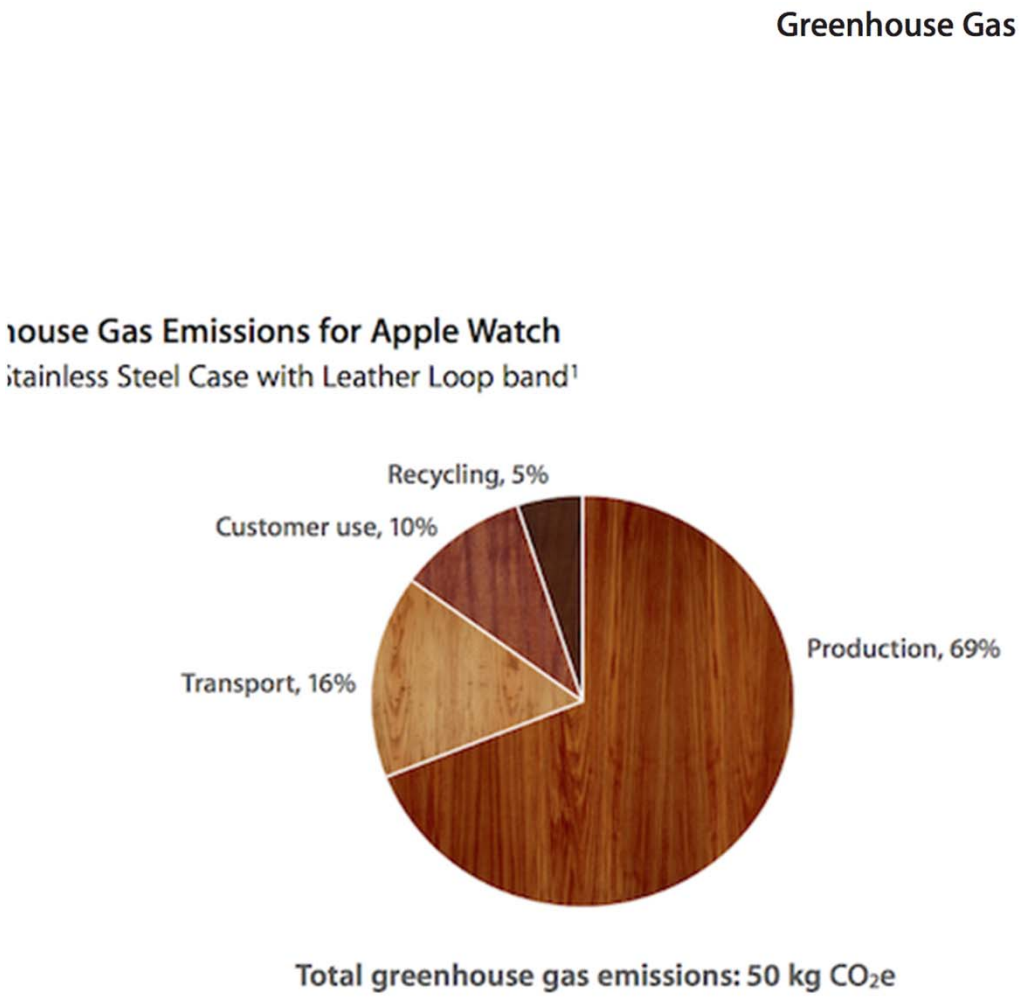
- **New ways to display information**
  - Interactive QR Code Scanning

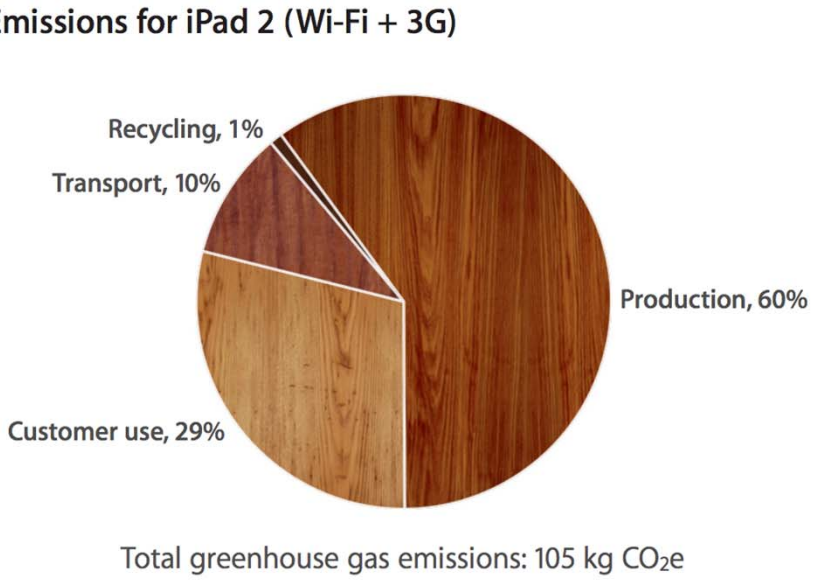


- **Actionable information**
  - In a small office in California, low- and no-cost energy-saving measures reduced plug load energy use by 40%. (NRDC)



Current Work Areas: Consumer Education





Research Challenges

- **Limited amount of researches have been done**
- **Few data sets are available for plug load devices:**
  - **Consumer electronics are fast growing and more sophisticated**
  - **Hard to compartmentalize/ categorize them in the future**
  - **There are just TOO MANY!**

Thank you!

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