Computer Gaming Systems

Energy Efficiency without Performance Compromise

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Team

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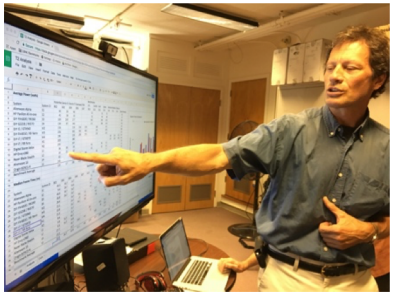

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Testing infrastructure, data management, analysis

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Energy reporting

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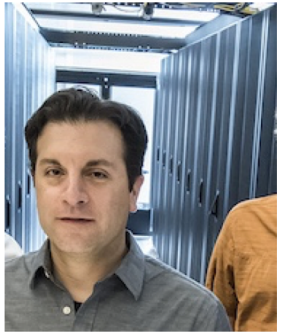

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Cloud gaming

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Testing lead

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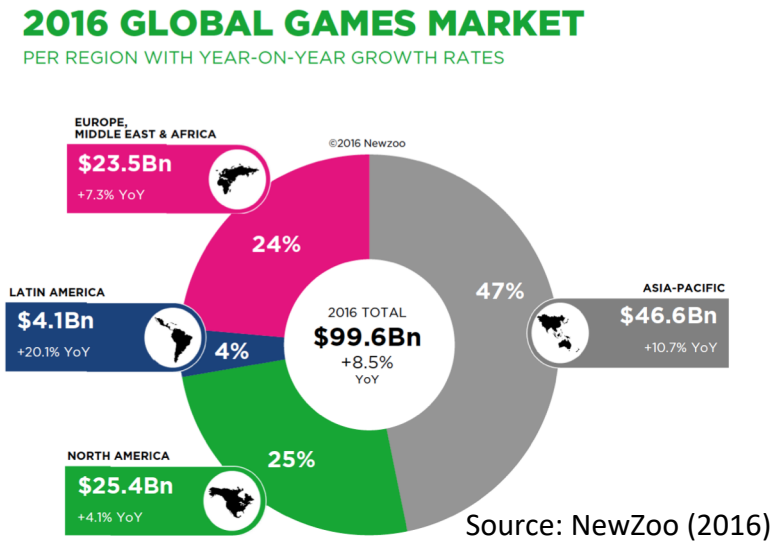
Consoles, market and standards research

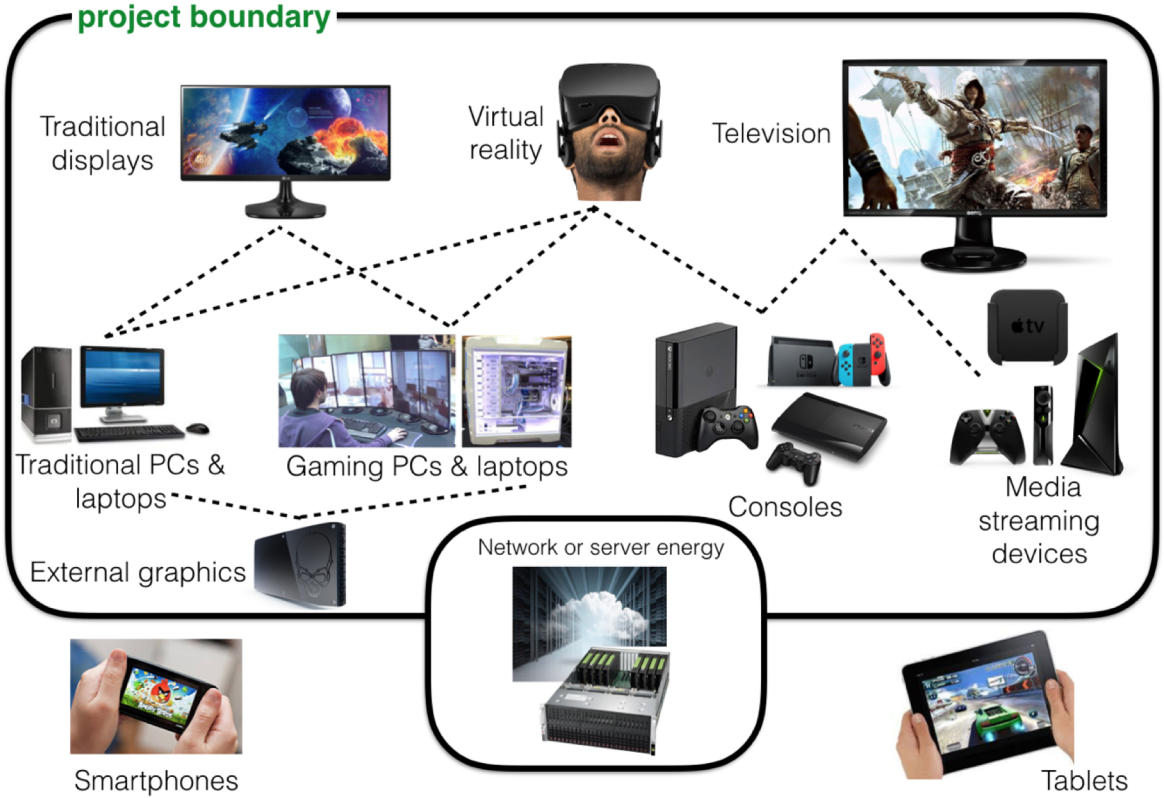
Gaming Marketplace

- **Number**
  - 2 to 3 billion people globally
  - 65% of population in U.S.
  - 15 million systems in California (excluding mobile)
- **Demographics**
  - All walks of life
  - Average age ~35 (25% under 18; 25% over 50)
  - More women (>18) than boys (<18)
- **Annual spend in U.S.**
  - Equipment: ~$6 billion
  - Energy: ~$6 billion
  - Games: ~$25 billion

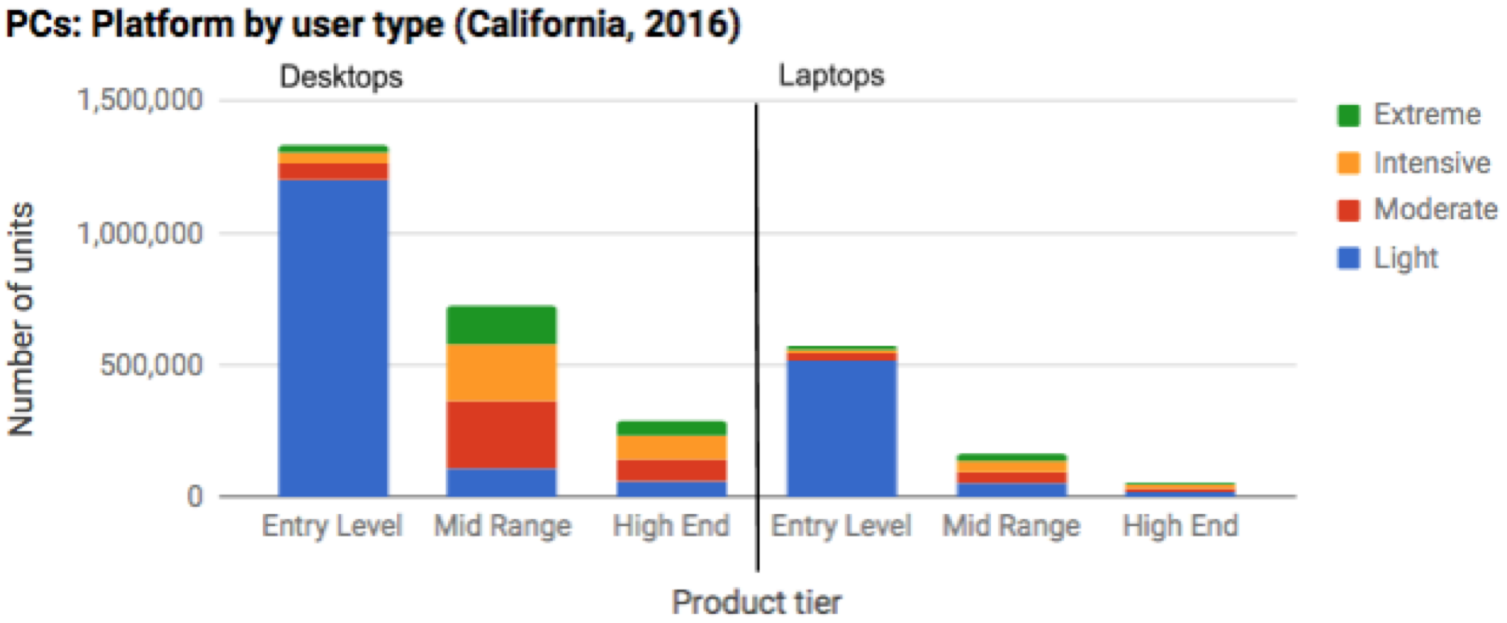


Source: NewZoo (2016)

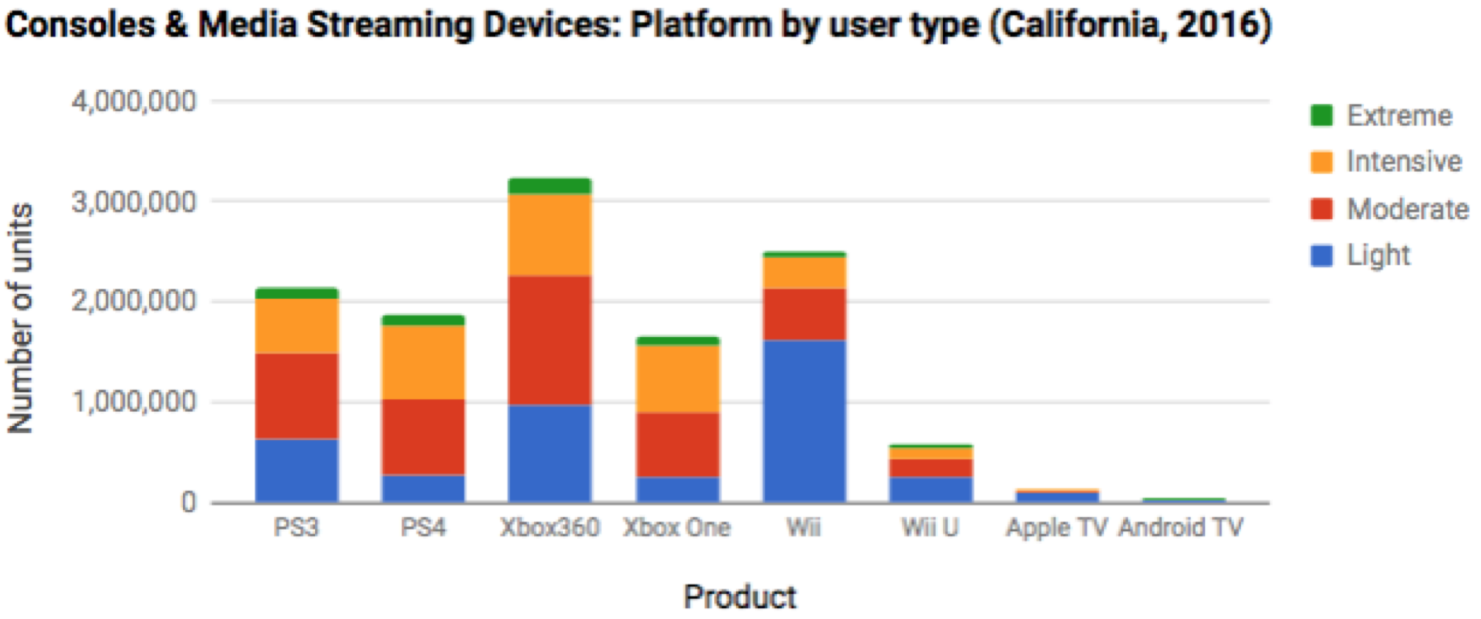
Scope


project boundary
Traditional displays
Virtual reality
Television
Traditional PCs & laptops
Gaming PCs & laptops
Consoles
Media streaming devices
External graphics
Network or server energy
Smartphones
Tablets

3 Million Gaming PCs in California



12 Million Consoles and MSDs in California



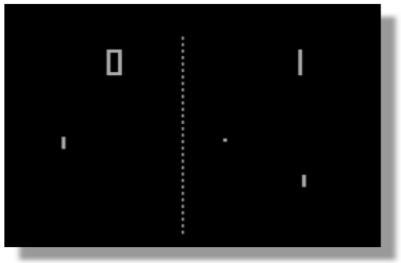
Testing Family Portrait

10 Desktops 5 Laptops 11 Consoles and MSDs

Power vs User Experience

1972

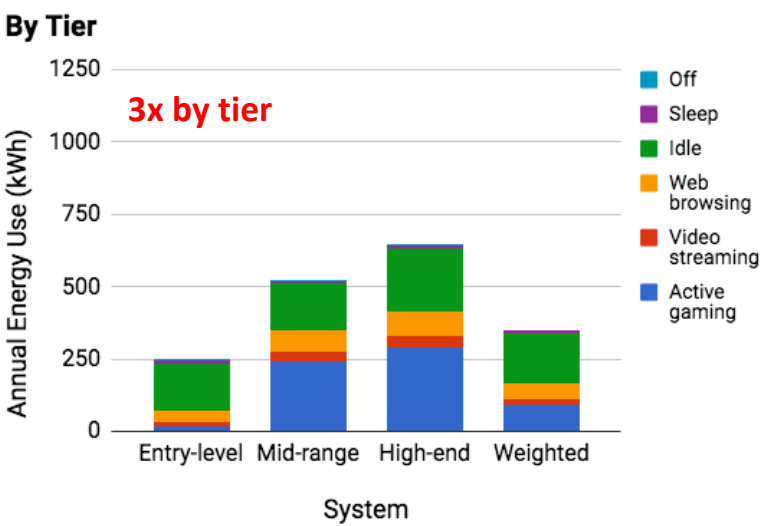
10 watts

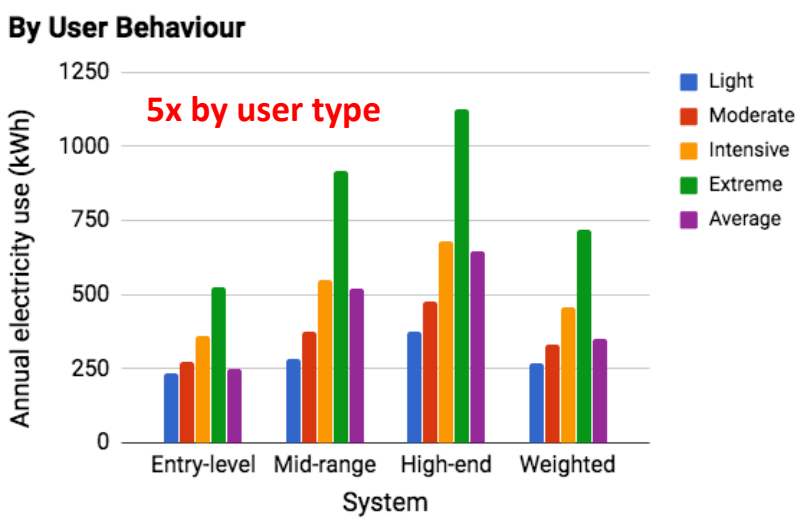


2017

500 watts

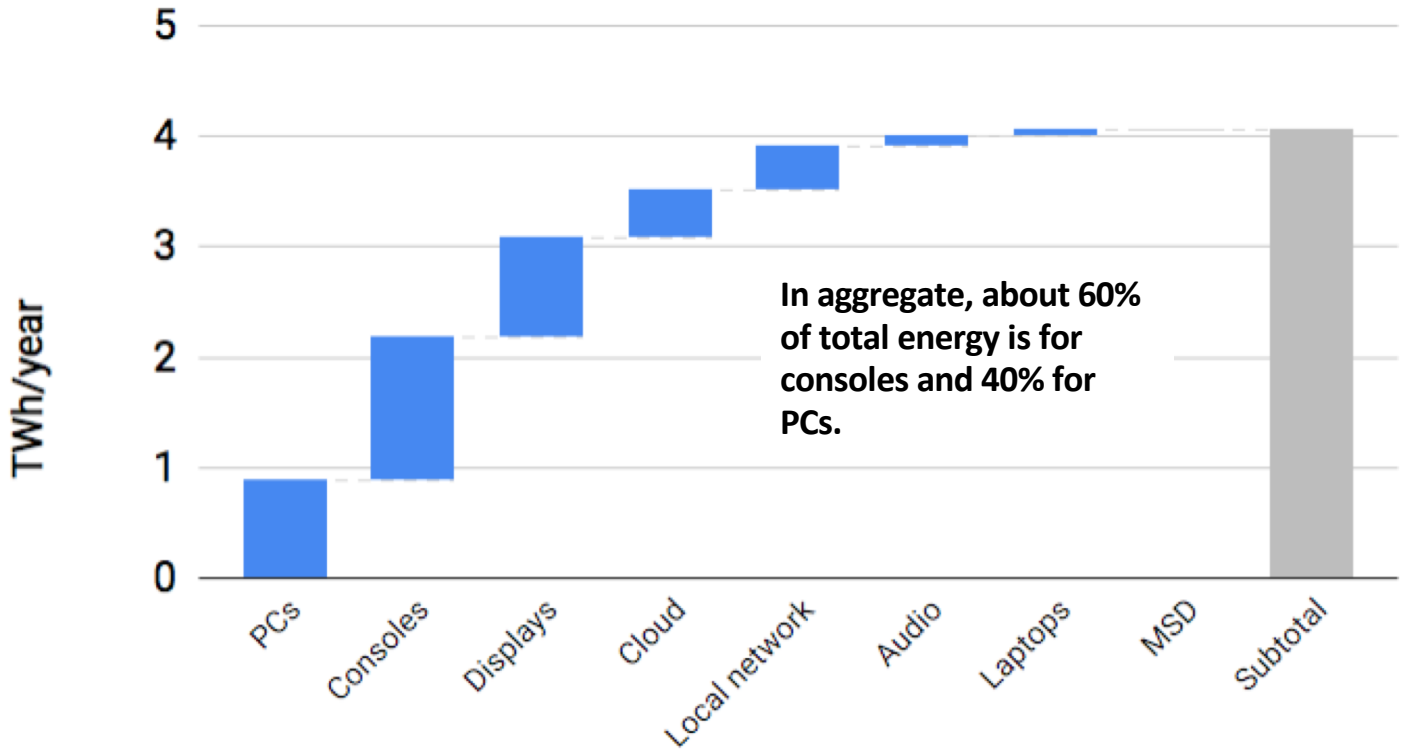
Desktop Energy Use





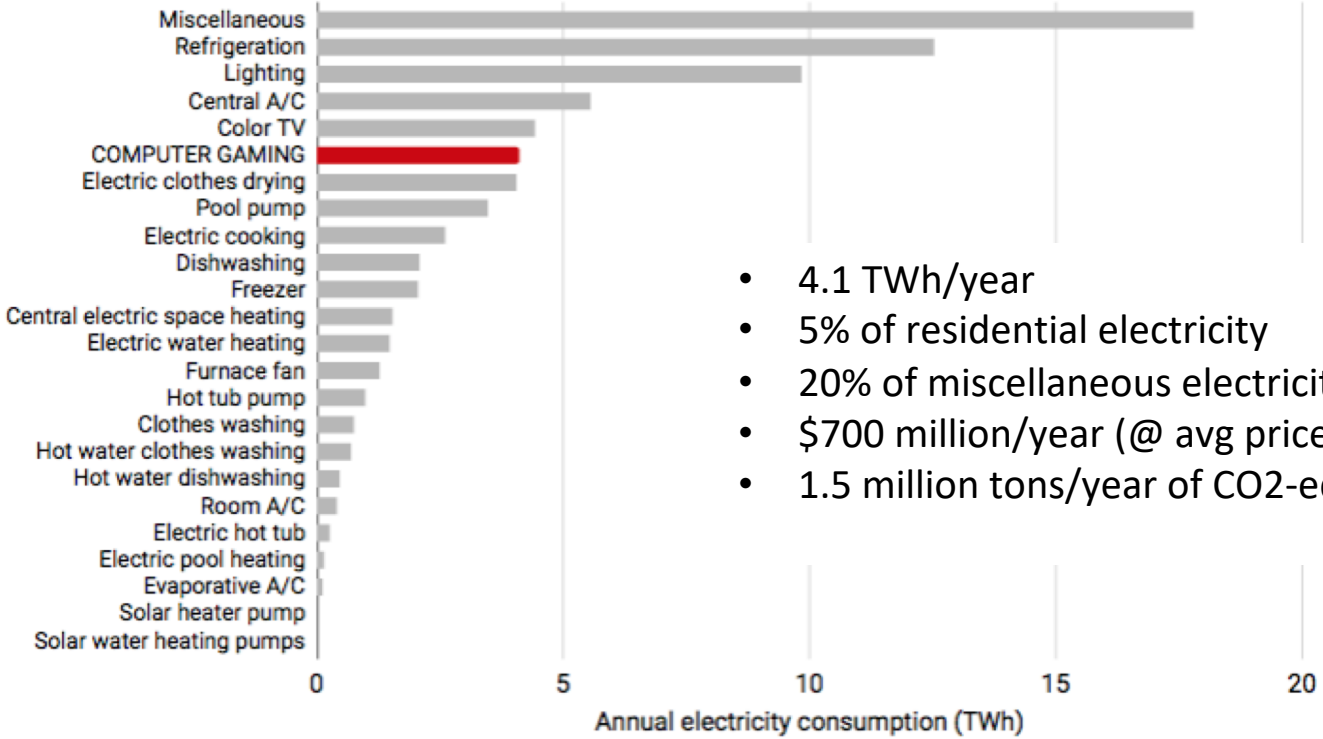
An Extreme user on an Entry-level system uses more energy than a Light user on a High-end system.

California Gaming Energy Use by Category



4.1 TWh

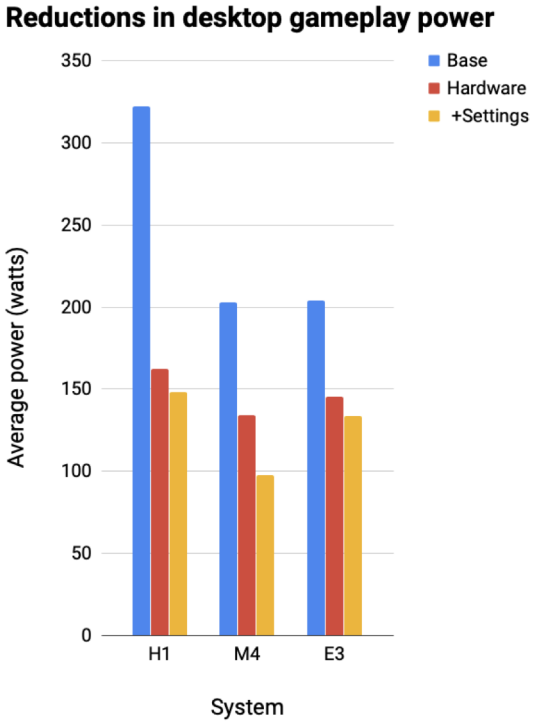
California Gaming Energy Use in Context

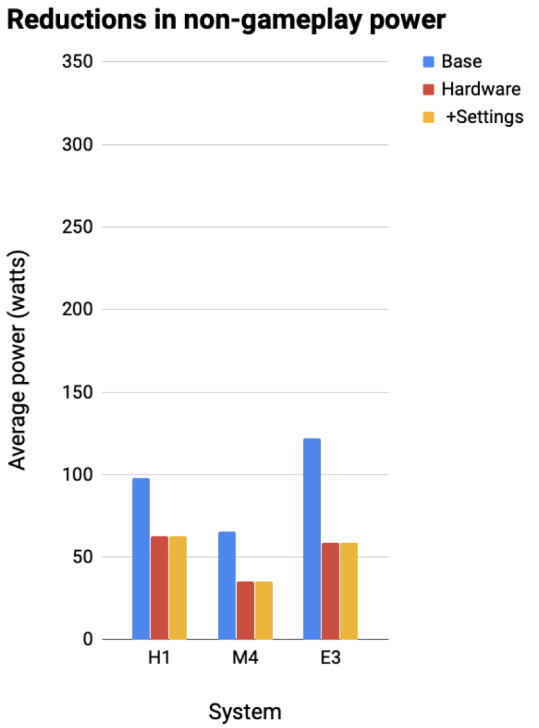


- 4.1 TWh/year
- 5% of residential electricity
- 20% of miscellaneous electricity
- $700 million/year (@ avg prices)
- 1.5 million tons/year of CO2-eq

Energy Efficiency Package Savings

52% savings on average





48% savings on average

Key Findings

- **Today**
  - Computer gaming is a significant, overlooked energy use in California
  - Computer gaming may be the most elusive plug load (or any load)
  - Behavior is stronger driver than technology: duty cycle, game choice

- **Tomorrow**
  - Per-system efficiency potential is on the order of 50% (PCs) and 40% (consoles)
  - Console UECs are trending down while PC UECs are trending up
  - Cloud-based gaming far more energy-intensive than local gaming

- **Policy**
  - Quantifying energy use per unit “services” (user experience) nearly impossible
  - Standards are probably a non-starter (but maybe workable for components)
  - Many other energy policy tools are quite applicable

Opportunities

- Market tracking and demand forecasting
  - Testing of latest products
  - Regularly update market analysis
  - Build gaming explicitly into forecasting
- Consumer information and tools
  - Disseminate results: gamers, media, manufacturers, developers
  - Online power calculator
  - Energy reporting
- Cloud based gaming
  - Idle and part-load conditions
  - Data centers
- Engagement with the game industry
  - Design competitions
  - Standardized test procedures
  - Model efforts after EU's "self-regulatory Initiative" among console manufacturers
- Voluntary ratings
  - System and component power
  - Game energy use

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The project reports can be found at:

greengaming.lbl.gov