Progress in energy efficiency associated with the console industry self-regulatory agreement

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My background

- A.B. History and Science, Harvard University; M.S. and Ph.D, Energy and Resources Group, UC Berkeley
- Lecturer at Stanford now, Research Fellow & Consulting Professor before that. Visiting professor in past at Stanford (2003-4, 2008), Yale (2009), UC Berkeley (2011).
- Formerly Staff Scientist + Group Leader (from 1991 to 2003) at Lawrence Berkeley National Lab (LBNL), post doc (1990-91), grad student (1984-90)
- Founded and led LBNL's Energy Forecasting group
  - Key technical support for EPA's Energy Star group
  - Analyzed efficiency standards, utility programs, and voluntary programs for DOE and others
- Coauthor on first comprehensive analysis of a 2C warming limit (1989)
- Focused on computing electricity use since early 1990s
  - Key recent work on data center electricity use and trends in aggregate computing efficiency for computers and networks
- Pubs listed at http://www.koomey.com

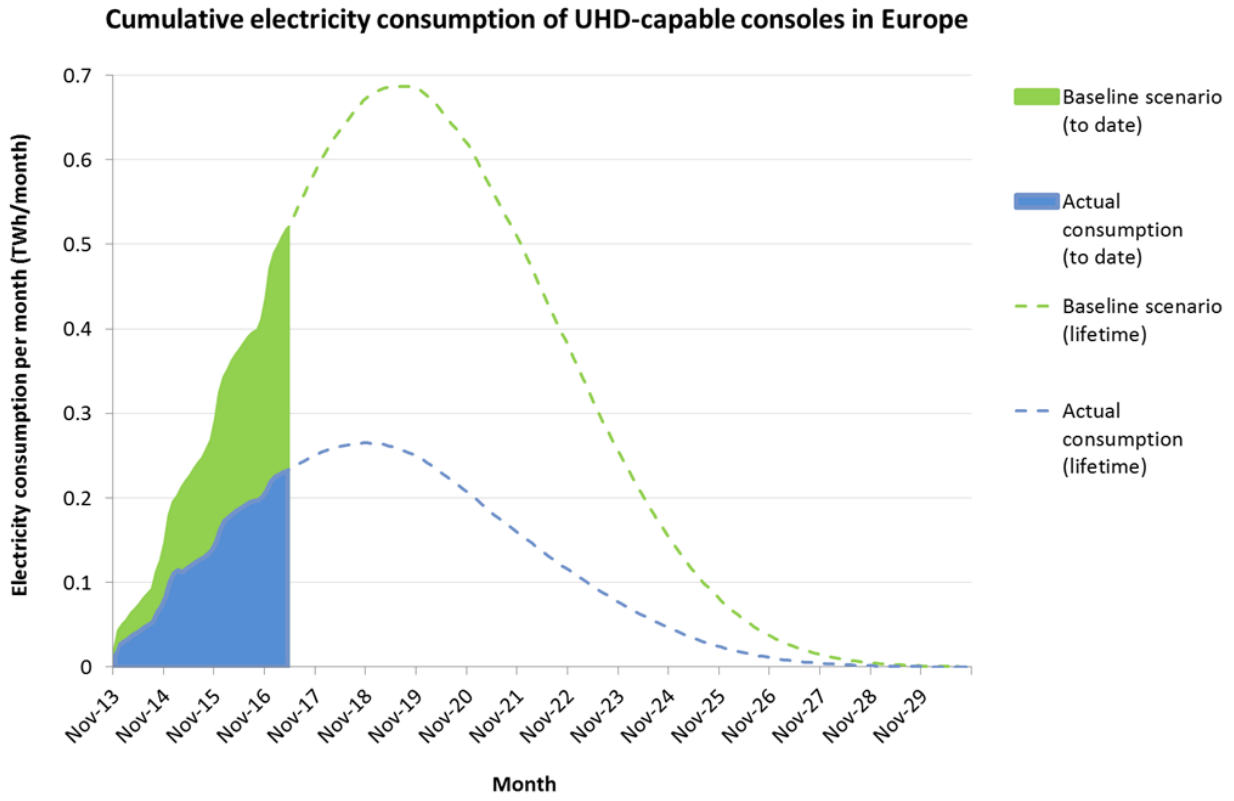
Savings estimates

- Accuracy/credibility
- Historical achievements
- Future ambition

Accuracy/credibility of savings estimates

- Based on peer-reviewed methods from Webb et al. (2013), Aslan (2017) and latest industry data
- Transparent calculations, updated as time passes
- Projected savings in 2020
  - Initial estimate: 1.1. TWh/year savings
  - Current estimate: About 5 TWh/year savings

Savings over time for console SRA

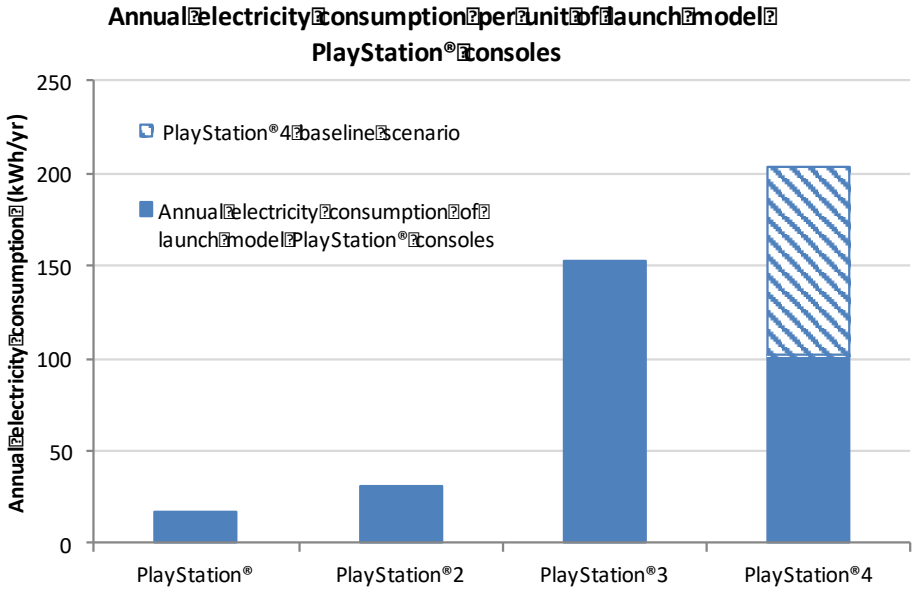


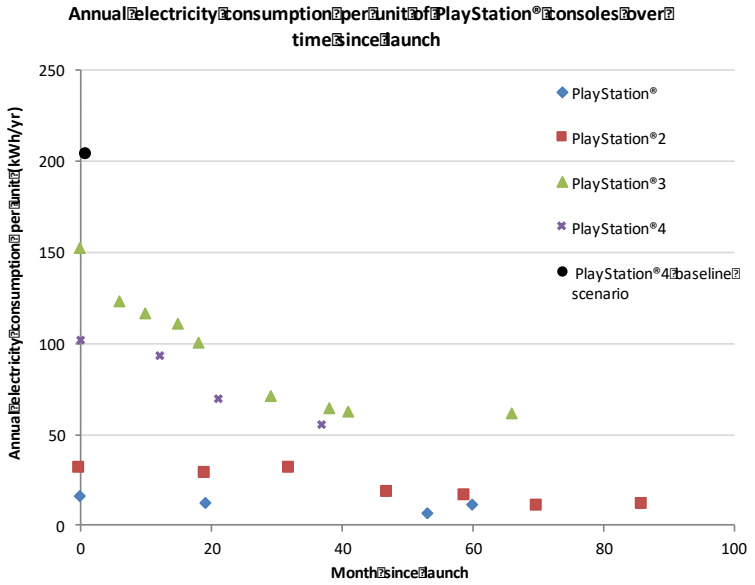
Savings rel. to baseline to be about 5 TWh/year in 2020 (vs. 1.1 TWh/year initially projected)
Source: Microsoft, Nintendo, and Sony. *Report on the 2017 review of the game console self regulatory initiative*. October 13, 2017, www.efficientgaming.eu

Historical achievements

- Sony's progress: Total energy consumption over time for PlayStation consoles
- Microsoft's progress: Xbox One S (2016) vs. most efficient Xbox 360
- Nintendo's progress: Wii U modal power consumption over time

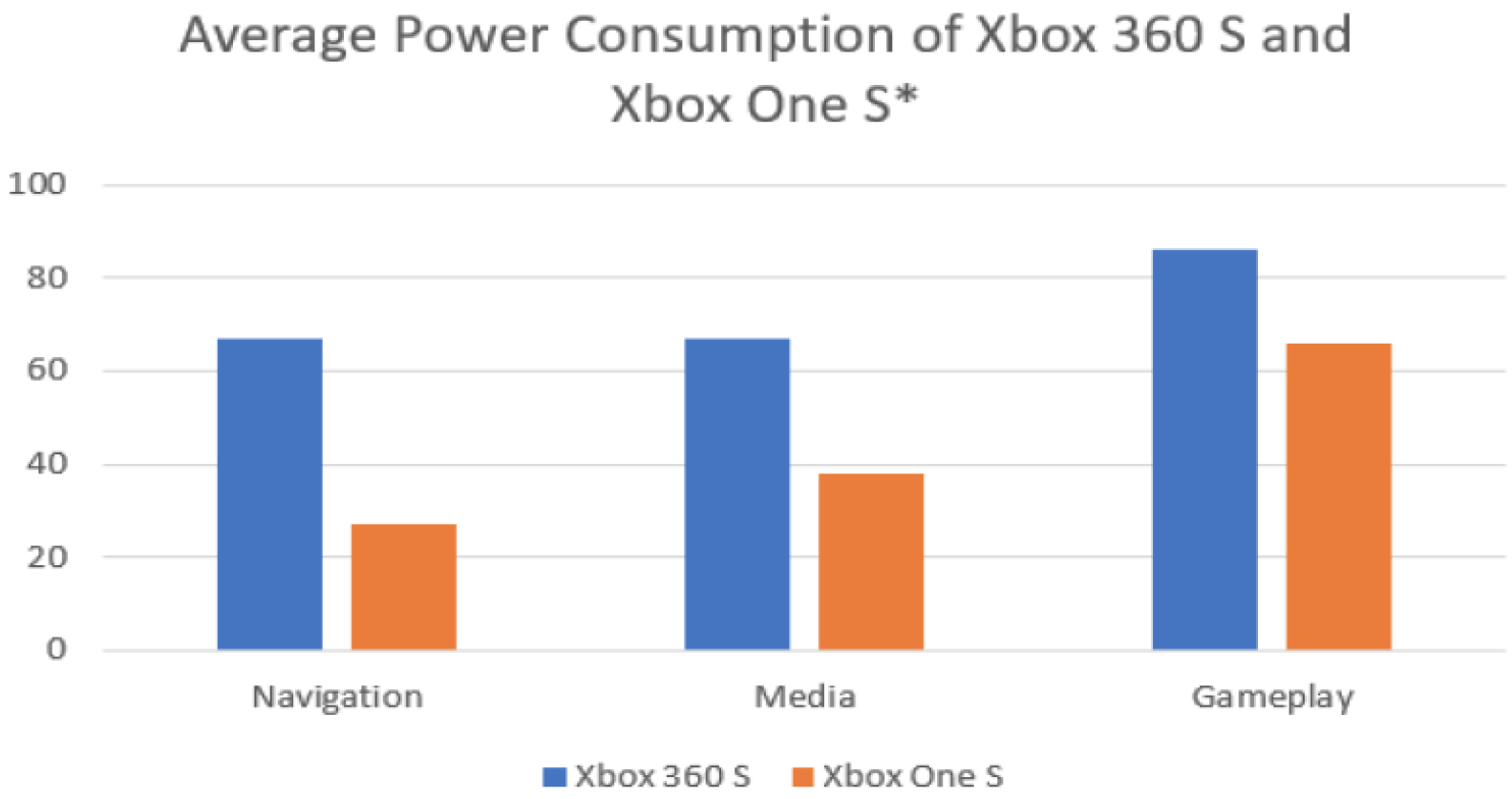
Sony's progress: Total energy consumption (TEC) over time for PlayStation consoles





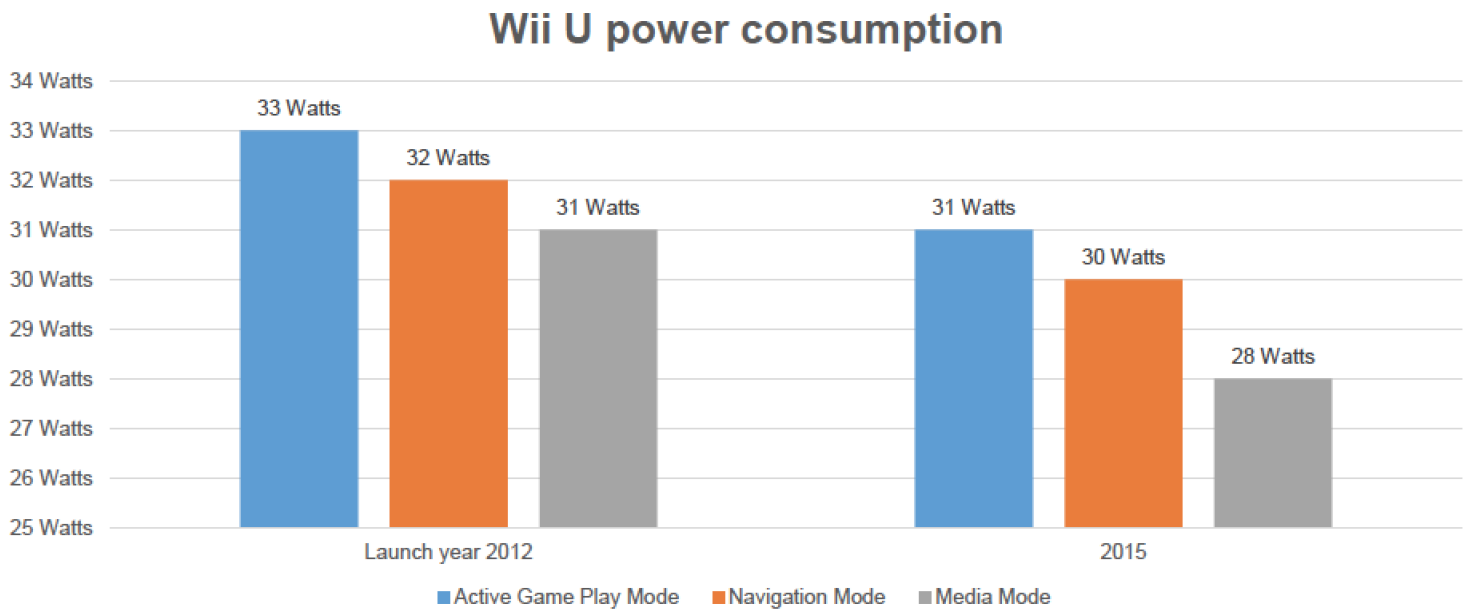
Launch models for new Sony consoles had increased TEC from PS1 to PS2, and from PS2 to PS3. PS4 broke that trend, with launch model TEC about one third lower for PS4 than PS3. Even with that progress in the launch model PS4 TEC rapidly decreased after the launch model.

Microsoft's progress: Xbox One S (2016) vs. most efficient Xbox 360



Consumption is in watts for each mode

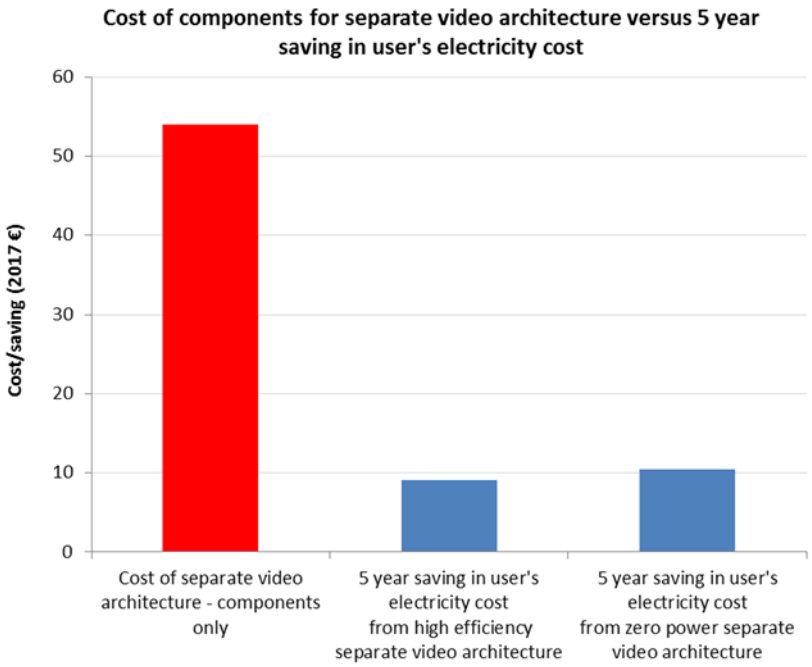
Nintendo's progress: Wii U modal power consumption over time



Future ambition

- New technologies may enable more progress in efficiency in future, but economic and technology limits constrain what can be done without complete redesign of console architecture.
- Example of economic and technology limits: Separate video architecture for media play

Separate video architecture not economically justified



Sources: Assumes current TEC numbers for PS4 from Aslan (2017) and low power architecture characteristics from Webb (2014). Also assumes 50:50 split in media time between streaming and DVD and constant average 2015 electricity prices for EU-28 (0.205€/kWh). High efficiency video architecture assumes a device similar to Apple TV, with a parts cost of about 54 Euros. This cost doesn't include assembly or markups. Five-year electricity savings are a simple sum projected over that period. Zero-power case is a thought experiment to show a bounding case. Increased latency from separate architecture not assessed here, but that affects consumer amenity.

Scenario	5 year TEC (kWh)	Δ TEC (kWh)	5 year running energy cost (2017 €)	Δ Running energy cost (2017 €)
Normal scenario - no separate video architec	278.61	-	57.12	-
High-efficiency separate video architecture	234.42	-44.20	48.06	-9.06
Zero-power separate video architecture	227.74	-50.87	46.69	-10.43

Conclusions

- Console industry self-regulatory agreement
  - prodded manufacturers to reduce TEC in initial launch models
  - prompted further efficiency improvements
- Savings calculations based on peer-reviewed analysis and measured data
- Significant savings compared to what would have happened in absence of the agreement
- Until industry launches a new generation of consoles, big jumps in efficiency are unlikely
- Separate video architecture not justified based on costs and energy savings

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