



The Influence of Regulations, Incentives and Social Consciousness on Power Management

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Introduction

- Much activity over past 40 years – 1970 to 2012
- Has all of this effort been for naught?
- What positive trends have resulted
- Has it really changed how people think?
- Are we any more energy conscientious today than 70 years ago?
- What are our responsibilities as engineers and product marketing and as corporate managers?
- What can we expect in the future?



Types of Efficiency Programs for EuPs*

- **Agency voluntary programs** (i.e. ENERGY STAR, EC Code of Conduct, 80 Plus) contain efficiency “**specifications**”
- **Agency mandatory programs** (CEC, US EISA2007, EC EcoDesign Directive, MEPS**) contain efficiency “**standards**”
- **Industry group “peer pressure” programs** (Climate Savers Initiative)
- **Horizontal programs** set efficiency requirements regardless of type of product; vertical programs are product dependent

Global Participation

Korea, Japan, China, Australia, Europe, United States, India,

* Energy using Products ** Minimum energy performance standard



Some of the Agencies

- EPA/Energy Star
- EcoDesign
- EU Code of Conduct
- California Energy Commission
- U.S. Department of Energy (formed 1976)
- Ecova, Inc. (formerly Ecos Consulting)
- Electric Power Research Institute
- Climate Savers → now The Green Grid
- American Council for an Energy Efficient Environment
- And many more...



**CAN THE INDIVIDUAL MAKE A
DIFFERENCE? – ABSOLUTELY**



Dr. Arthur Rosenfeld “Father of Efficiency”

Appointed by Governor Davis

4/2000 to 1/2005

Appointed by Governor Schwarzenegger

1/2005 to 1/2010

Art Rosenfeld received his Ph.D. in Physics in 1954 at the University of Chicago under Nobel Laureate Enrico Fermi, and then joined the Department of Physics at the University of California at Berkeley



Dr. Rosenfeld is the co-founder of the American Council for an Energy Efficiency Economy (ACEEE), and the University of California's Institute for Energy and the Environment (CIEE).

A unit of energy is named for Dr. Rosenfeld



Key Tools

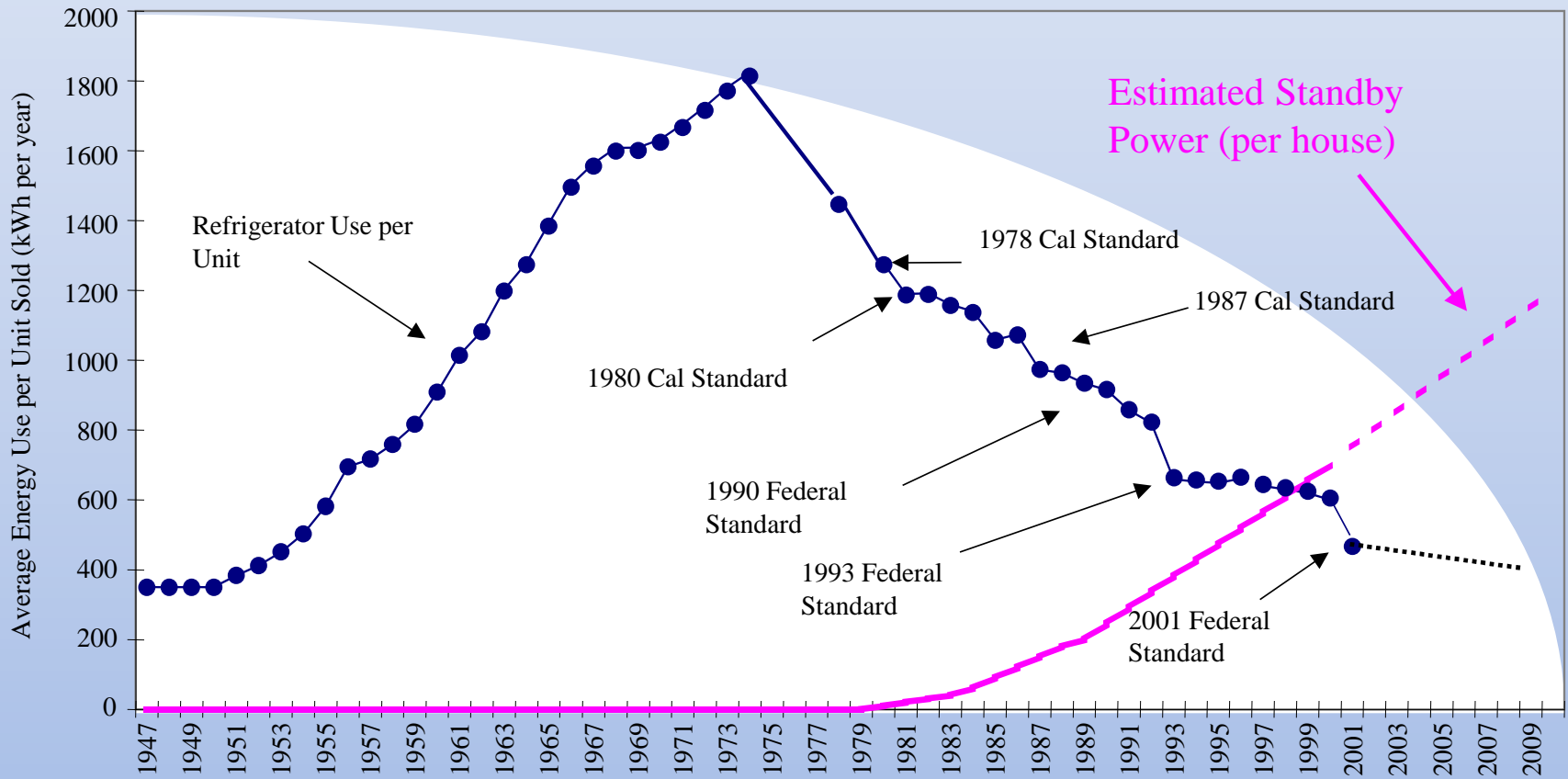
- Macro Math
 - Dr. Rosenfeld's contribution: Applied macro-math to energy efficiency
 - 1 Exajoule (10^{18} primary energy) ~ 30 Rosenfelds
 - Worth of a watt – by ATT in 1978 , updated by Mark Jacobs at APEC 2008
- The Delphi Method
 - Is a structured communication technique
 - Originally developed as a systematic, interactive forecasting method which relies on a panel of experts
 - In the standard version
 - Experts answer questionnaires in two or more rounds.
 - After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments.
 - Produces questionable results if the sample is small
- Other Macro Maths - Wolfram's *Mathematica*



CAN REGULATIONS MAKE A DIFFERENCE? - YES



An Early Example of Success



Source: Arthur Rosenfeld, California Energy Commission

Estimated Standby Power Growth vs. Refrigeration Power Consumption
3/20/2013

APEC 2013

The “California Effect”

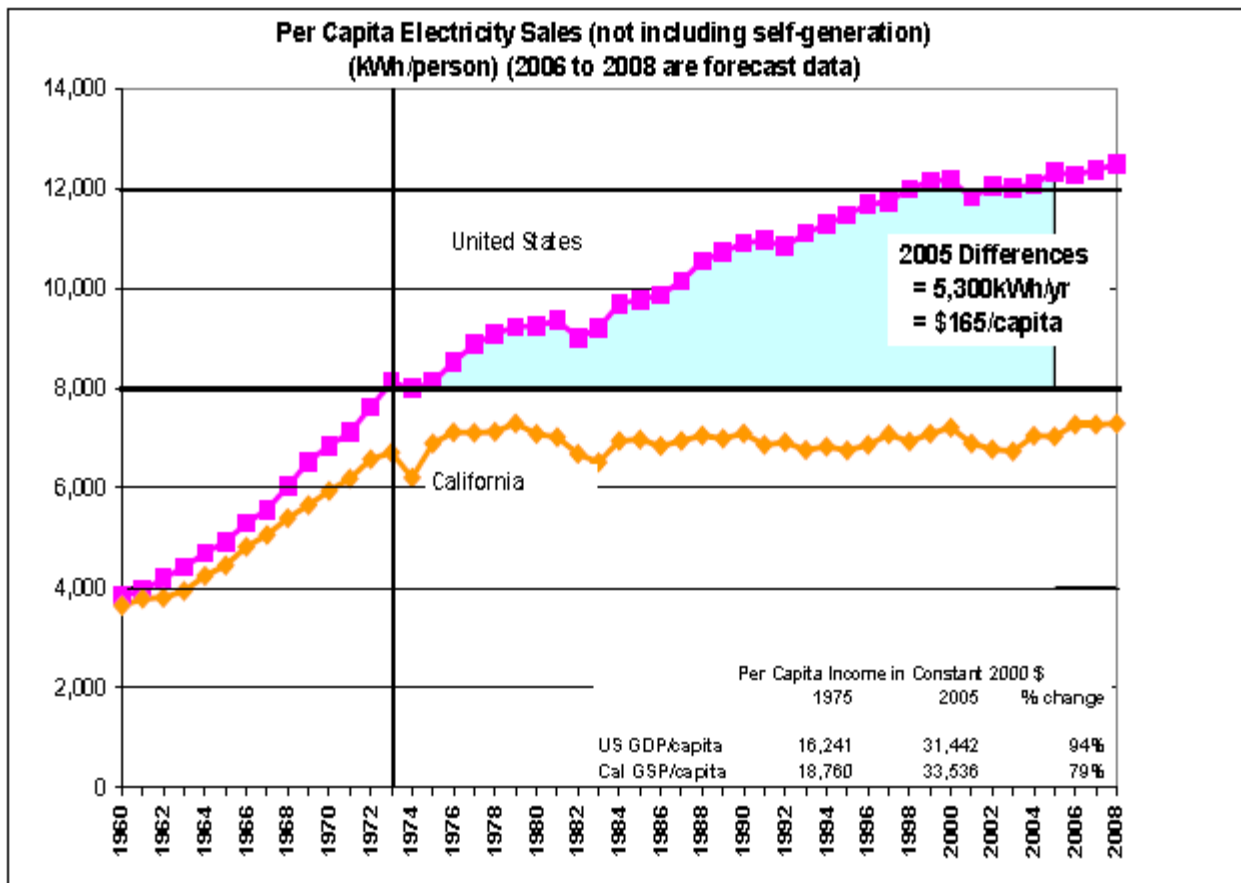


Figure 2: California per capita electricity consumption relative to the rest of the United States (Source: Rosenfeld 2008)

Energy Consumed by U.S. Manufacturing

- More efficient motors
- More efficient ???
- Erosion of U.S. Manufacturing
- Accounts for 25% of U.S. energy
- Causing stress on Utilities

U.S. Electricity Use on Wane

By REBECCA SMITH

Americans are using more energy to power their air conditioning systems, for example. But their electricity use is barely growing, posing a daunting challenge for the nation's utilities.

The Energy Information Administration is projecting that electricity use in the U.S. will rise an average of just 0.6% a year for industrial users and 0.7% for homes through 2040.

That's a far cry from the mid-1970s, when electricity consumption was growing by more than 8% a year. Even after the Arab oil embargo in 1973, the growth in electricity demand slowed to about 4% annually, but those days may be long gone.

In response to tepid demand, U.S. electricity production fell in

2008 and 2009, amid the recession, then ticked up slightly in 2010 before falling again in 2011.

For decades, electricity use was viewed as a barometer of economic growth, but the link has become less clear cut in recent years, partly because of a big push to make major appliances and other products, such as compact fluorescent lights and high-efficiency motors, that use less electricity.

The erosion of U.S. manufacturing, which has contributed to the decline in industrial electricity use, is a factor, too. Manufacturing, which accounts for about a quarter of the nation's total, from 1998 to 2010, the electricity used for manufacturing fell 18%. That's because of new more efficient and smaller machines produced fewer goods in the U.S.

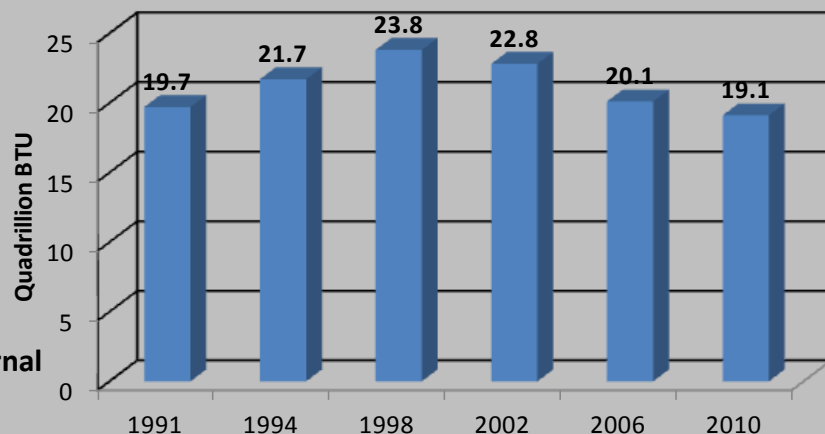
Electricity use may be helping the environment, since most of the nation's electricity still comes from burning fossil fuels. But it has power companies scrambling to trim spending or redirect capital investment, to improve their profits regardless of consumption patterns.

Some companies, including Public Service Enterprise Group Inc. and Northeast Utilities, are pouring money into high-voltage transmission lines—superhighways for electricity—because federal regulators are allowing them to collect above-average returns from customers on those outlays to encourage new investment in the nation's aging power networks.

Others are slashing spending, including Exelon Corp., which is cutting investment in nuclear-



Total Energy Used for U.S. Manufacturing



Source: U.S. Energy Information Administration & Wall Street Journal

Sweden runs out of garbage, forced to import from Norway

- Swedes are *big* on recycling. Only 4 percent of all waste generated in the country is landfilled
- But is bit of a problem given that the country relies on waste to heat and to provide electricity
- So they turned to their neighbor



[Reduce, Reuse, Recycle, Waste](#)

Photo: [Smath/Flickr](#)



Social Consciousness

- Public is resisting smart grid attempts to control family appliances
- Manufacturers have resisted improved efficiency
- Other manufacturers have promoted improved efficiency
- “Improved HVAC (heating, ventilation ,and air-conditioning) performance in buildings has been one of the most profitable and uncontroversial ways for society to save energy and money.” Source: Dr. Arthur Rosenfeld
- The “Green” Campaign has probably had the most impact
- Successful world-wide efforts of EPA/Energy Star

The Solar Maze

- The Solar Example
 - Incentives to install
 - Incentives to invest in manufacturing
 - Incentive from the utility – an oxymoron?
 - “I will pay you for using less of my product.”
- Solar Maze
 - State laws vary
 - Local laws apply
 - Rebates slow in coming
 - Turning on the solar system can take months
 - Difficulty in getting two-way power meters installed

ENERGY

Officials consider altering mandate

Changing rules for renewables on table

By Ryan Randazzo
The Republic | azcentral.com

Arizona regulators are considering sweeping changes to the way utilities such as Arizona Public Service Co. comply with the mandate to get 15 percent of their electricity from renewable sources by 2025.

One change could reduce the mandate for APS to 13.35 percent. Other changes could affect the incentives that utilities pay for homeowners and businesses to install solar.



Incentives

- Finite life can have ultimate negative effect
- On-Going incentives are much better
- Lowering the power bill is one of the best incentives
 - What is genuine? What is fake?
 - Even Energy Star had an credibility incident with their self qualification program and had to implement third party qualification



PFC – Hardest Standard to Sell

- When we promote PFC
 - We say it provides improved power factor
 - But most times we mean it reduce harmonics
- Difficult to explain PFC to public
- Ever present harmonic distortion – office power is a square wave most of the time
- Harmonics destroy equipment
 - Transformers overhead
 - Motors overheat

And maybe do even more!



Is Harmonic Distortion Dangerous?

- Harmonic distortions creates circulating currents on the ground line and produces voltage potentials
- Does this presents a danger to the public
- How many incidents have been caused by this phenomenon?
- Are we citing the wrong causes?

East-Village-Woman-Was-Electrocuted-on-Street-With-Metal-Plate,·Medical-Examiner-Says ¶

By ANTHONY RAMIREZ
Published: January 22, 2011
The New York Times

The New York Times reported that a woman was electrocuted on a slush-covered street near her home in Manhattan. The woman was electrocuted in the New York City medical examiner's office said yesterday.

Witnesses said Jodie S. Lane, 30, a doctoral student in clinical psychology at Columbia University in New York City, was walking her two dogs in front of Veniero's pastry shop on East 14th Street shortly before 6:30 p.m. Friday when her dogs started

Woman·shocked,·dog·killed·by·possible-flaw·in·city·electrical·line ¶

By Paul Ludlow ¶
Ambitious Dispatch Friday, January 27, 2012 10:14 PM ¶

Lezlie Combs was walking her Siberian husky in the Iuka Park ravine in the University District when her dog began to jump and "scream."
She rushed to the edge of the ravine, only to be knocked back by a nasty shock.
As a police officer arrived in response to the woman's screams for help, her dog, only to be knocked back by a nasty shock.
A police officer arrived in response to the woman's screams for help, from a city electrical conduit buried along Iuka Avenue near the ravine. The husky and shocked Combs. She was not seriously injured.

Dog electrocuted on west-end Toronto sidewalk

Fateful step leaves dog dead, owner angry

[http://www.blogger.com/document.write\('Email story'\)](http://www.blogger.com/document.write('Email story'));

INCIDENTS OF STRAY VOLTAGE

Stray voltage has led to many electrocutions in the U.S. in recent years, including:

- Jodie Lane, a 30-year-old doctoral student at Columbia University in New York, was killed when she stepped on a service box lid while walking her two dogs in 2004. The current was reportedly transferred to her from the dogs, who survived. Her death triggered an investigation that led the state to adopt strict regulations on stray voltage.



IS THE REGULATION LANDSCAPE BECOMING MORE COMPLEX? - YES



EcoDesign – Over 30 Lots

■	PC:s and servers, Lot 3	Regulatory Committee 28 February 2013.
■	Imaging equipment, Lot 4	Voluntary agreement recognized.
■	Televisions, Lot 5	Consultation Forum revision of <u>ecodesign requirements</u> 8 Oct 2012. Regulatory <u>Committe amendment</u> 21 March 2013.
■	Standby and off-mode losses of <u>EuPs</u> , Lot 6	Entry into force 7 January 2009. Amendment to ISC in November 2012.
■	Battery chargers and external power supplies, Lot 7	Entry into force 27 April 2009
■	Tertiary Lighting, Lot 8–9	Entry into force 13 April 2009
■	<u>Room air conditioning appliances, Lot 10</u>	<u>Regulation in force 26 March 2012.</u>
■	Residential ventilation and kitchen hoods Lot 10	Consultation Forum 6 Nov 2012
■	Electric motors, Lot 11	Entry into force 12 August 2009.
■	Ventilation fans, Lot 11	Regulation in force 26 April 2011.
■	Circulators in buildings, Lot 11	Entry into force 12 August 2009 Amendments proposed in April 2011.

Source: <http://www.psma.com/technical-forums/energy-efficiency/efficiency-database>



New EcoDesign Regulations

- ENER Lot 27: **Uninterruptible power supplies (UPS)**
- ENER Lot 28: **Pumps** (extended product approach including motors, VSD and controls, where appropriate) for private and public waste water (including all stages including buildings, networks and treatment facilities) and for fluids with high solid content
- ENER Lot 29: **Pumps** (extended product approach including motors, VSD and controls, where appropriate) for private and public swimming pools, ponds, fountains and aquariums, as well as clean water pumps larger than those regulated under Lot 11
- ENER Lot 30: **Products in motor systems** outside the scope of the Regulation 640/2009 on electric motors, such as special purpose inverter duty motors (asynchronous servo motors), permanent magnet motors, motors cooled by their load (fans), including motors and products under Article 1, Points 2(b), (c) and (d) and including drives, such as soft starters, torque or variable speed drives (VSD) from 200W – 1000kW. The study should also cover motors in the scope of the Regulation 640/2009 from 750kW – 1000kW.
- ENER Lot 31: **Products in motor systems** outside of the scope of Lot 30 and the Regulation 640/2009 on electric motors, in particular compressors, including small compressors, and their possible drives.

Source: <http://www.psma.com/technical-forums/energy-efficiency/efficiency-database>



FUTURE CHALLENGES



The Challenges

- Maintaining an balance between environment and engineering reality
- What are our responsibilities as a participant in the Power Management Industry?
- Our designs should be anchored in high efficiency
- However, we are usually confronted with tough choices

Is the Wireless Charger A Step Backwards?

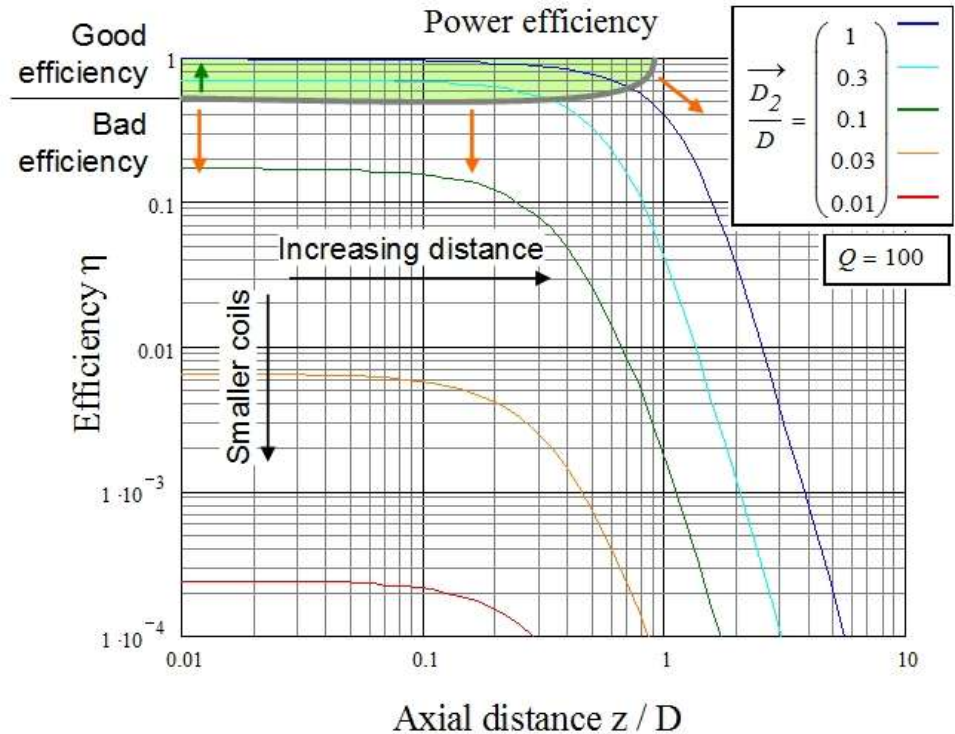
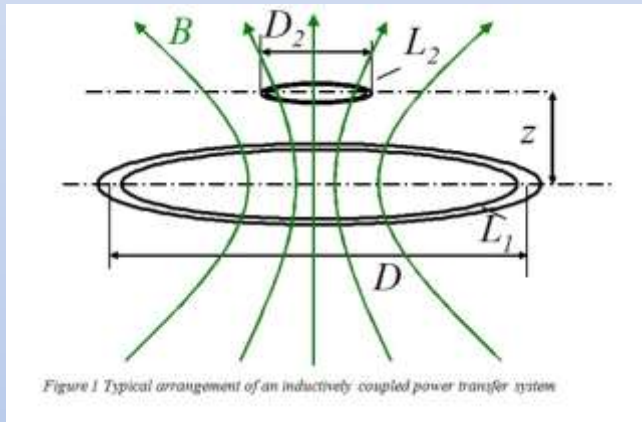
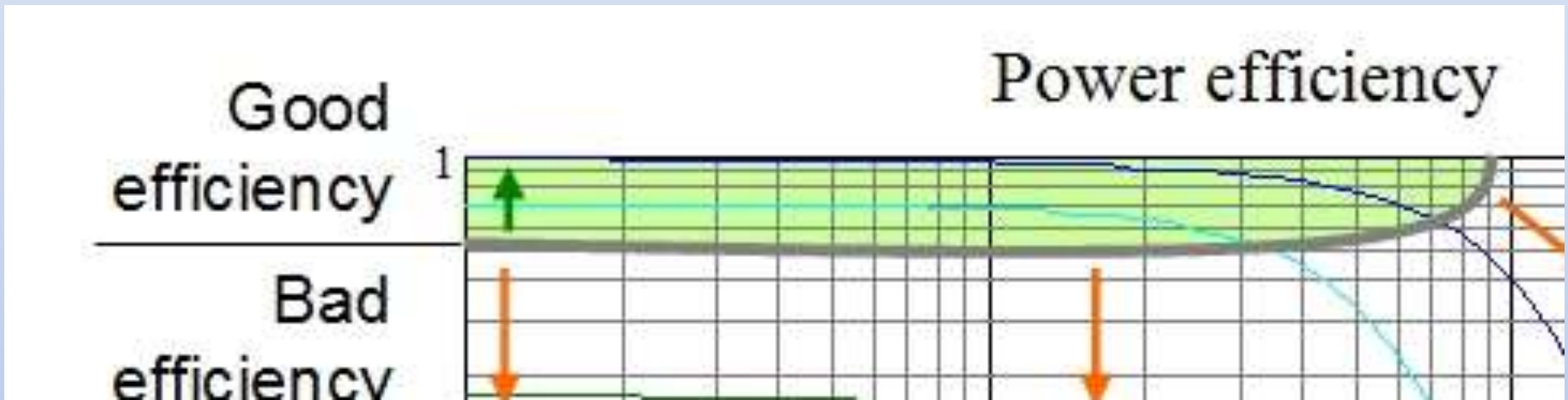


Figure 2 Power efficiency for an inductive power transfer system consisting of loop inductors in dependence on their axial distance z with size ratio as parameter. Calculated for a quality factor of $Q = 100$

Source: Wireless Power Consortium

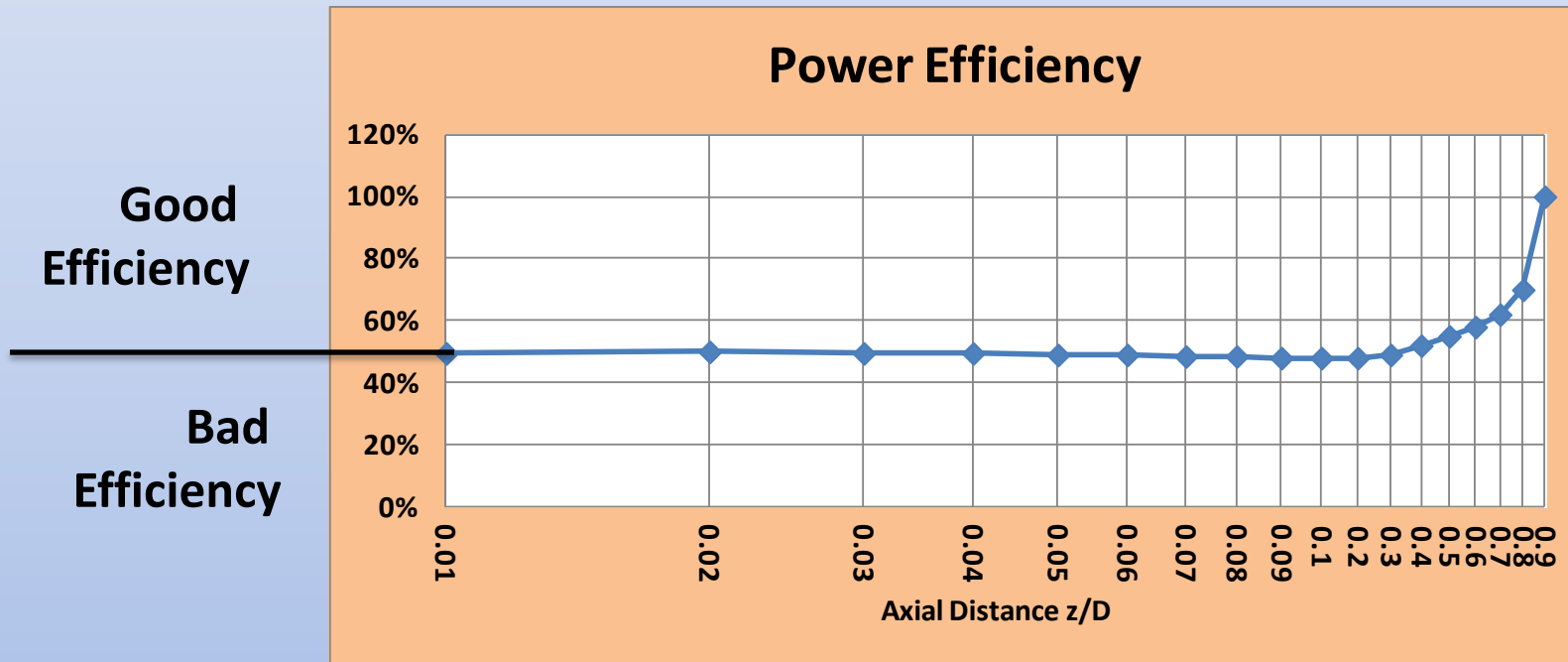
WC Efficiency Challenge



- The cost of convenience – 85% η down to less than 50%?



A More Realistic Presentation





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