Power Supply Energy Efficiency: Challenges and Opportunities

Chris Calwell

VP, Policy and Research

Ecos Consulting

Presentation to PSMA

March 11, 2002

Key Questions Behind Ecos Consulting's Power Supply Research

- How many power supplies are out there?
- What does it mean for a power supply to be energy efficient?
- How important are active power efficiency losses compared to standby power consumption?
- Would it be cost effective to improve efficiency?
- What could be done to drive that change?
- How much difference would it make?

Estimated Power Supply Sales & Number in Use

	North America		Global	
Power Supply Type	Unit Sales / Year	Total Units in Use	Unit Sales / Year	Total Units in Use
External	> 250 million	> 1 billion	> 1 billion	> 3 billion
Internal	> 250 million	> 1.5 billion	0.5 to 1.5 billion	> 3 billion
Total	> 500 million	> 2.5 billion	> 1.5 to 2.5 billion	> 6 billion

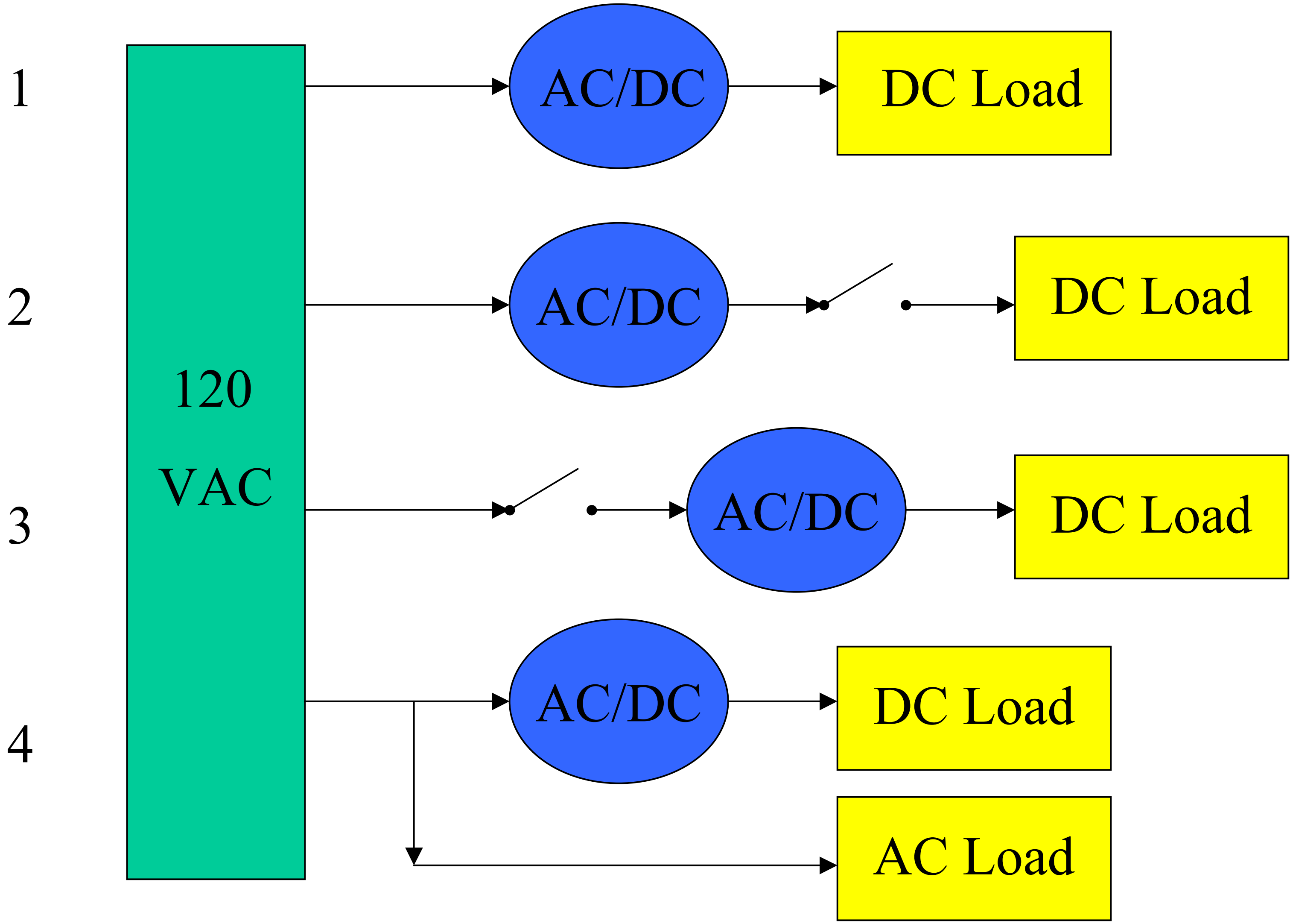
Defining Terms

Term	Meaning
power supply	Circuit cuts AC voltage, converts to DC
active mode	Full operational state (usually not 100% of rated load, though)
sleep mode	A lower power state than active mode – product retains some ability to respond quickly to input
standby mode	Functionally equivalent state to “off” from a user perspective, but may still be drawing some electrical power
hard “off” mode	Switch allows power to be interrupted in front of power supply, causing zero power consumption in standby mode

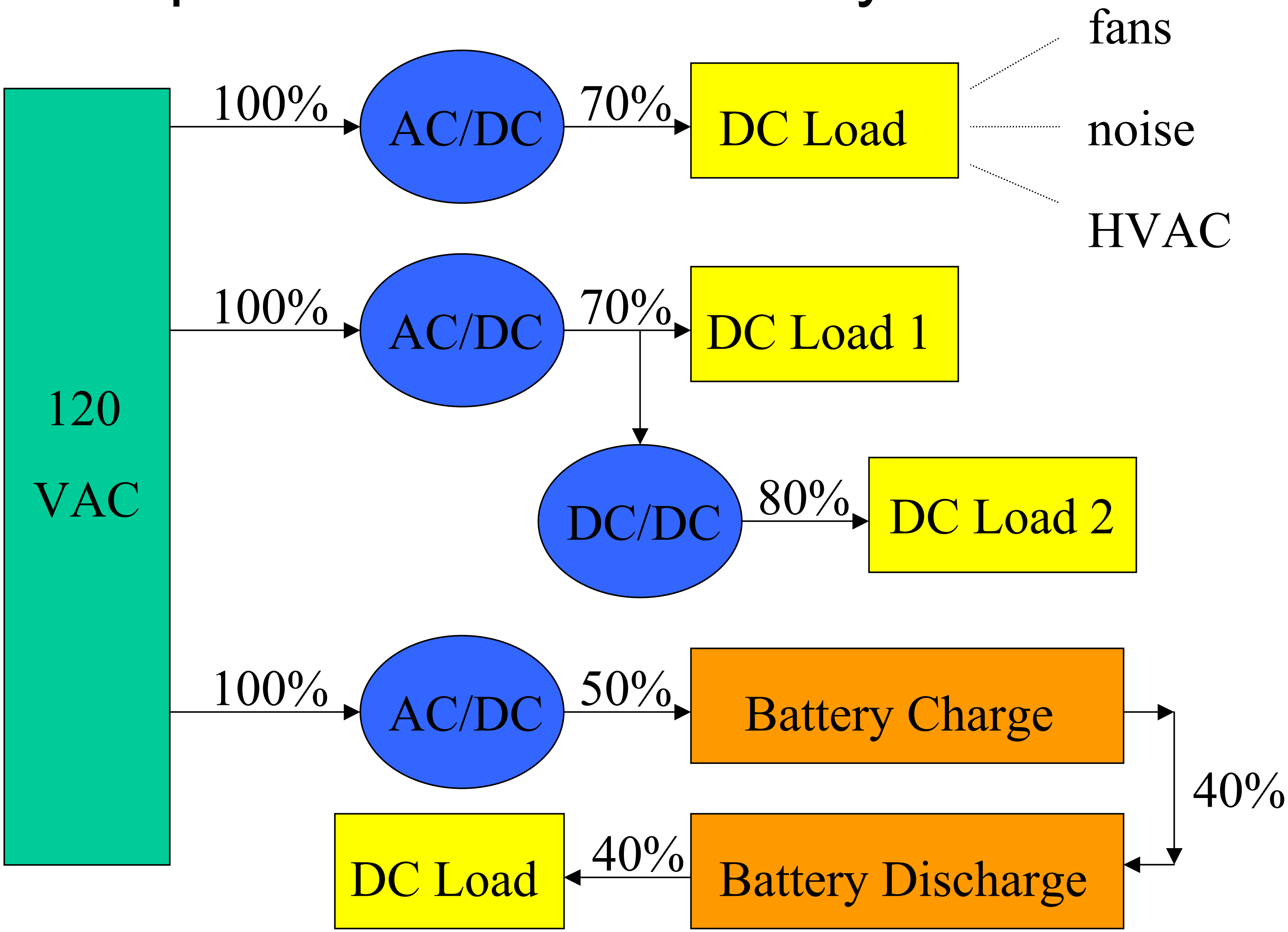
What Is an “Efficient” Power Supply?

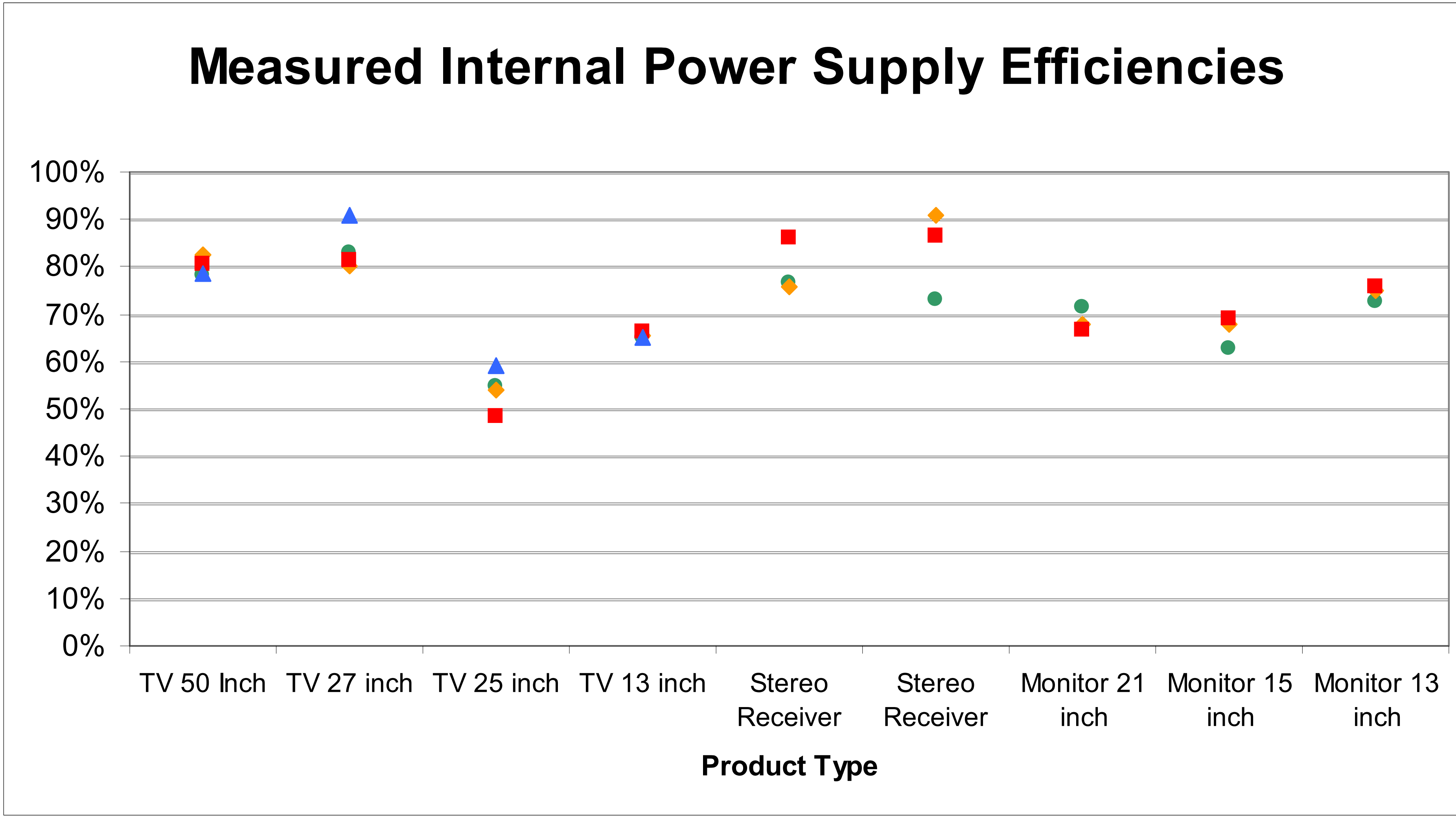
- “Efficiency” = useful DC power out / AC power in
- Measure both when product is operating (active mode)
- If product has high active power use or long average hours of use/day, active will dominate
- If not, sleep and standby modes may dominate
- Most power supplies always draw less than full rated power (part load efficiency)
- Ideally, a power supply-containing product has minimal standby consumption, high operating efficiency across a wide range of load conditions, and is smart enough to “sleep” after inactivity.

Power Supply Location in the Circuit Matters



Multiple Places for Efficiency Loss

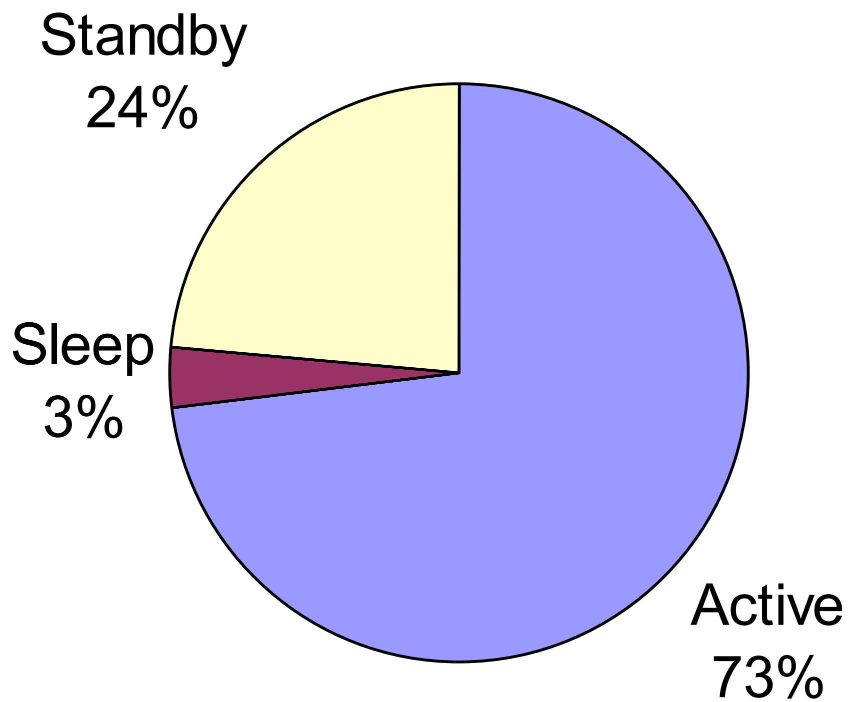



Measured Internal Power Supply Efficiencies
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
TV 50 Inch
TV 27 inch
TV 25 inch
TV 13 inch
Stereo Receiver
Stereo Receiver
Monitor 21 inch
Monitor 15 inch
Monitor 13 inch
Product Type

Total U.S. Electricity Flowing Through Power Supplies:

207 billion kwh/year, worth about $17 billion/year

At least 6% of U.S. electricity use!

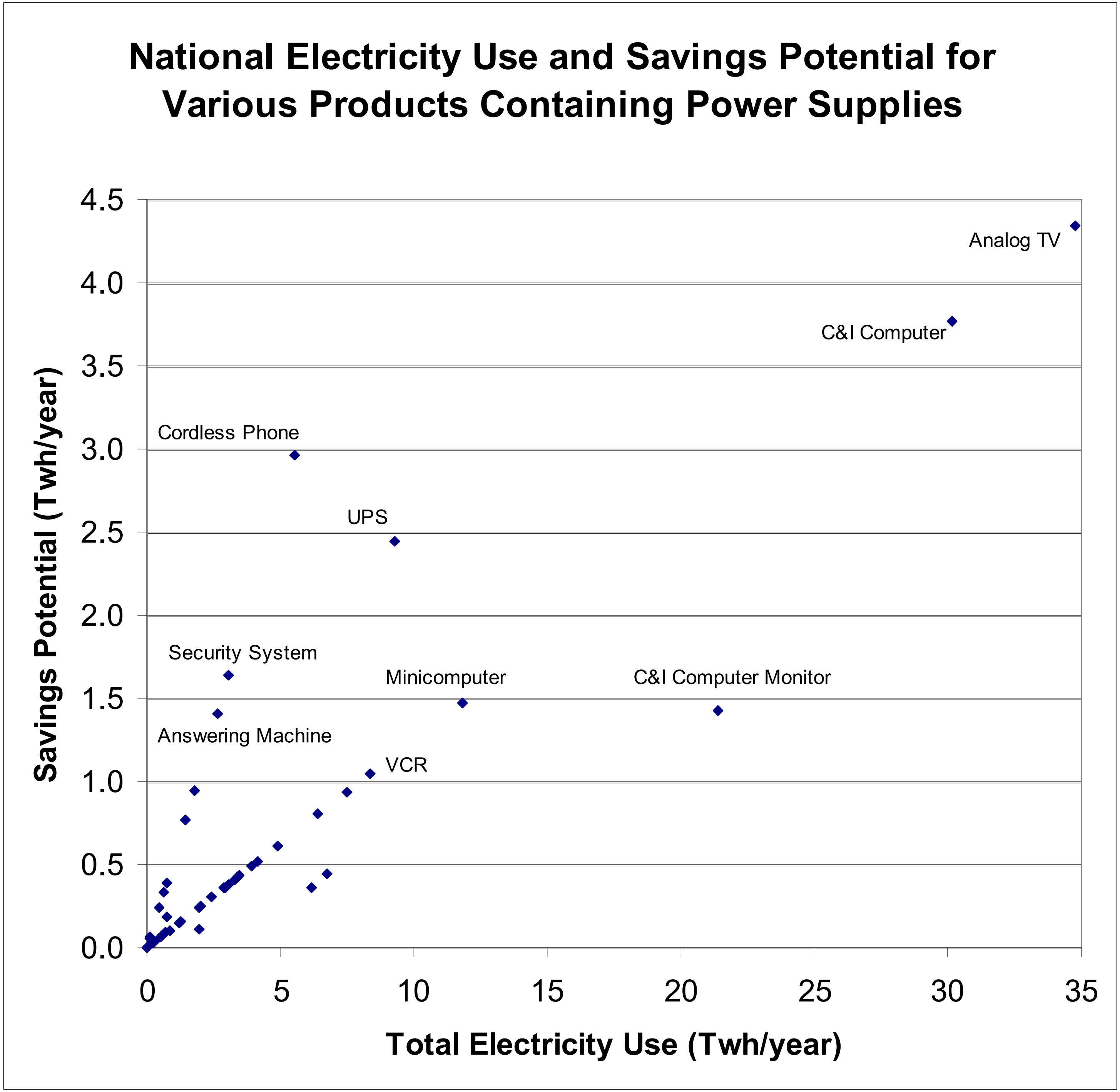


Savings Potential is Huge

- What if all linear power supplies were improved from about 30% efficiency to 80%?
- What if all switching power supplies were improved from about 70% efficiency to 80%?
- Annual savings would be more than 1% of total U.S. electricity use: about 32 billion kwh and more than $2.5 billion in lower energy bills.
- Very cost effective – incremental costs often less than $1 (in some cases pennies) per power supply.
- Additional savings possible from substantial reductions in standby mode power consumption (currently averages 50 to 100 watts/home in many industrial countries).

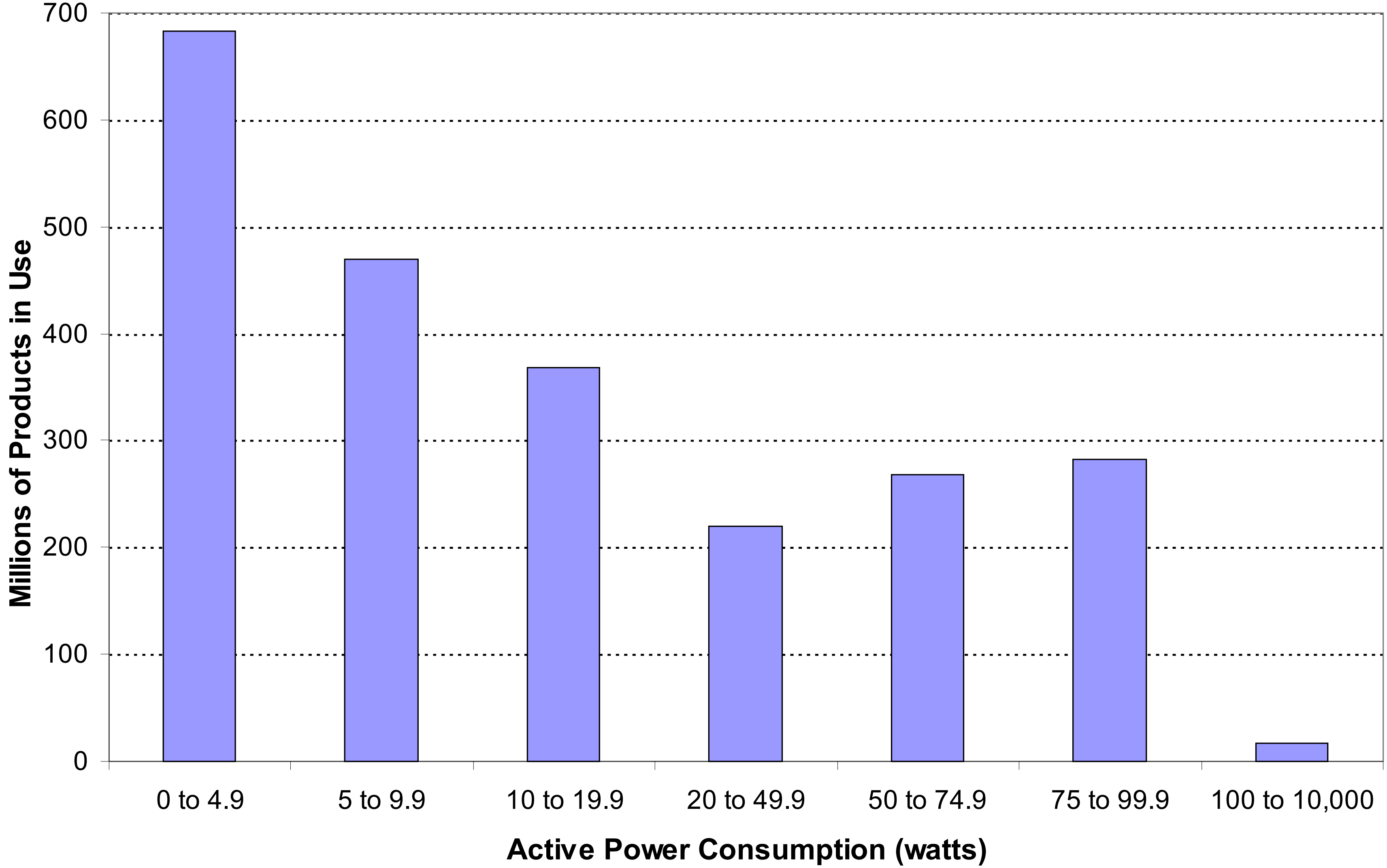
Which Power Supply-Containing Products Use the Most Electricity?

Product	# in Use	Active kwh/year	Sleep kwh/year	Standby kwh/year	Total kwh/year	Total twh/year
Analog TV	250,000,000	105.1		33.8	139.0	34.7
Desktop Computer (C/I)	94,000,000	296.1	18	6.6	321.0	30.2
Computer Monitor (C/I)	94,000,000	205.0	20	2.2	227.7	21.4
Minicomputers	2,000,000	3,854.4			3,854.4	11.8
Uninterruptible Power Supply	29,500,000	314.8			314.8	9.3
VCR	150,000,000	6.0		49.6	55.6	8.3
Desktop Computer (Res)	75,000,000	79.7	4	16.0	99.7	7.5
Computer Monitor (Res)	75,000,000	56.9	4	29.1	89.7	6.7
Mainframe Computer	110,000	38,544.0			38,544.0	6.4
Stereo Component	75,000,000	73.2		9.2	82.5	6.2
Cordless Phone	128,400,000	31.3		12.0	43.3	5.6

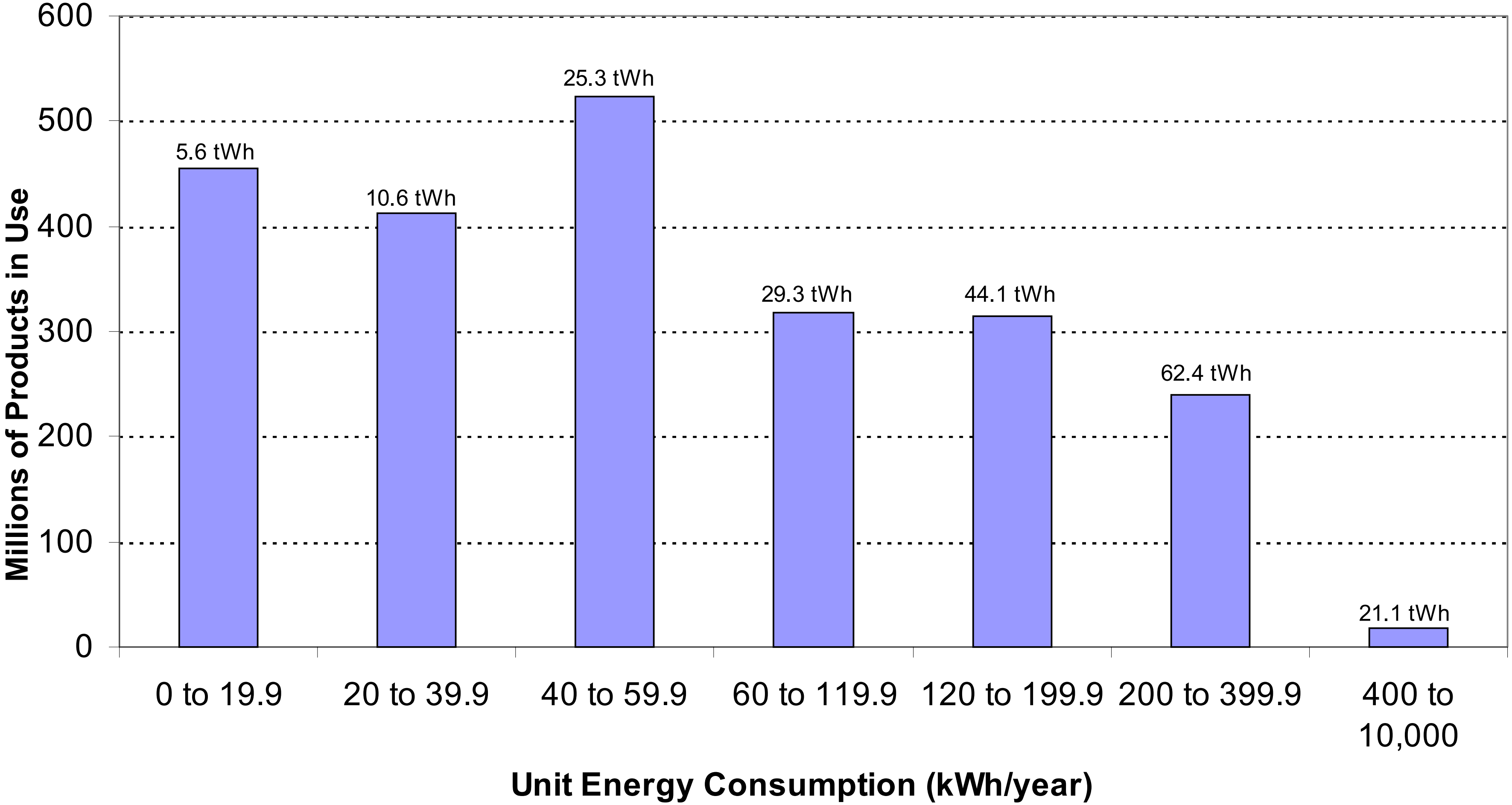


National Electricity Use and Savings Potential for Various Products Containing Power Supplies
Savings Potential (Twh/year)
Total Electricity Use (Twh/year)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
0
5
10
15
20
25
30
35
Analog TV
C&I Computer
Cordless Phone
UPS
Security System
Minicomputer
C&I Computer Monitor
Answering Machine
VCR

Total Number of Power Supply-Containing Products in Use in the U.S., by Wattage



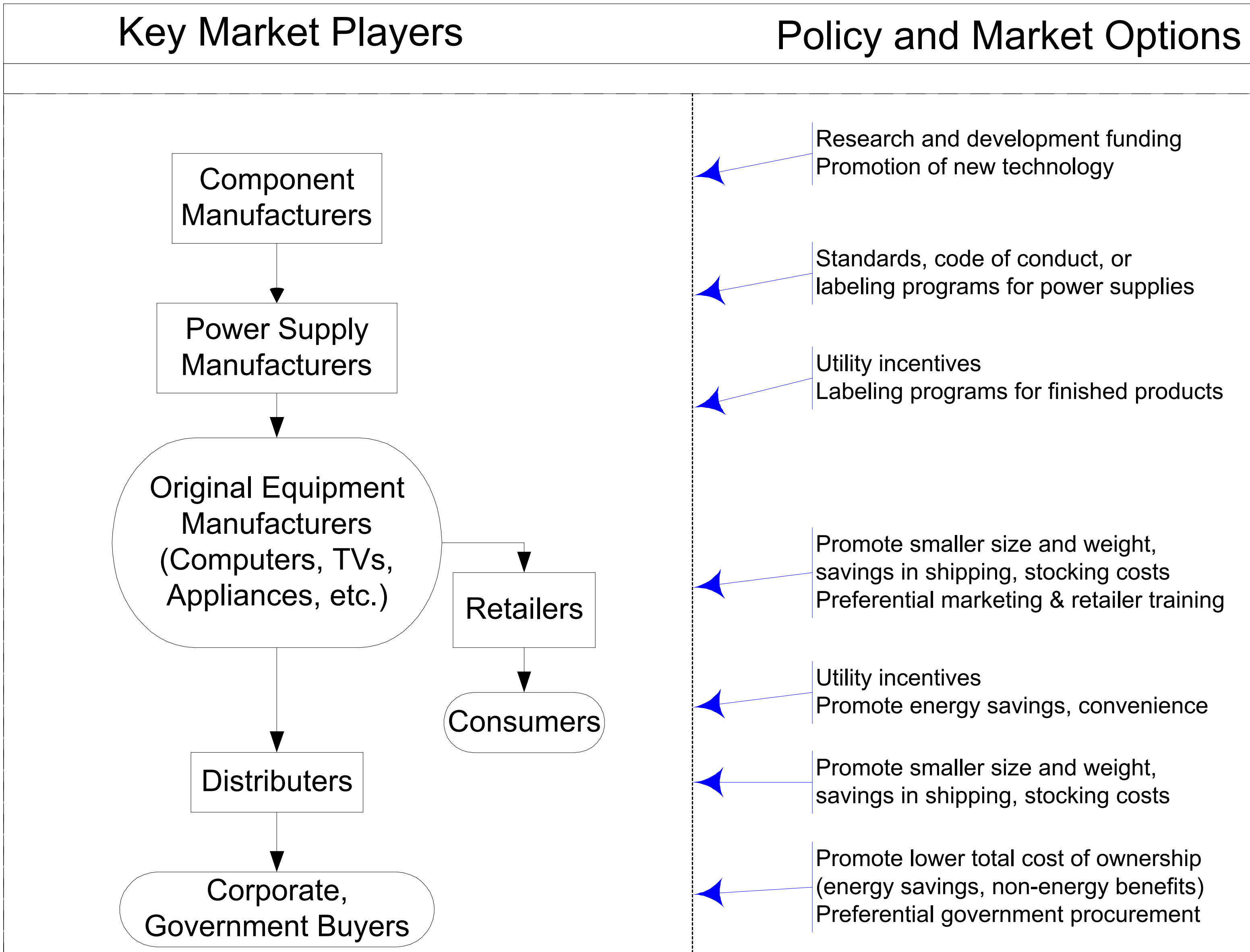
Total Number of Power Supply-Containing Products in Use in the U.S., by Unit kWh/year



Policy Ideas on the Table

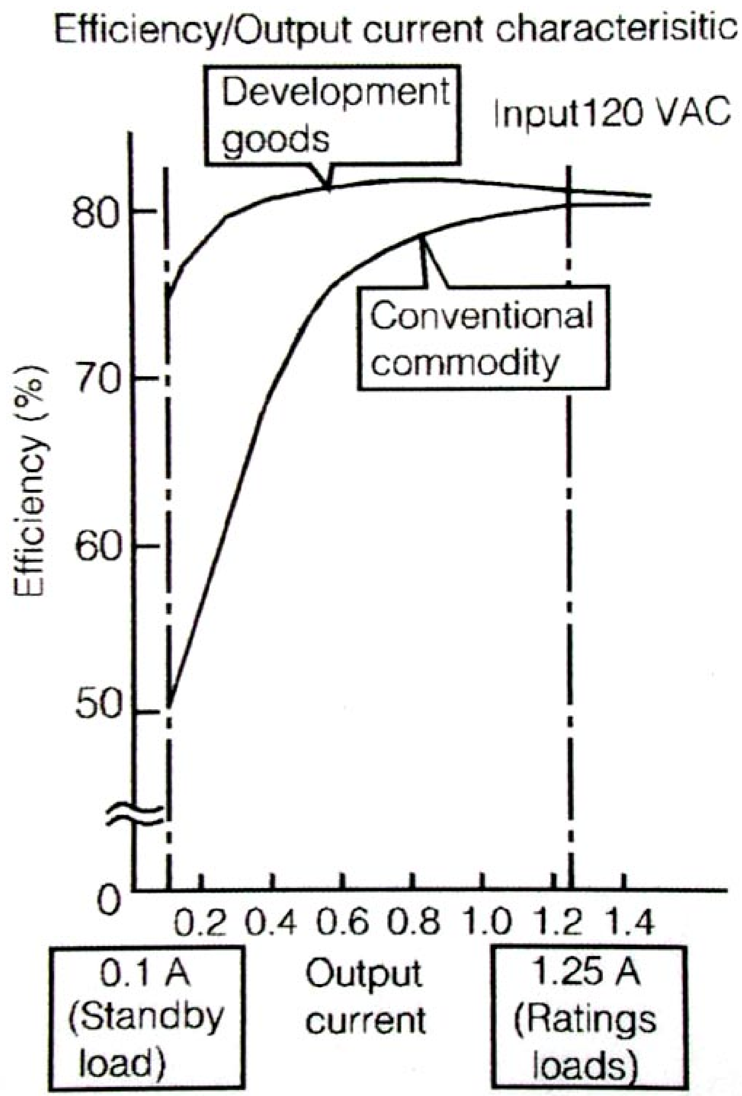
- Consider active, sleep, and standby efficiencies in Energy Star specifications for electronics
- Use federal, state, and private procurement to encourage sale of highly efficient designs
- Targeted financial incentives directed at OEMs, final assemblers, retailers, or consumers (idea proposed by CEC Commissioner Dr. Art Rosenfeld in SF)
- Federal and/or state-level efficiency standards
- Working through voluntary industry specifications like Intel's PC 2000 process

Power Supply Market Snapshot

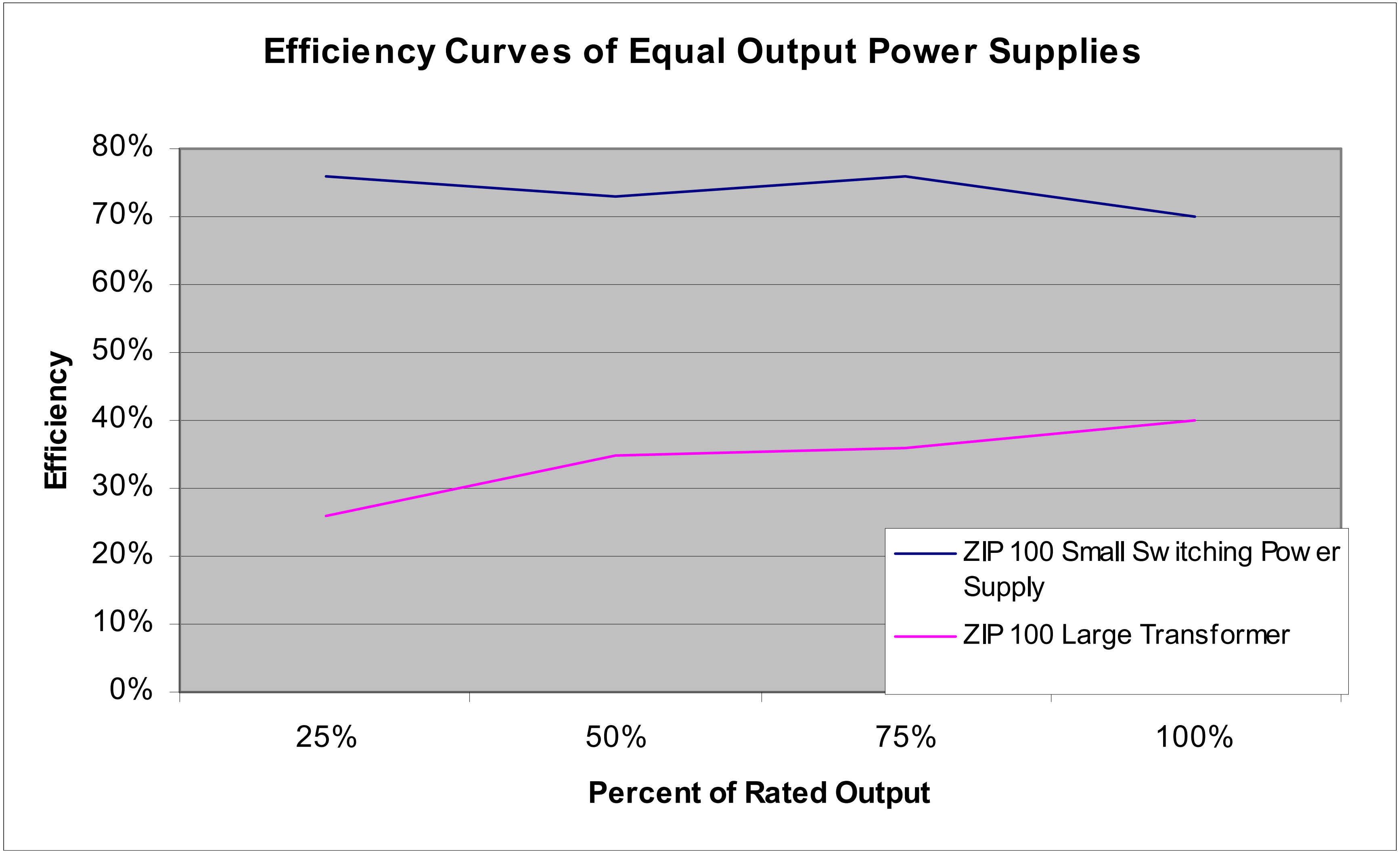


Do We Need Standardized Efficiency Curves?

- Power use at 0% load
- Efficiency % at 25% load
- Efficiency % at 50% load
- Efficiency % at 75% load
- Efficiency % at 100% load



Courtesy of Panasonic


Efficiency Curves of Equal Output Power Supplies
80%
70%
60%
50%
40%
30%
20%
10%
0%
Efficiency
25%
50%
75%
100%
Percent of Rated Output
ZIP 100 Small Switching Power Supply
ZIP 100 Large Transformer

Focus on Non-Energy Benefits!

Key Market Advantages for Highly Efficient Power Supplies

- Reduce travel weight & size
- Free up outlets / increase convenience
- More units per shipping container & more room for merchandise in store
- Already meets existing standby and pending active mode efficiency specs – future-proof!

Price vs. Value Propositions

Goal: Lowest Price

- Take cost out "at all costs"
- Quality and reliability can drop
- No product differentiation
- Least common denominator design: no features, no profits
- Penny-wise/pound foolish – what saves the buyer $1 up-front can add $10 or $20 to lifetime energy costs
- All of us pay more – higher energy bills, more air pollution, more new power plants and power lines

Goal: Highest Value

- Emphasis on clever design and differentiation: multiple viable paths to success
- Minimize lifecycle cost: purchase price + lifetime maintenance, energy, & pollution costs
- Specs, labels, and utility programs help build a message of value: "may cost more, but worth more"
- Products more desirable – smaller, quieter, cooler, more convenient