

# Smart Meters: A New Gateway... HAN Devices and Protocols

James Pace  
Senior Director, SW Product Management  
Silver Spring Networks



ConnectivityWeek 2008

# Context: Smart Grid / AMI Network

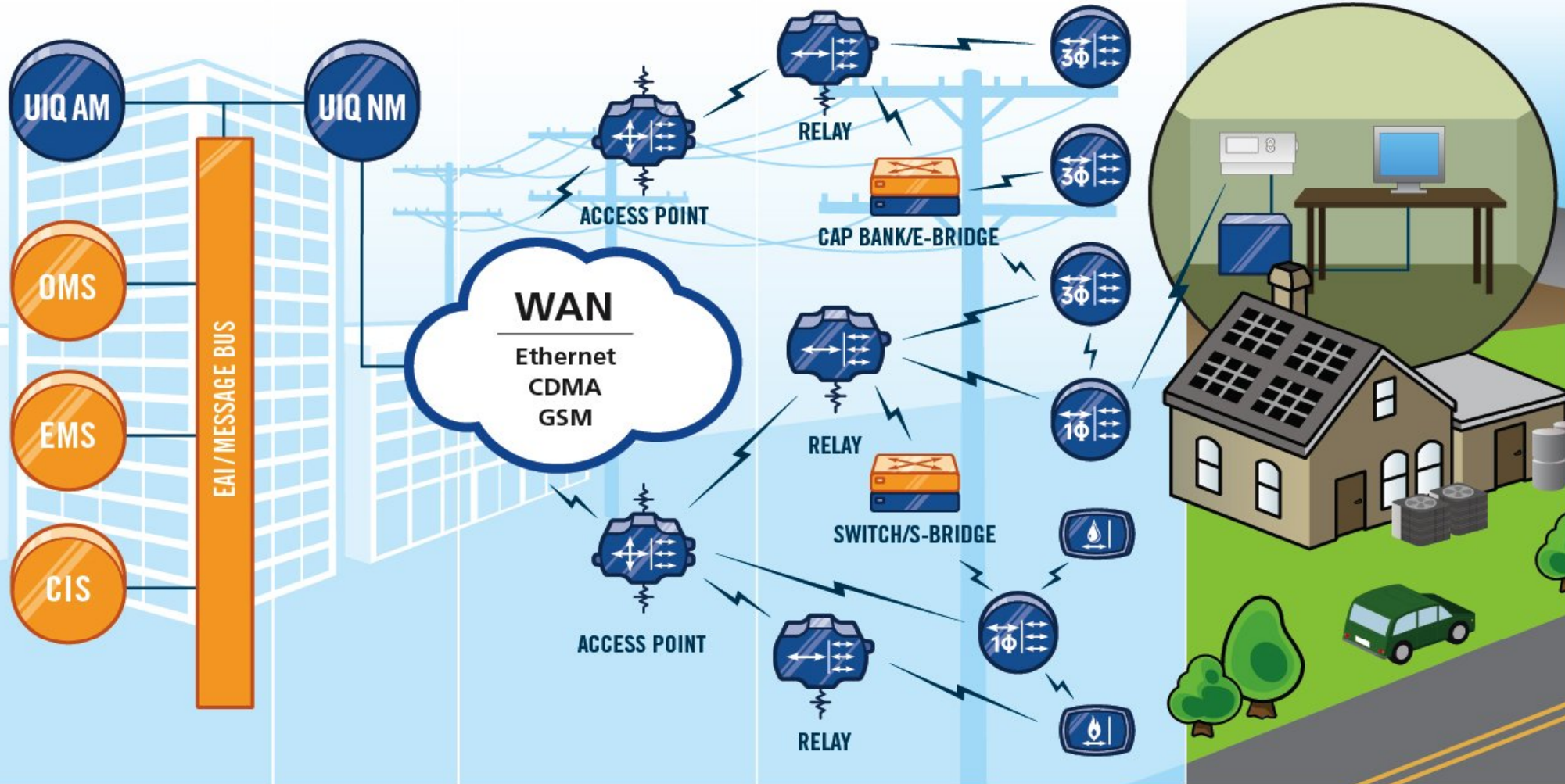
BACK OFFICE

NETWORK  
OPERATING  
CENTER

SMART GRID  
NETWORK

SMART GRID  
DEVICES

SMART HOME



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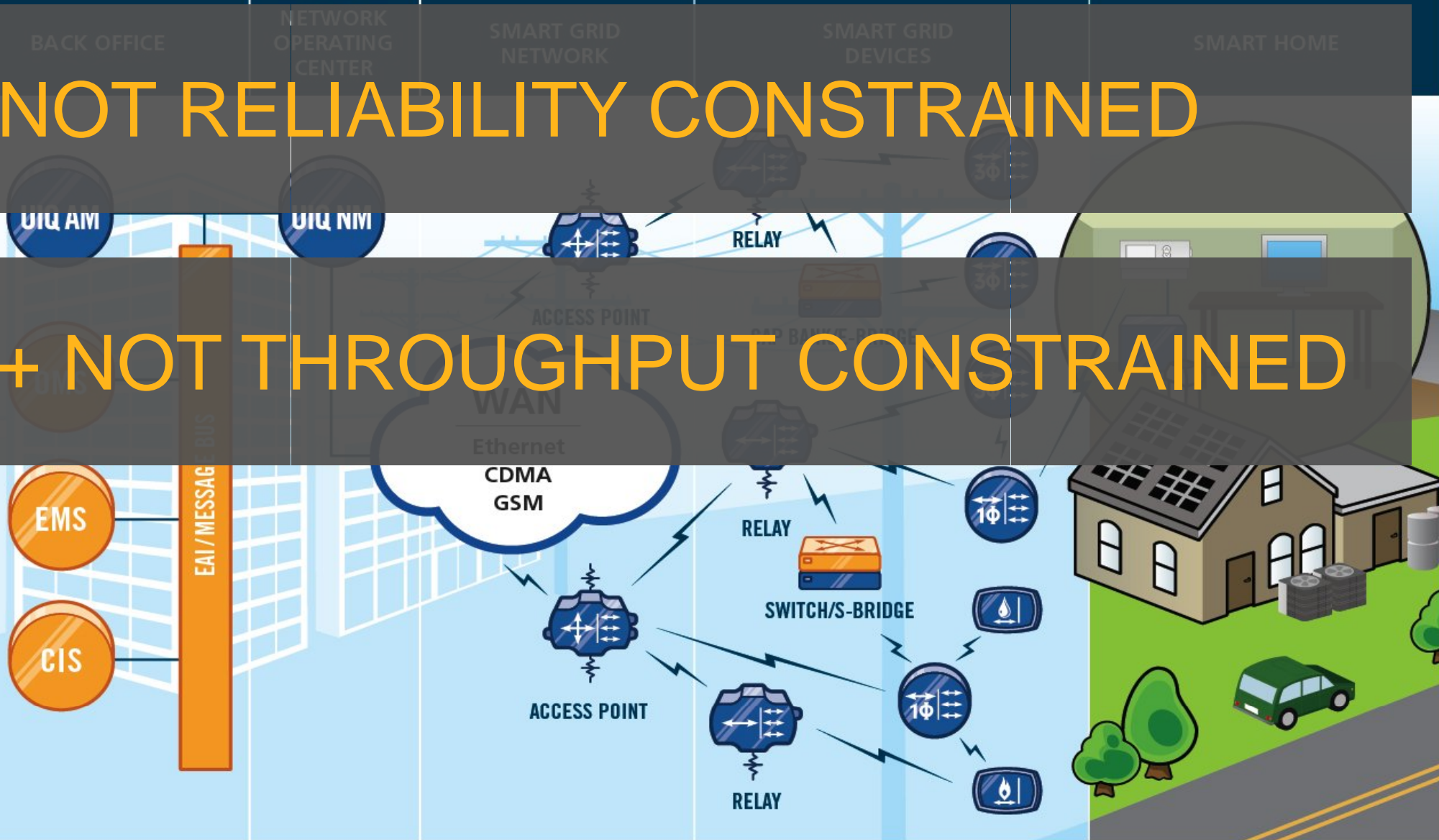
NOT RELIABILITY CONSTRAINED



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+ NOT THROUGHPUT CONSTRAINED



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= EXTRACT VALUE FROM THE EDGE

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NETWORK

IHD = \$10 - \$100 (?)

SMART HOME

PCT = \$50 - \$100 (?)

Load Control = \$20 (?)

Service Switch  $\leq$  \$25 (?)

HAN Module = \$5 -> \$15

PHEV?

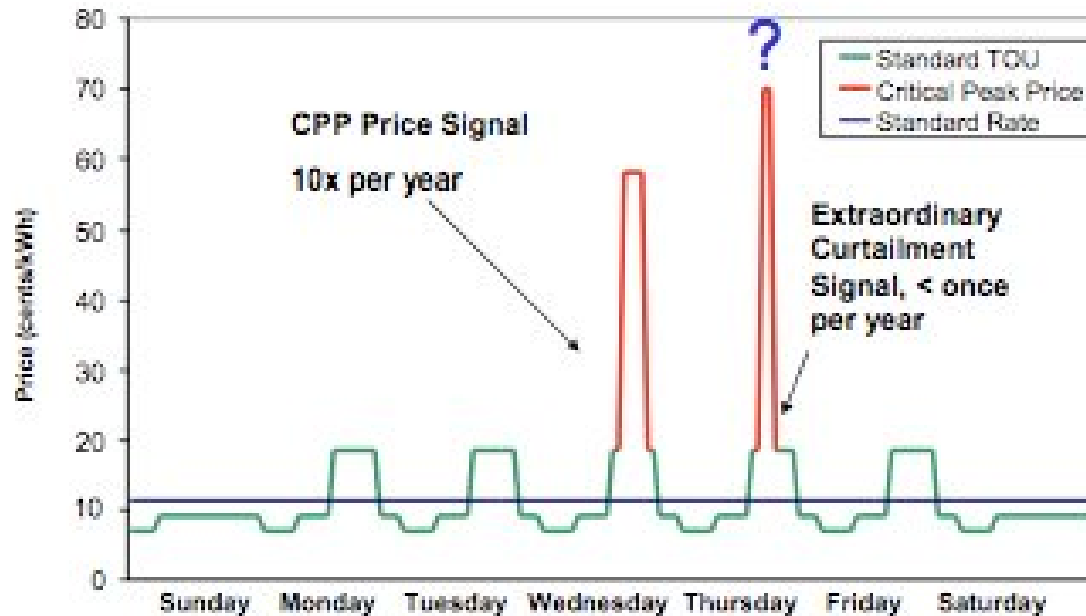
= EXTRACT VALUE FROM THE EDGE

# It's All About the Peaks

## Critical Peak Pricing (CPP) with additional curtailment option

Potential Annual Customer Savings:

10 afternoons x 4 hours x 1kw = 40 kWh at 70 cents/kWh = ~\$30/year



*Efficiency*  
*Energy for the Future*

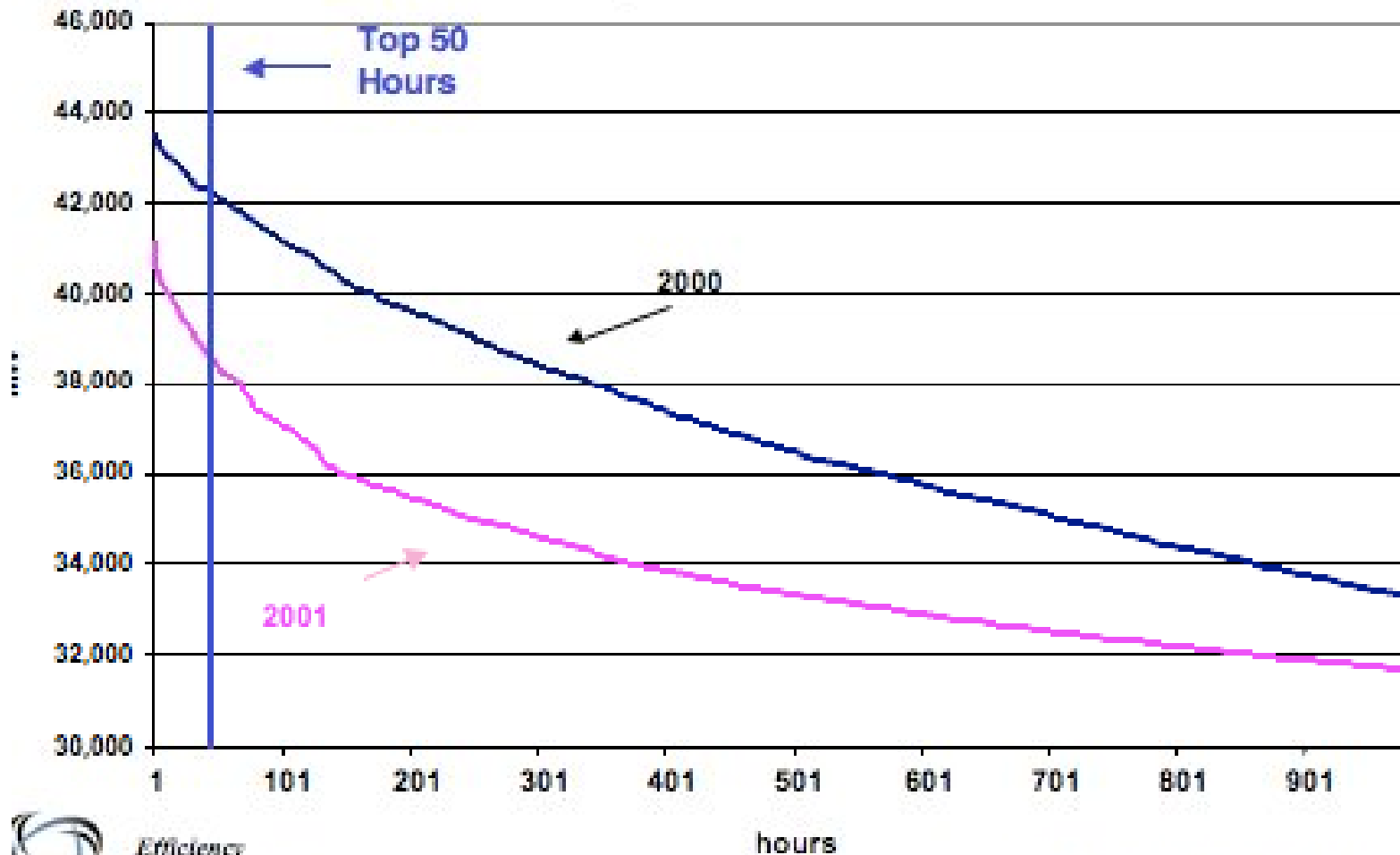
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# It's Still All About the Peaks

Actual ISO Load 2000 and 2001  
Sorted Highest to Lowest in a Load Duration Curve  
Highest 1000 Hours



Efficiency  
Energy for the Future

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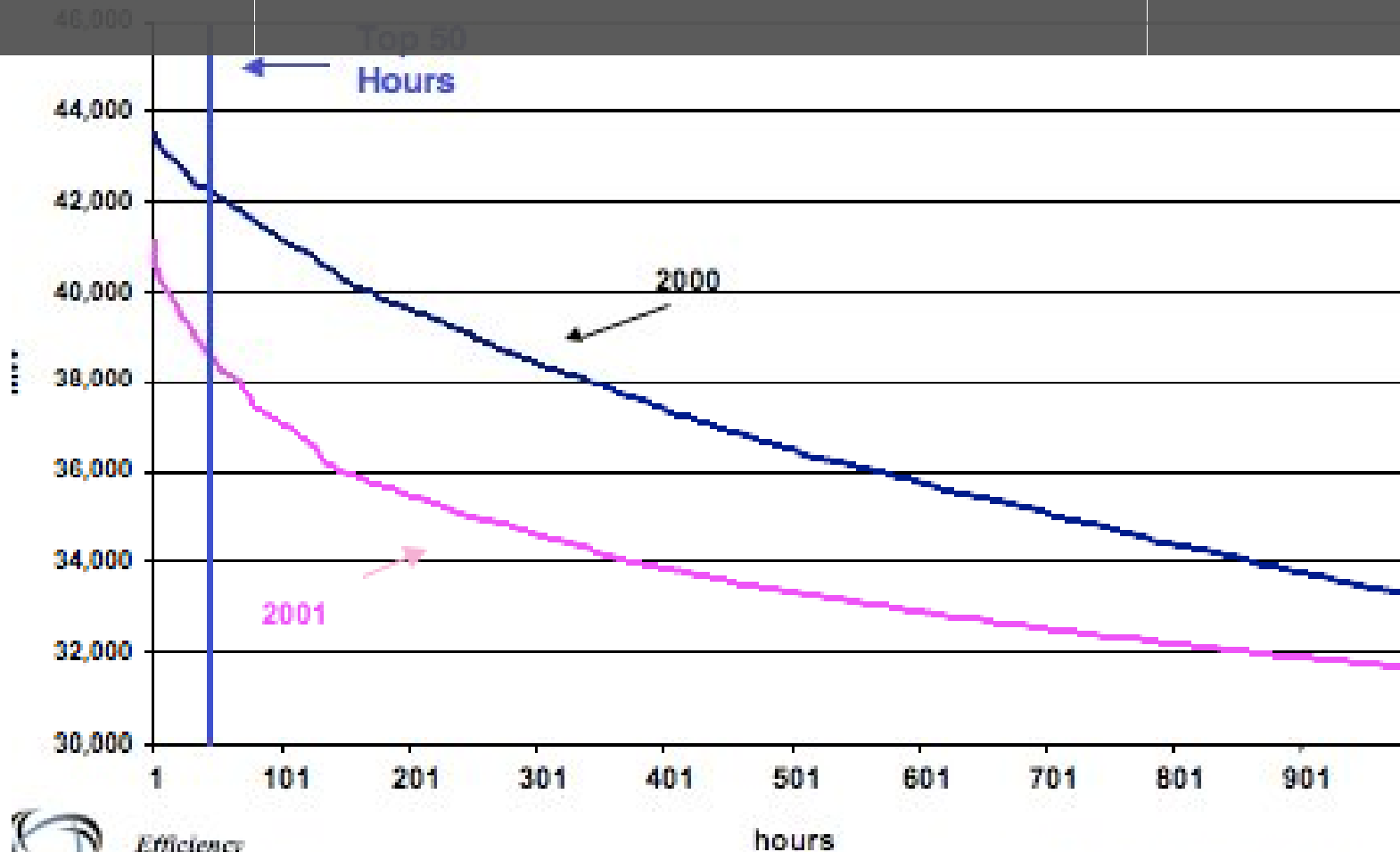
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# The Peaks, Value, and Network Reliability

Assume 5M Residences

Actual ISO Load 2000 and 2001  
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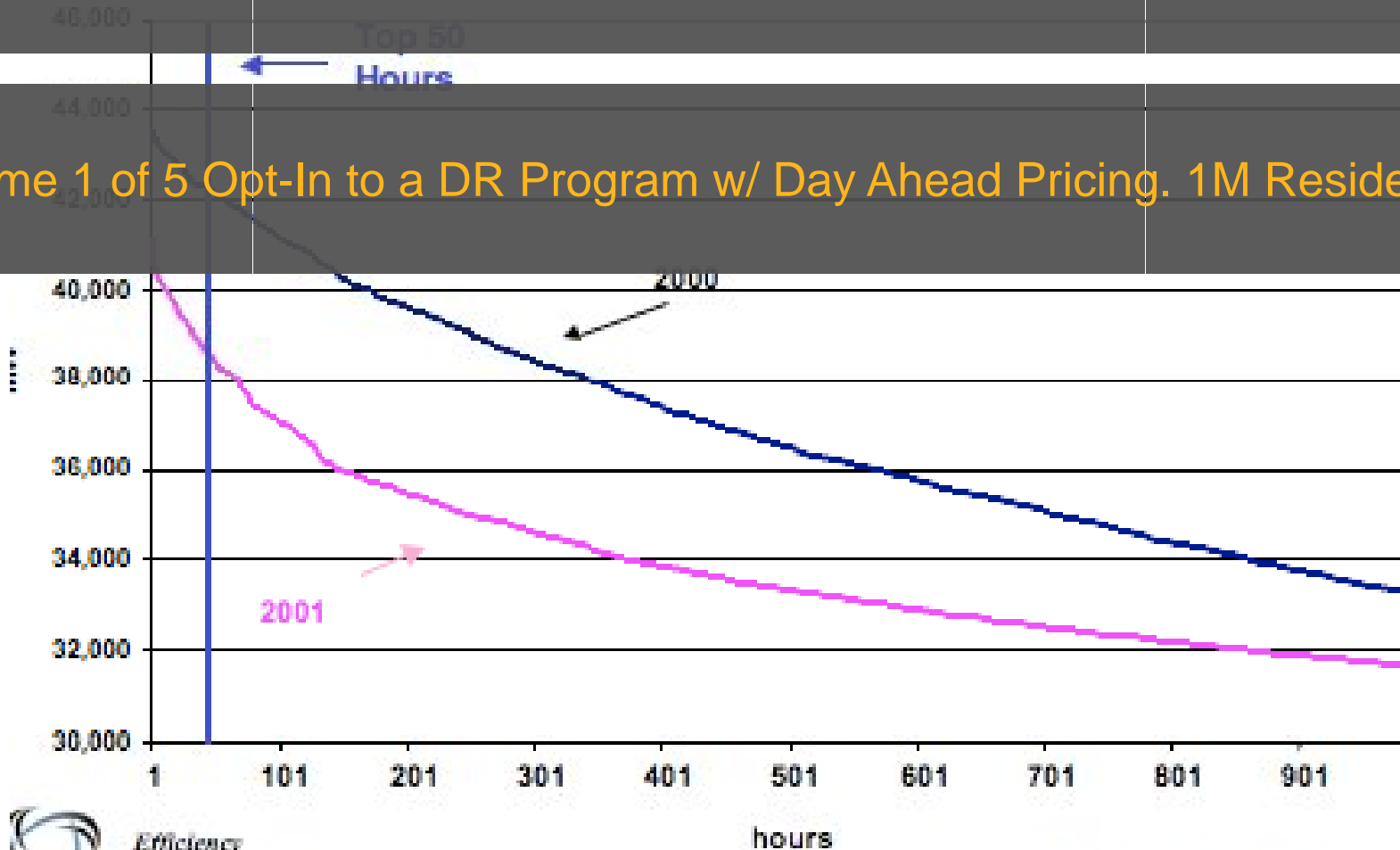
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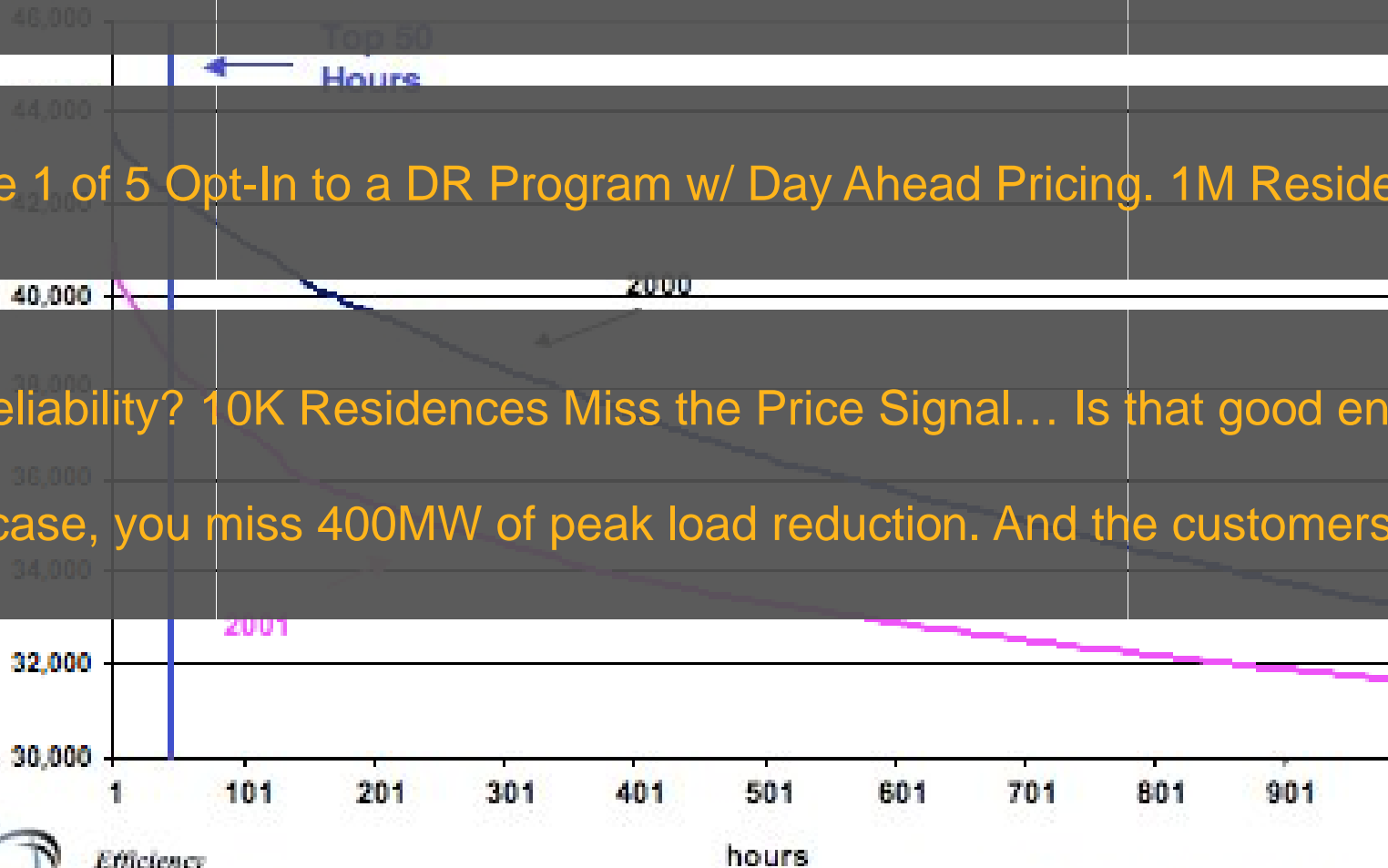


Assume 1 of 5 Opt-In to a DR Program w/ Day Ahead Pricing. 1M Residences...

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99% Reliability? 10K Residences Miss the Price Signal... Is that good enough?

In this case, you miss 400MW of peak load reduction. And the customers...



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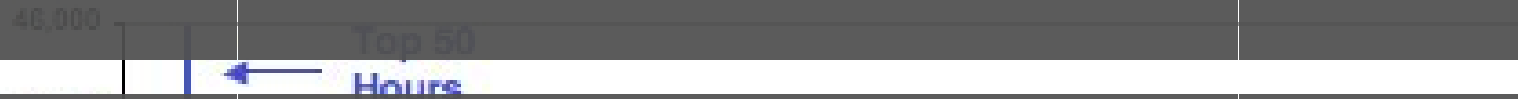
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What if it's an emergency curtailment? Arguably you need 99.9% or 99.99%  
--> Why use a hammer if there is a scalpel available?



Energy for the Future

Journal Research, Page 19

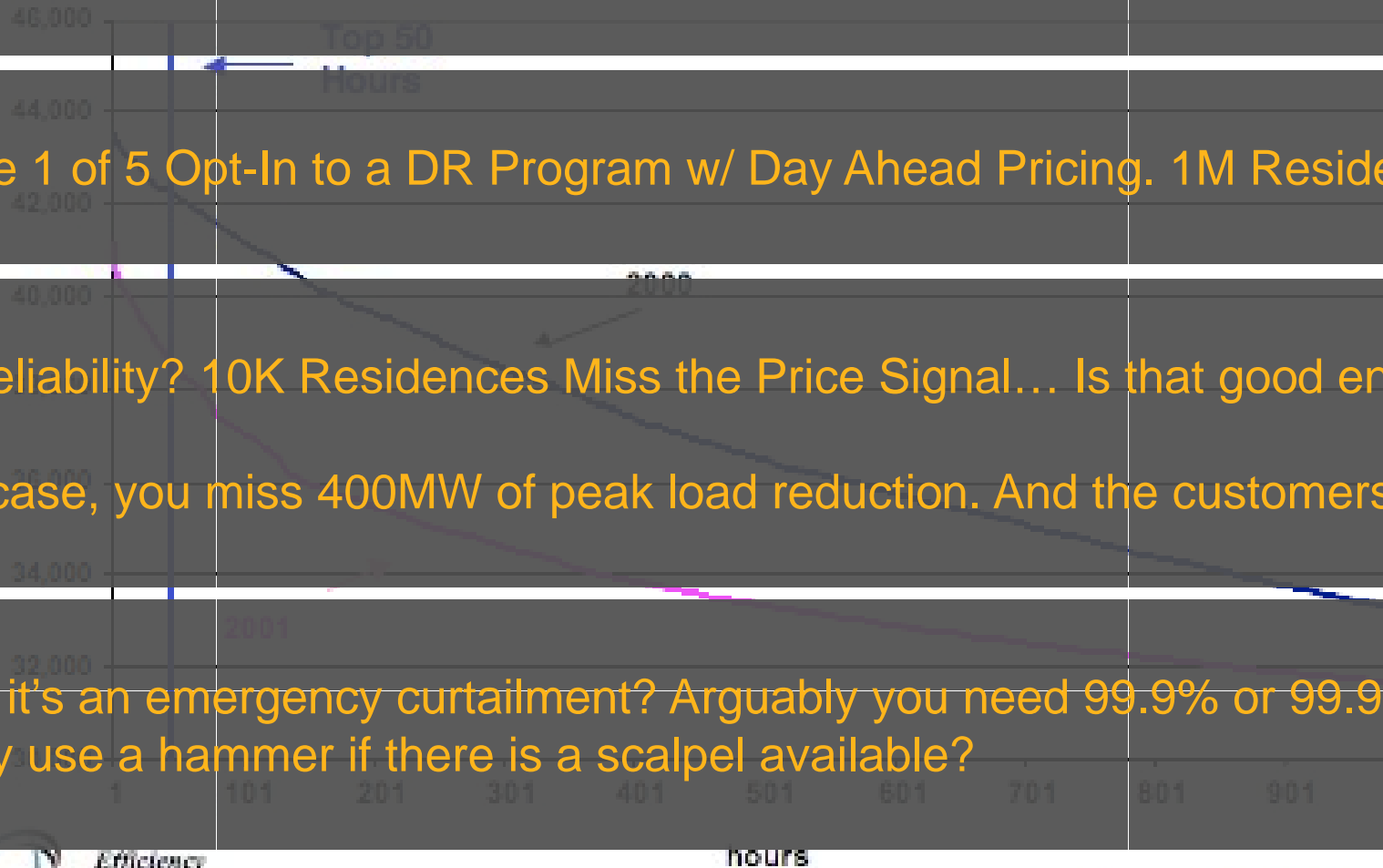
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And that's just getting the signal to the meter...



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# HAN Devices

## Programmable Communicating Thermostats:

- Standalone?
- Title 24?
- Integrated In-Home Display?
- As a Gateway?

## Load Control Devices:

- Pool pumps, water heaters...
- Built-in sub-metering



Not dead yet!

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# More HAN Devices

## In Home Displays

- Standalone?
- Integrated with Other Devices?
- Ambience?
- Magnetic?

## Distributed Generation

- Solar, Inverters
- Wind
- Storage (dispatchable)

## Pluggable Hybrid Electric Vehicles

## Electric Vehicles



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# Media and Protocols

## RF or PLC

- If RF, 433MHz? 868MHz? 902MHz? 2.4GHz? Other? Licensed?
- If PLC, some flavor of HomePlug? 1.0 or AV? C and C? Echelon?

With RF, once you choose the band, you need a protocol (or two)...

- ZigBee/802.15.4 (2.4GHz or 902MHz)
- IPv6/802.15.4 (aka 6LoWPAN) (2.4GHz or 902MHz)
- WiFi (2.4GHz)
- Others? Zensys Z-Wave? ONE-NET? (902MHz)

One Size Fits All? Unlikely.

- There's may be difference between PENETRATING the premise from the meter and the intra-premise media...
- High rises? MDUs?

## So, Who Has Really Stepped Up? The ZigBee Alliance



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# More Standards

## ZigBee Alliance

### ZigBee Pro

As mentioned, the Smart Energy Profile

<http://www.zigbee.org/>

## OpenHAN

<http://www.ucaiug.org/OpenHAN/default.aspx>

HAN or HAN?

## AMI-SEC

<http://www.ucaiug.org/UtilityAMI/AMISEC/default.aspx>

## UtilityAMI and OpenAMI

<http://www.ucaiug.org/UtilityAMI/default.aspx>

<http://www.ucaiug.org/OpenAMIug/default.aspx>

# Models

Utility purchases en masse?

Prime-the-pump?

Retail models?

Rate recovery? Rebates?

Regulated versus De-regulated (e.g., Texas)

Dense versus sparse AMI deployments?

Conflicting goals between REPs and TDSPs?

Open Access to TDSP AMI network? SLAs? Throttling? Opacity?

In-band over AMI network? Out-of-band over Internet? Both?

Interesting Residential Energy Management Offerings Being Deployed.

In conjunction with utility?

Independent?

# Conclusions

- Deployment of demand responsive infrastructure assumes that value will be returned to IOUs and ratepayers.
- To extract value, a capable AMI infrastructure MUST be deployed.
- A capable AMI infrastructure is not reliability-constrained or throughput-constrained.
- HANs and demand responsive devices are nascent...
- ...but much progress has been made.