Panel #1 "Future Solutions for Smart Energy Deployments"

11:30 AM – 12:15 AM

- Moderator:
  - Alison Rowe, Global Executive Director, Sustainability, International Business, Fujitsu

- Panelists:
  - Wei-Peng, Sr. Member of Research Staff, Fujitsu Laboratories of America, Inc.
  - Ulrich Herberg, Member of Research Staff, Fujitsu Laboratories of America, Inc.
  - Yu Yonezawa, Researcher, Fujitsu Laboratories Ltd.

Future Solutions for Smart Energy Deployments

Alison Rowe
Global Executive Director Sustainability
International Business Group
Fujitsu Limited

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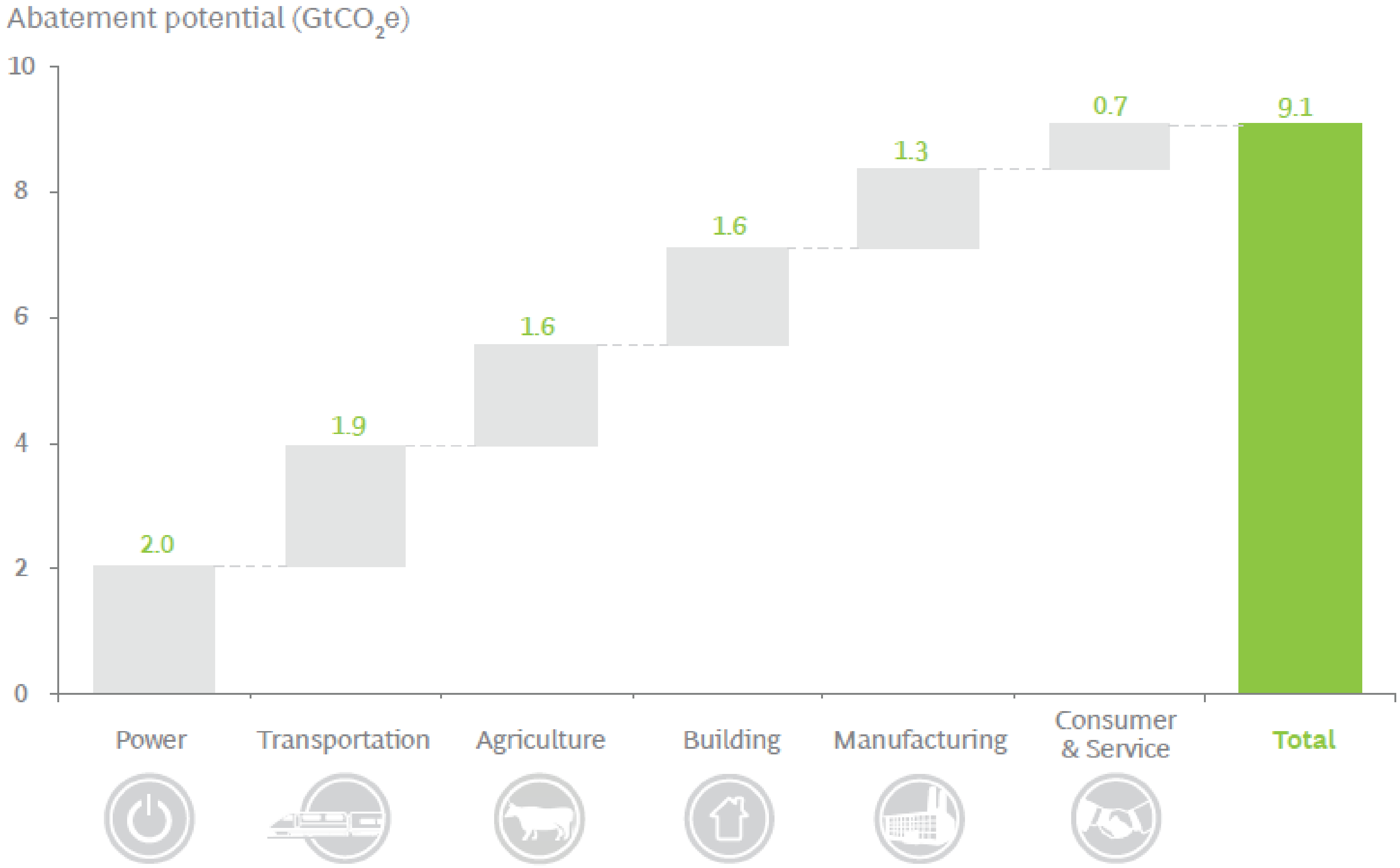
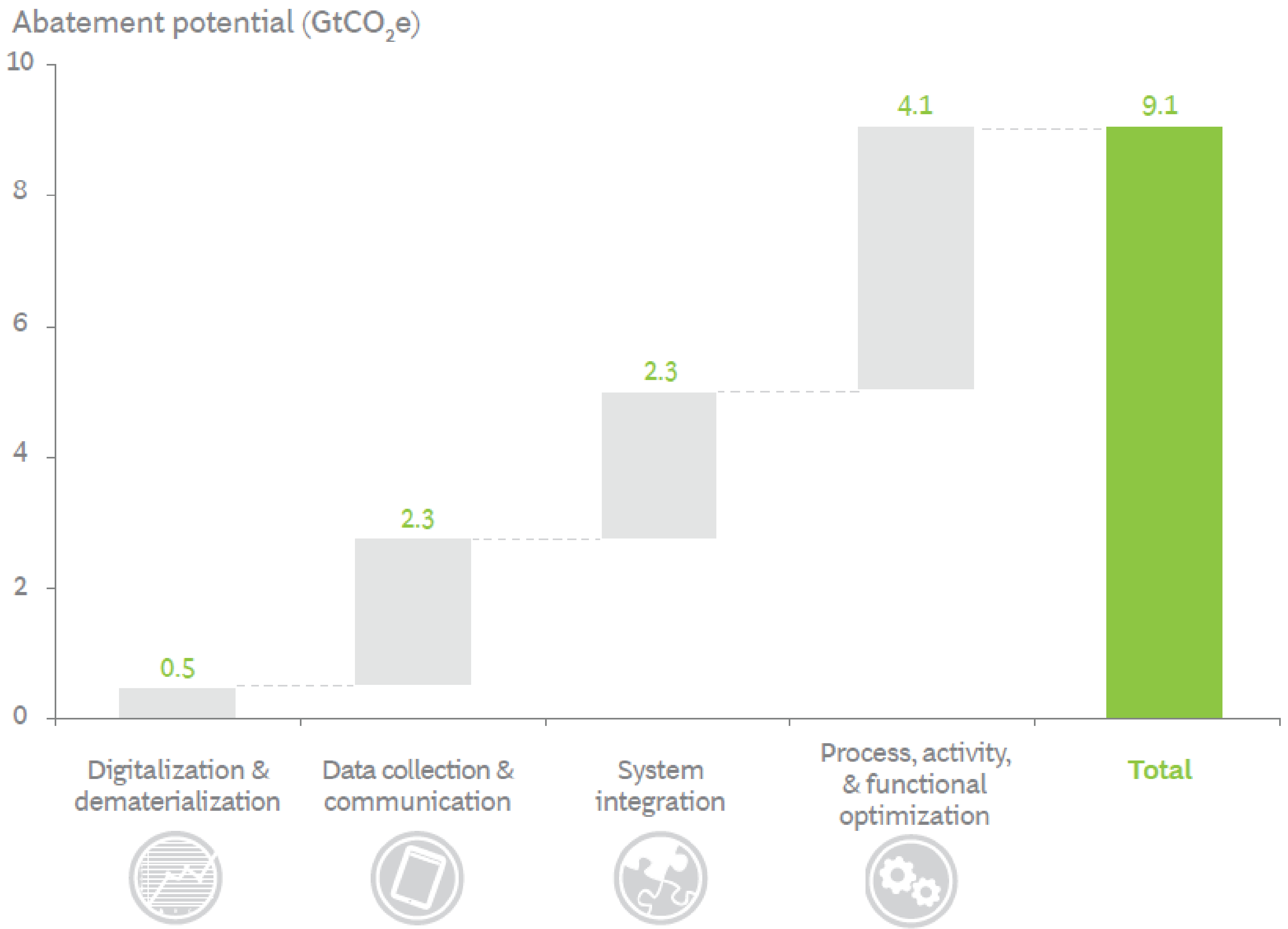
Setting the scene

ICT-enabled solutions offer the potential to reduce GHG emissions by 16.5%, create 29.5 million jobs and yield USD 1.9 trillion in savings



Source : GeSI SMARTer 2020 Report

Areas of abatement potential



Source : GeSI SMARTer 2020 Report

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Smart Approaches in Smart Energy & Smart Grid

Wei-Peng Chen
Cloud-based Solution Innovation Group
Fujitsu Laboratories of America, Inc.

Future Trends in Power Systems

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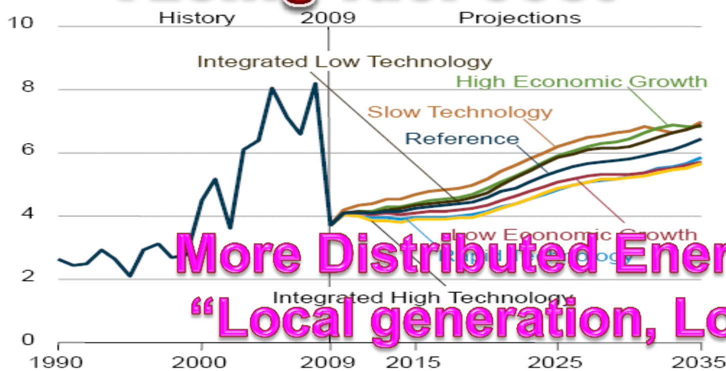
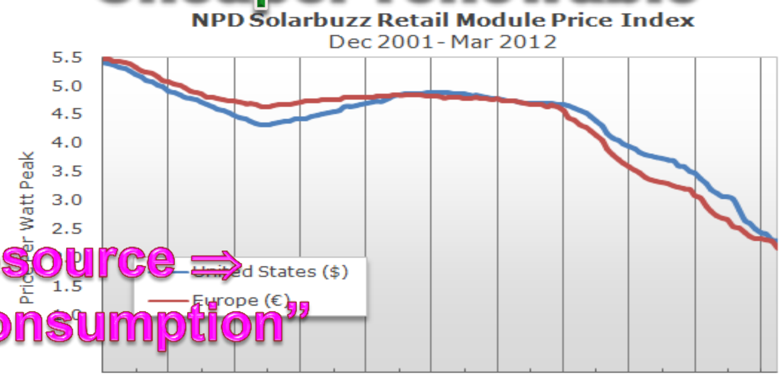
- General trends:

Rising fuel cost



Cheaper renewable



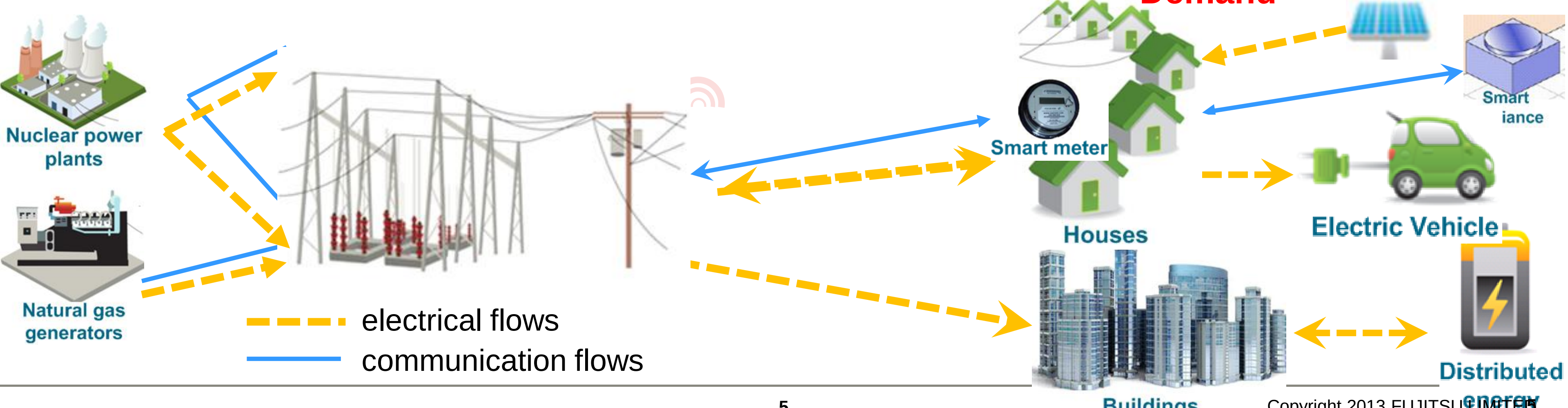
More Distributed Energy Resource ⇒ "Local generation, Local consumption"

- Power industry restructuring in three aspects:

1. Distributed Generation & Renewable 2. Sensing & Intelligent Control

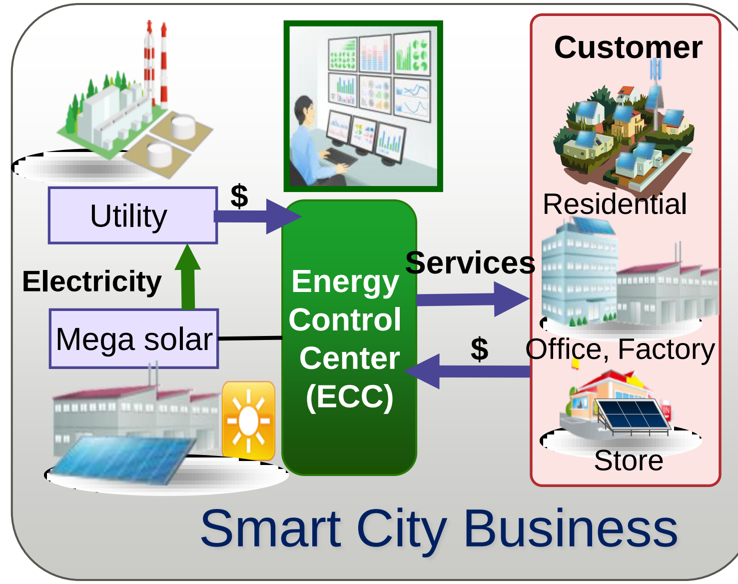
3. Demand Response and Distributed Storage

Generation **Transmission & Distribution** **Demand**



Fujitsu's EMS Solution Deployment

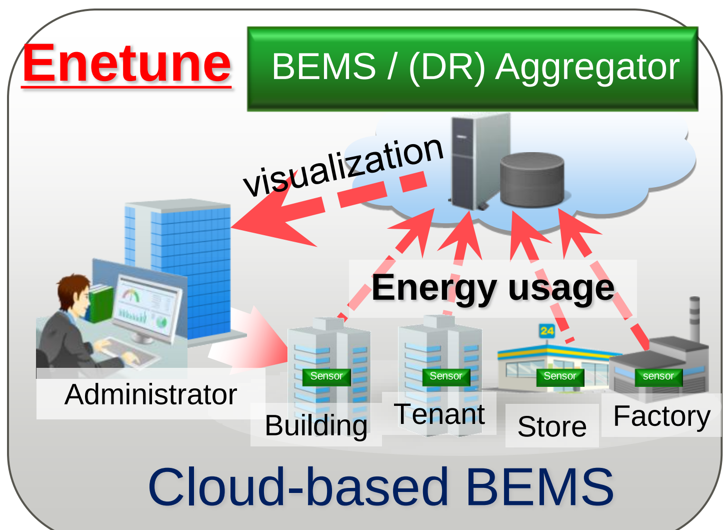
- From buildings to communities
  - Electricity savings mandates for C&I facilities
    - Great East Japan Earthquake resulted in changes to Japan's Smart Grid policy
  - Power demand shaping/demand response service is essential for smart cities



2013-15

Rolling blackouts in Tokyo area
http://www.asahi.com/special/10005/TKY201103170561.html

2011



2012-13

Reduce Peak Power Demand

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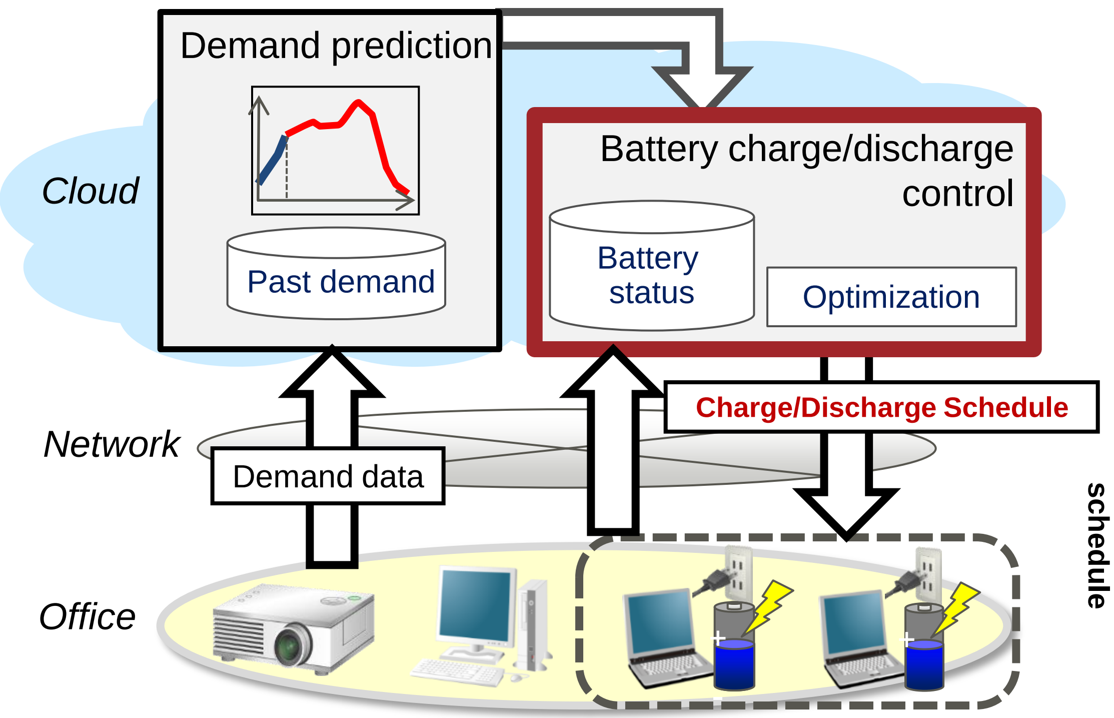
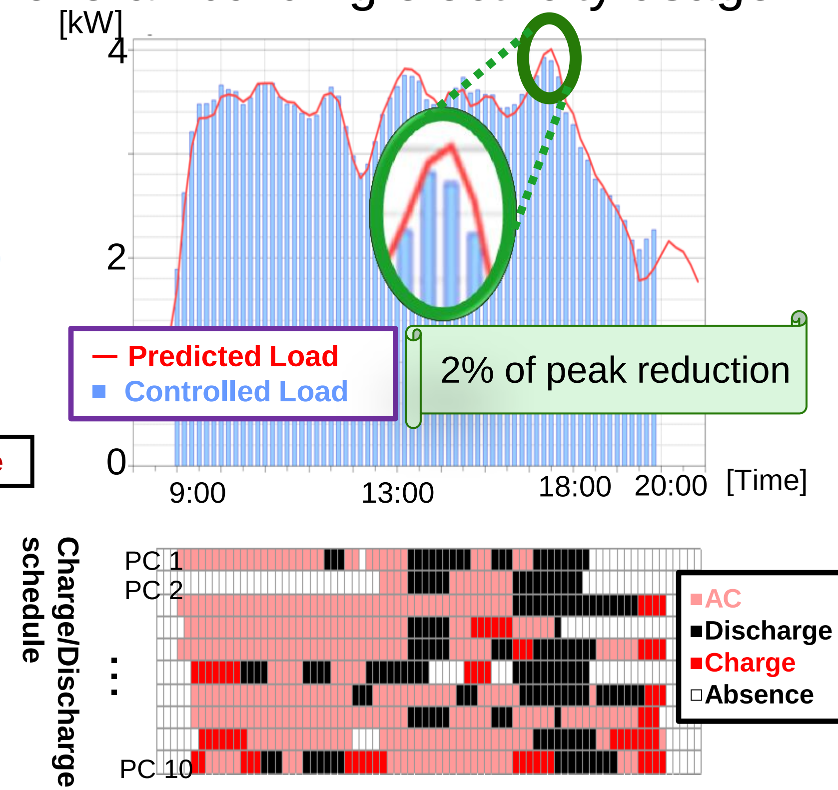
- Cloud service for achieving peak demand shaping in each community through control of distributed batteries
- First step is to attempt to reduce peak demand by controlling the batteries of office notebook PCs
  - Experiments show 2-3% reduction of overall building electricity usage





FLA Research Goal: Enabling the Smart Grid of the Future

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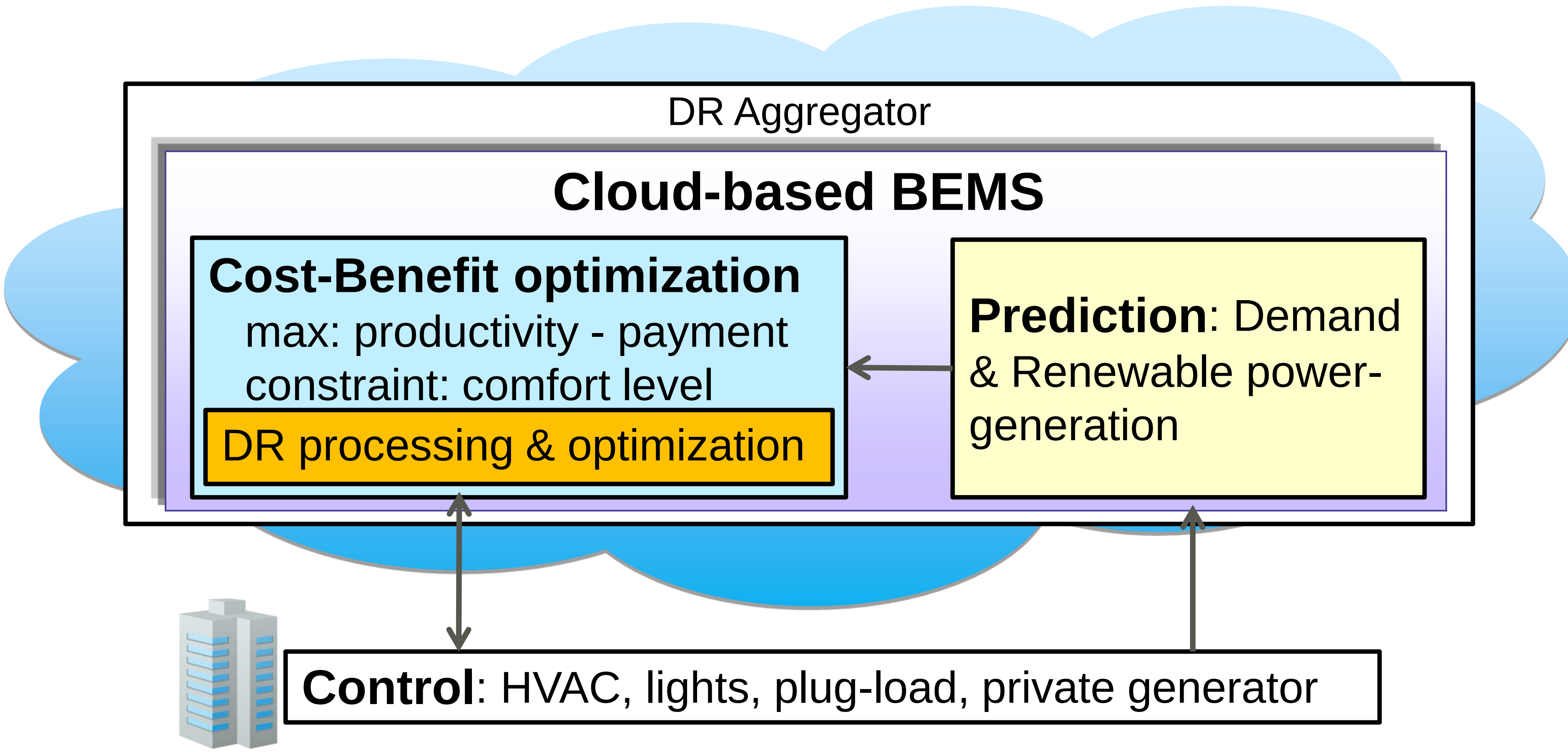
Challenges:

- How to save $$ on electricity while meeting productivity goals?
- How to balance electricity supply & demand in the future Smart Grid?



Demand Response using OpenADR2.0

Ulrich Herberg, PhD
Solutions for Electricity Distribution Networks
Fujitsu Laboratories of America, Inc.

World Energy Consumption (Outlook)

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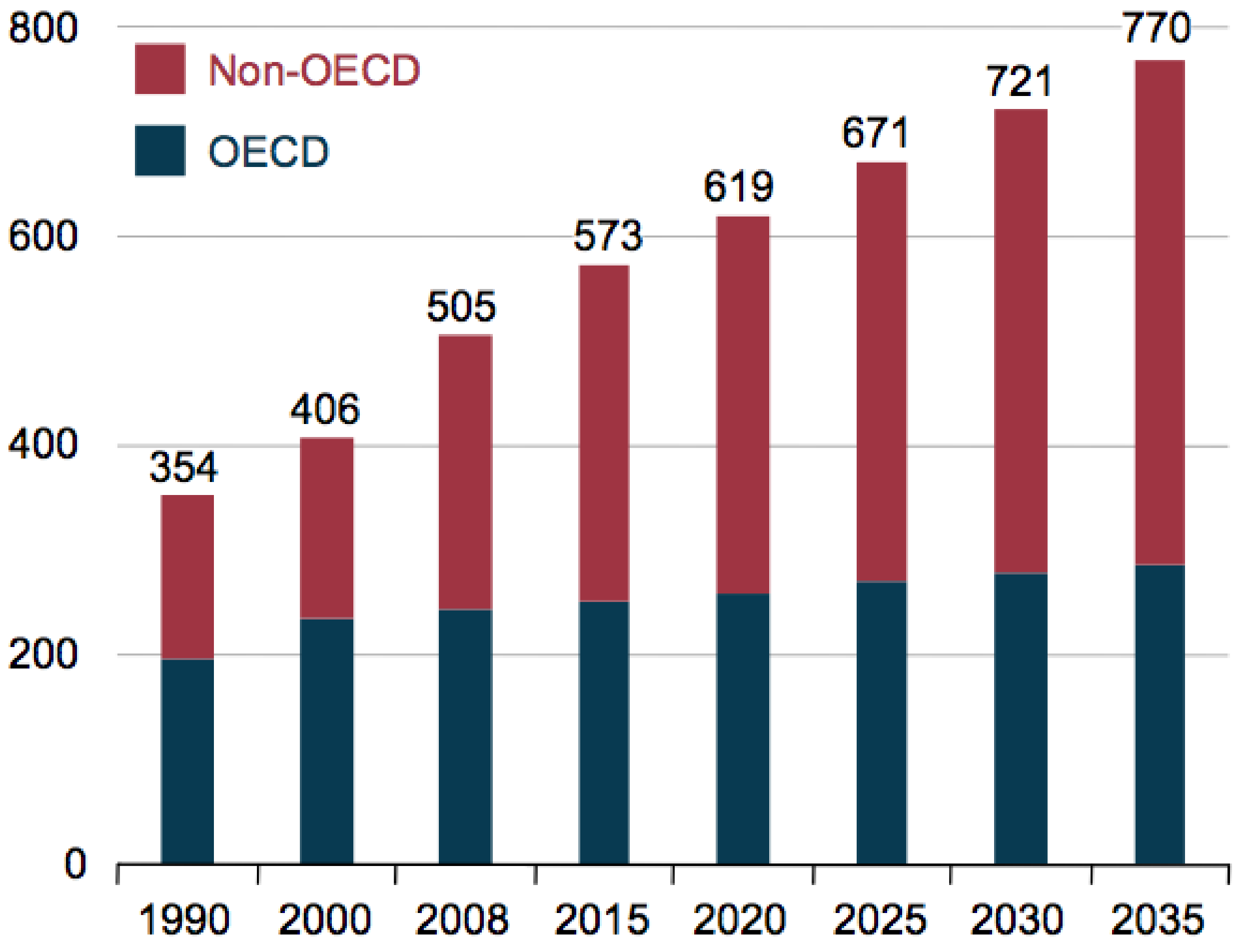
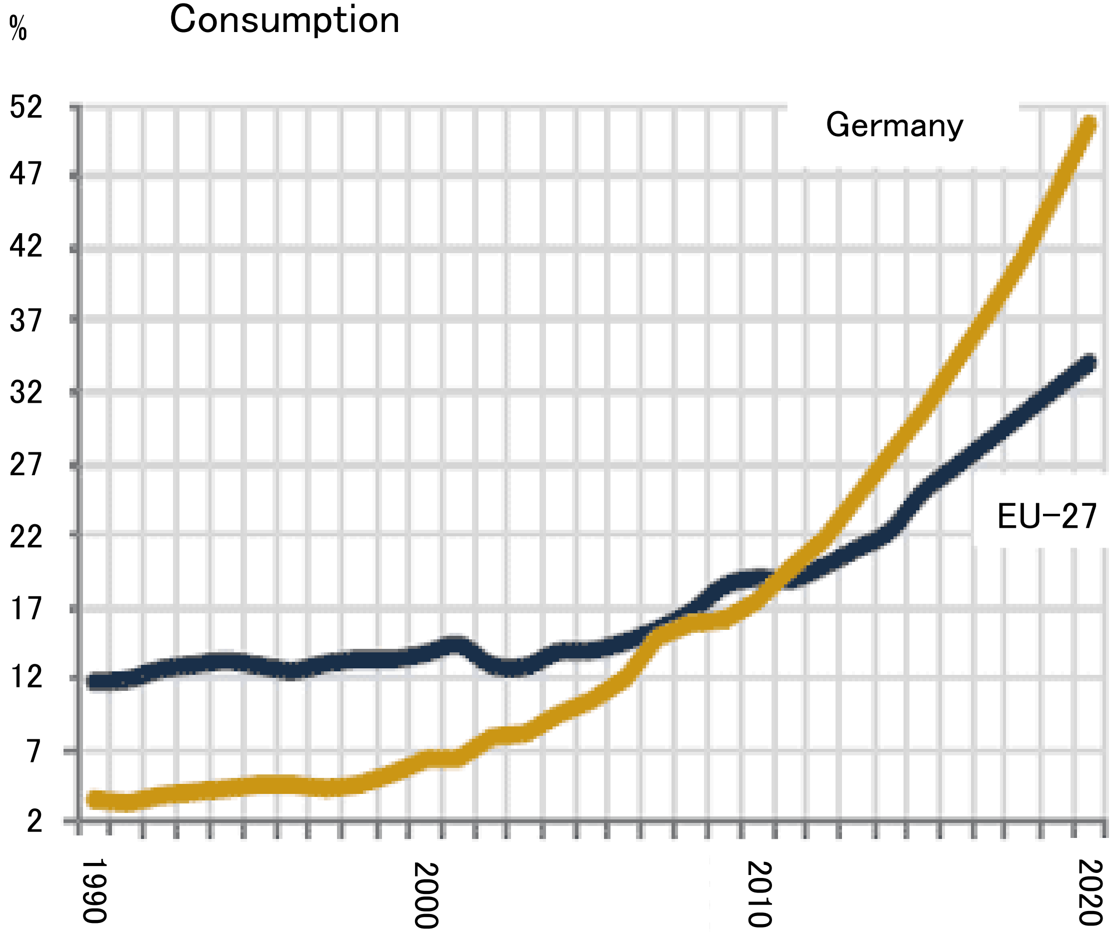
Figure 1. World energy consumption, 1990-2035 (quadrillion Btu)



Source: EIA International Energy Outlook 2011

“Renewables will account for half of Germany’s energy by 2020”

Electricity from RES as % in Gross Electricity Consumption



Source: CGES (March 2012)

Renewable Electricity Capacity (US West)

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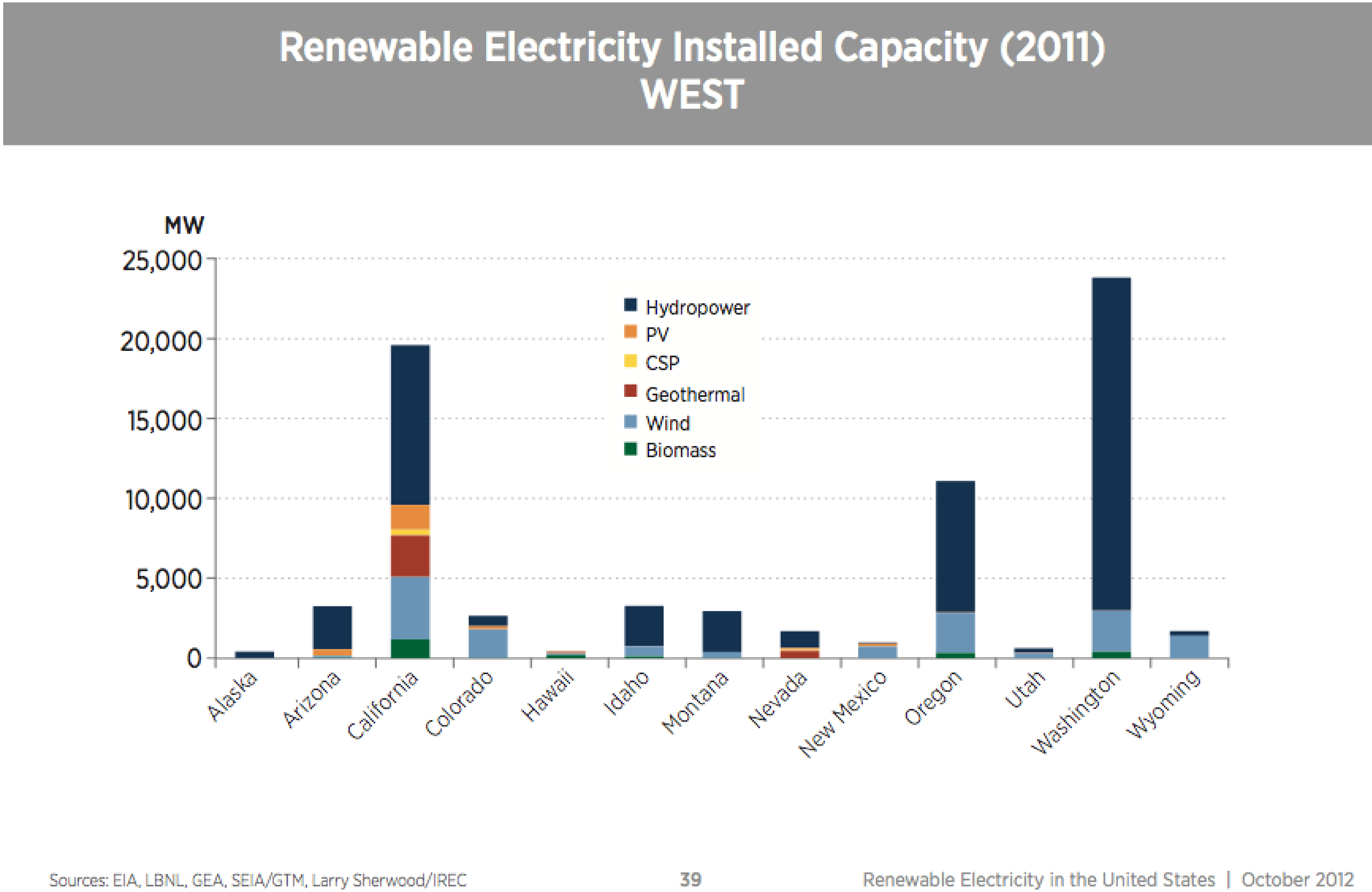
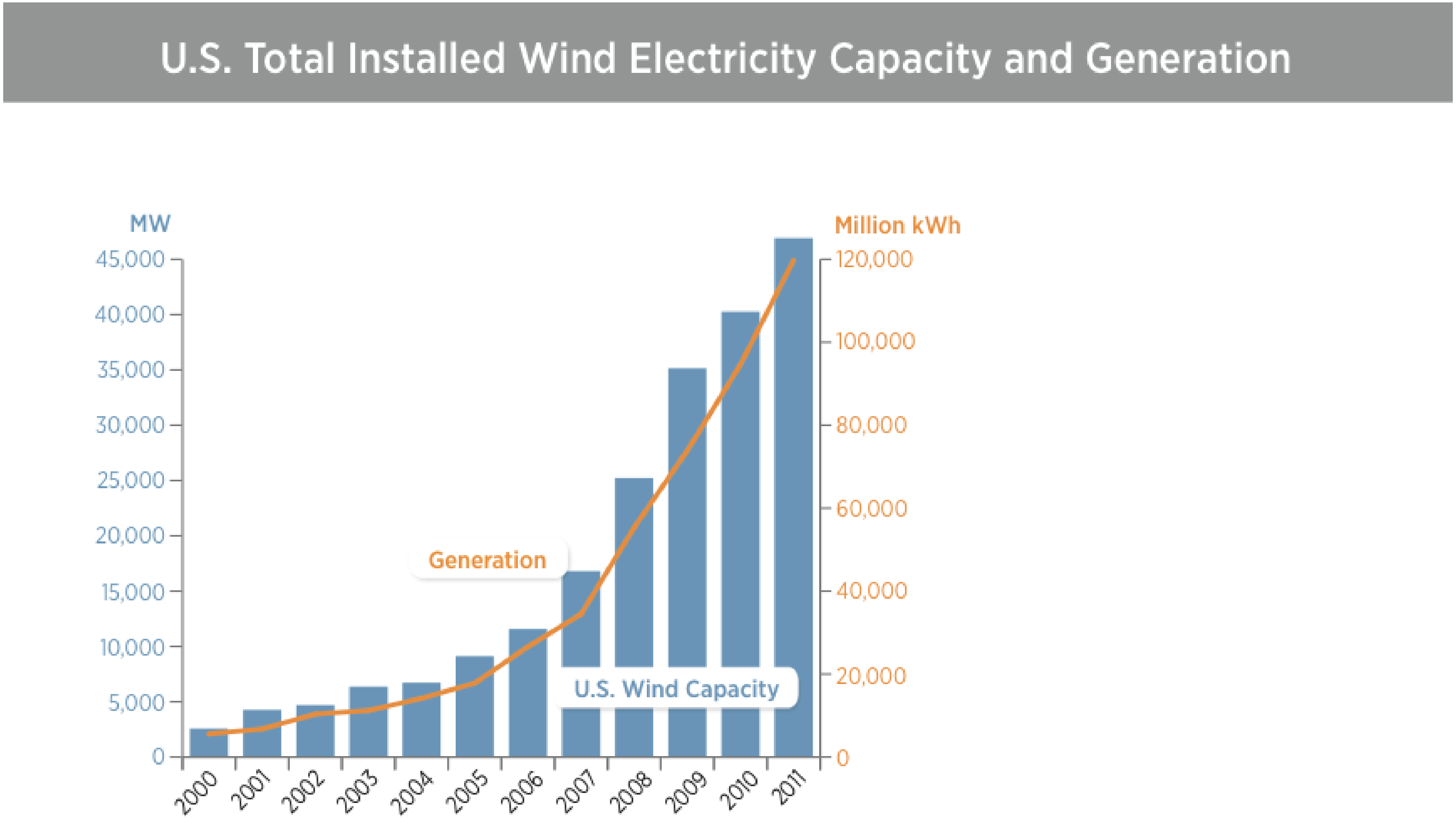


Source: NREL 2011 Renewable Energy Data Book

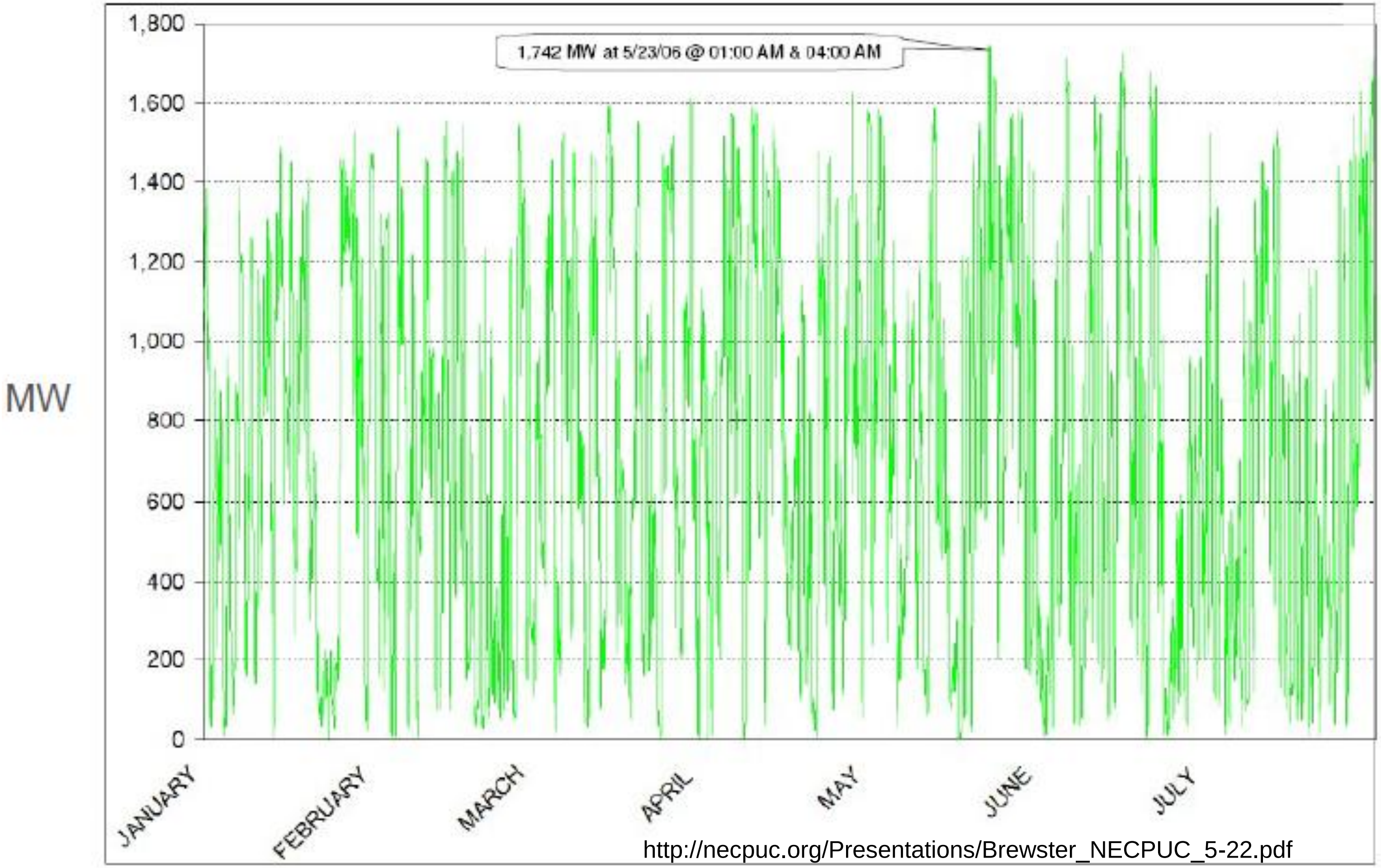
Wind Capacity and Generation



Source: NREL 2011 Renewable Energy Data Book

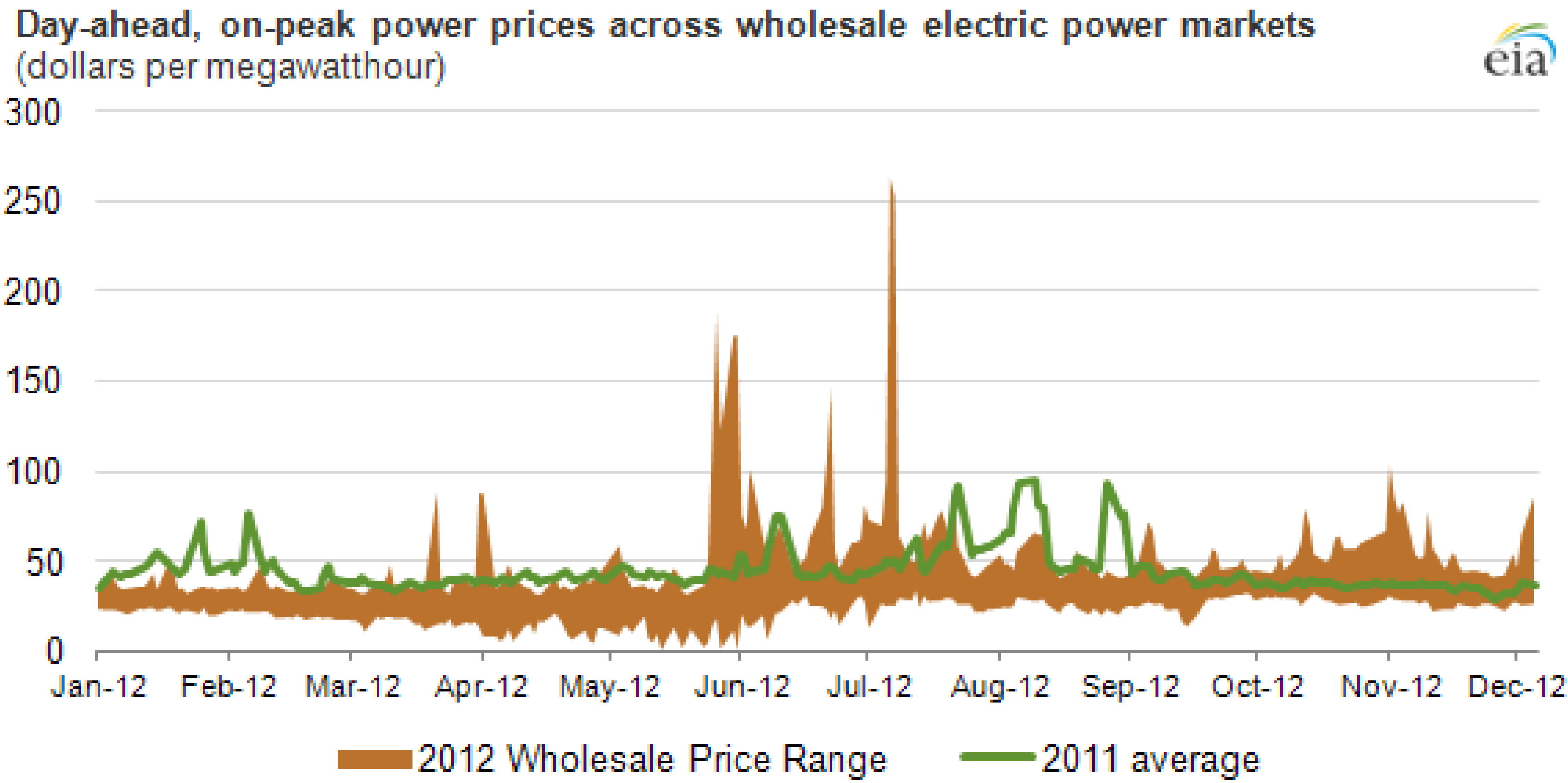
Volatility of Renewables

Hourly **wind** output in ERCOT (Texas)



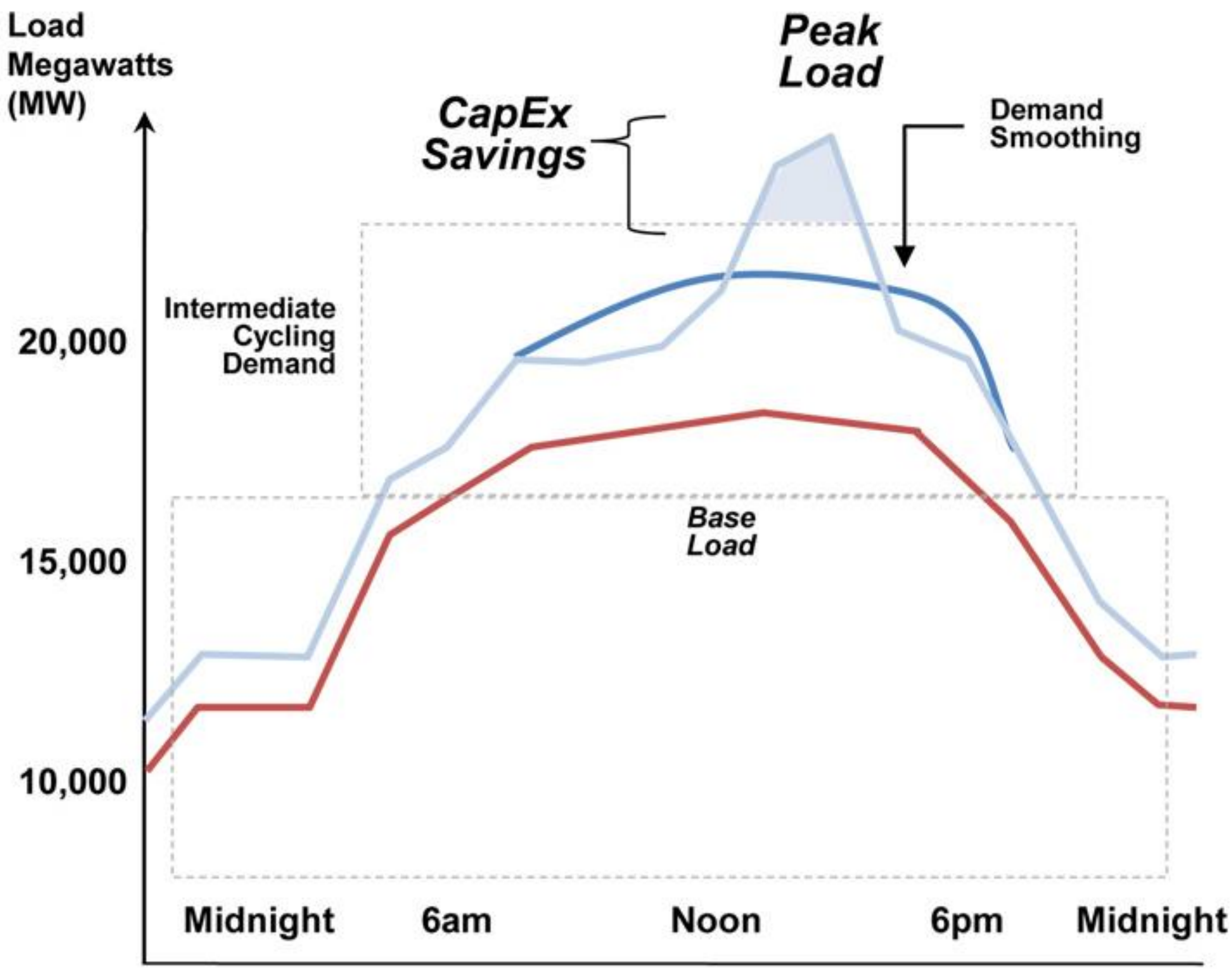
http://necpuc.org/Presentations/Brewster_NECPUC_5-22.pdf

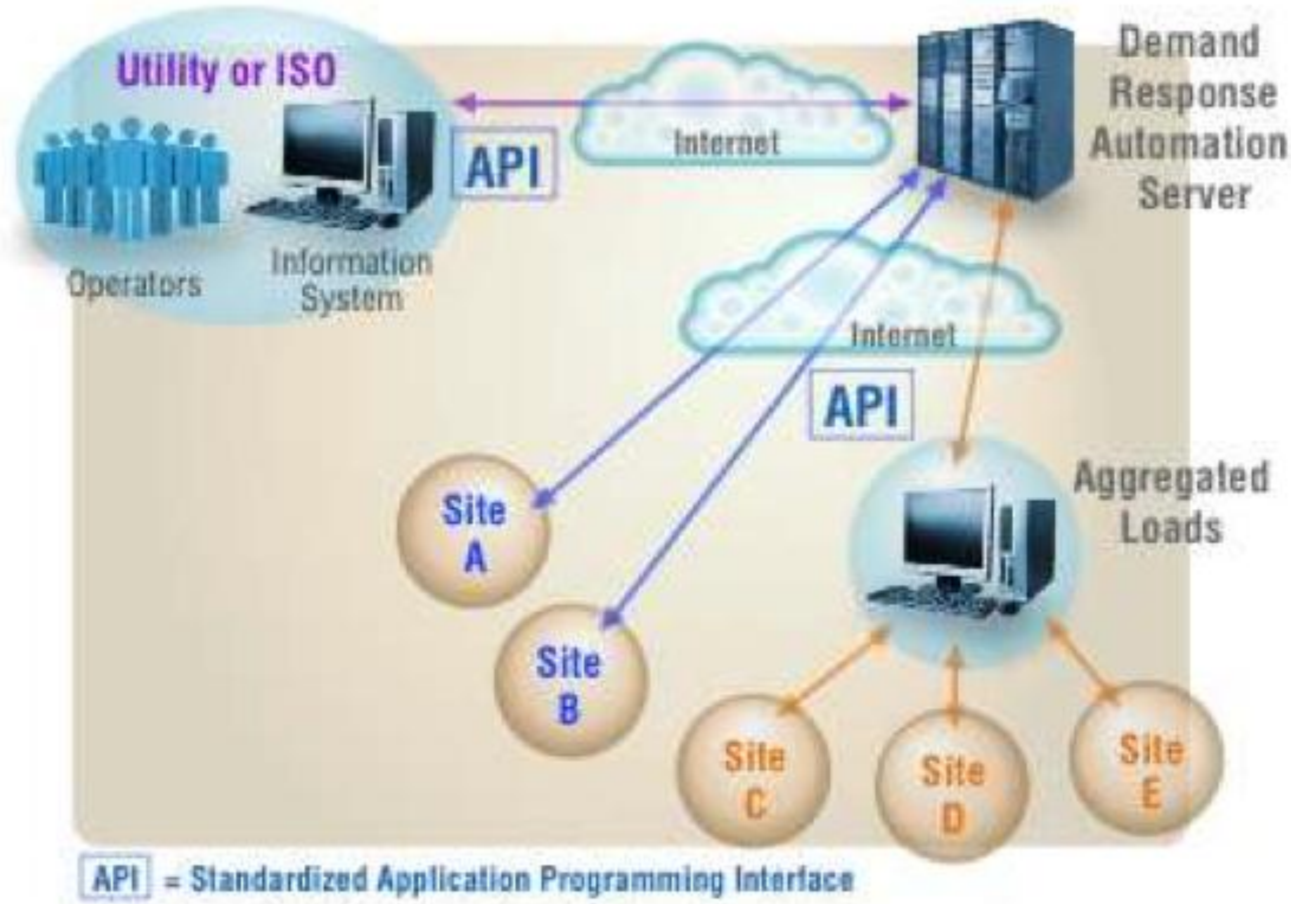
Wholesale Peak Price Range



Source: U.S. Energy Information Administration, based on SNL Energy.
Note: Data include day-ahead, on-peak prices from Mid-Columbia, CAISO NP-15, CAISO SP-15, Palo Verde, PJM N. Illinois Hub, ERCOT Houston Zone, Entergy, PJM Western Hub, NYISO Zone J, NE-ISO Mass Hub, MISO Illinois Hub, and Into Southern pricing points.

Demand Response



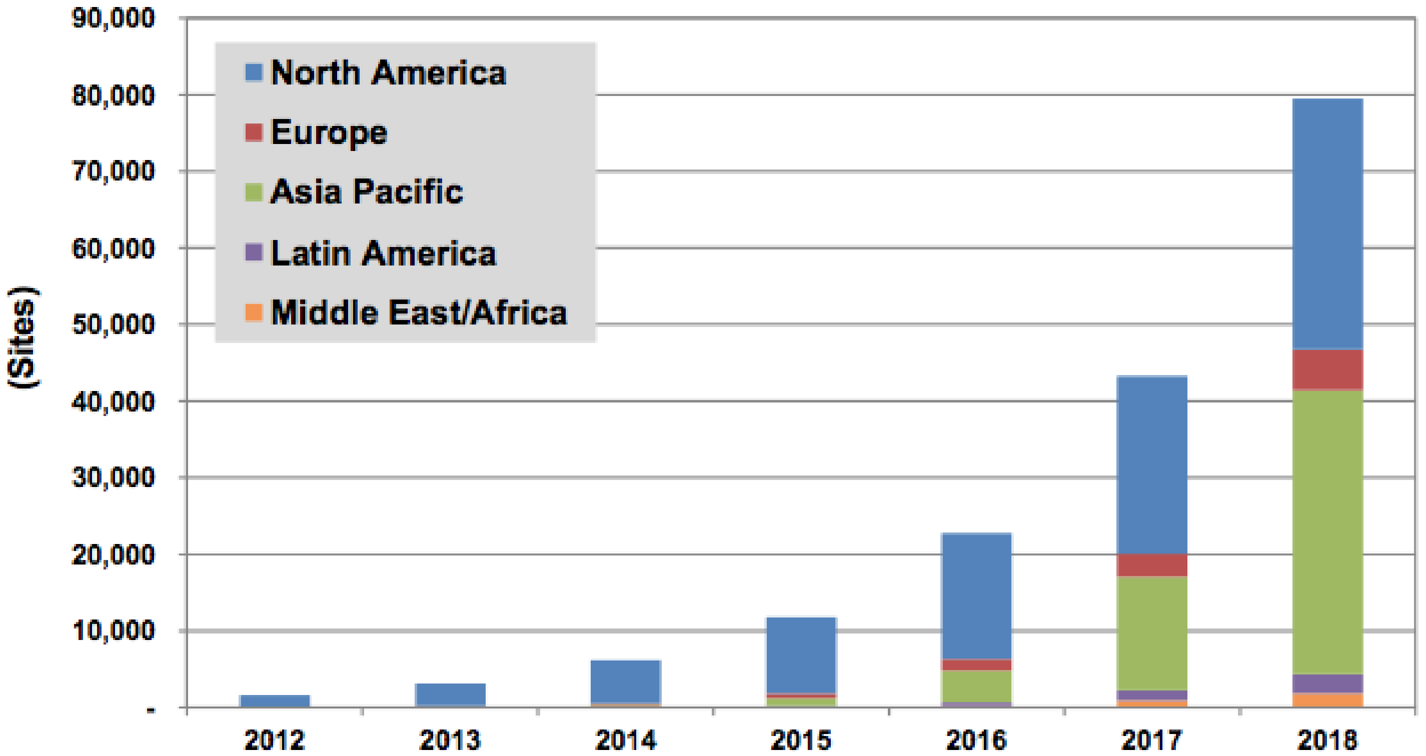


Source: LBNL

openadr.org

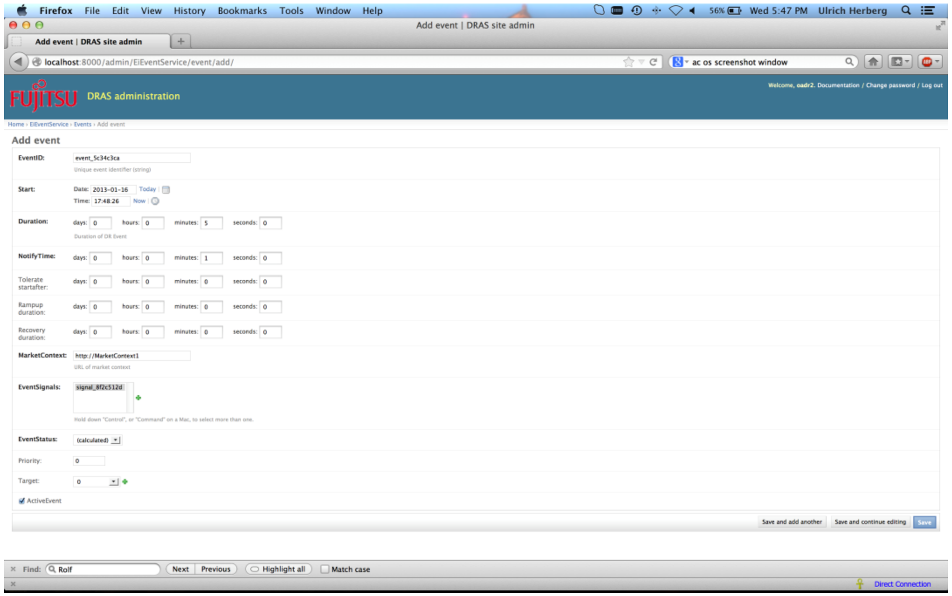
openADR FUJITSU

Chart 1.1 *Auto-DR Sites with OpenADR Standard by Region, World Markets: 2011-2018*



(Source: Pike Research)

Fujitsu Labs: OpenADR Prototype



Fujitsu OpenADR2.0 Server

DR event
(increase set point by x)

thermostat

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High-capacity 2.5kW power supply units for servers: Achieves world-class 94.8% conversion efficiency

Yu Yonezawa
FUJITSU LABORATORIES LTD.
Server Technologies Laboratory

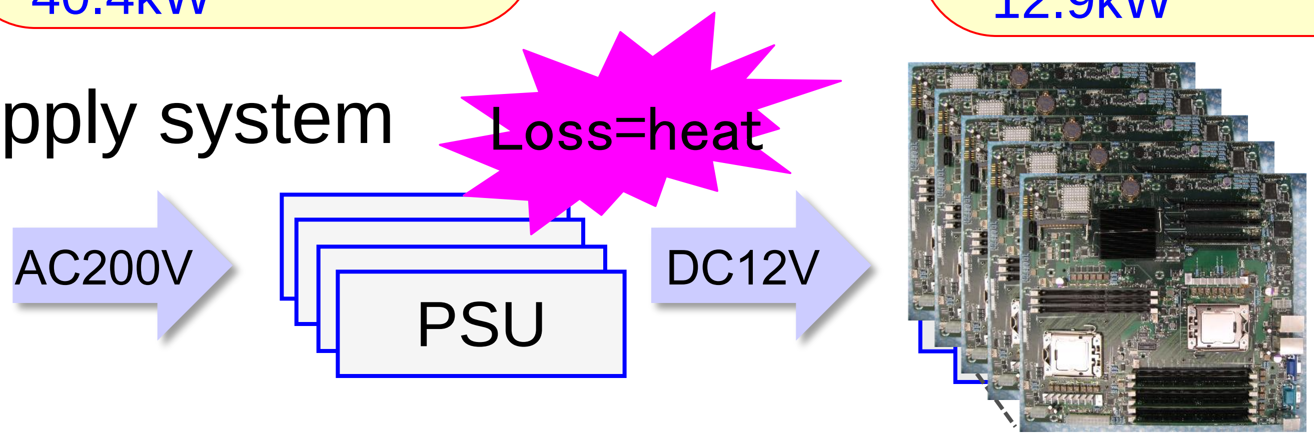
Power supply for server

High performance servers

UNIX server
SPARC Enterprise
M9000
・64CPU（256 cores）
・Memory：4TB
・Power consumption：
40.4kW

Blade server
PRIMERGY BX900
・Blade number ：18
・36CPU（128 cores）
・Memory：3.45TB
・Power consumption：
12.9kW

Power supply system

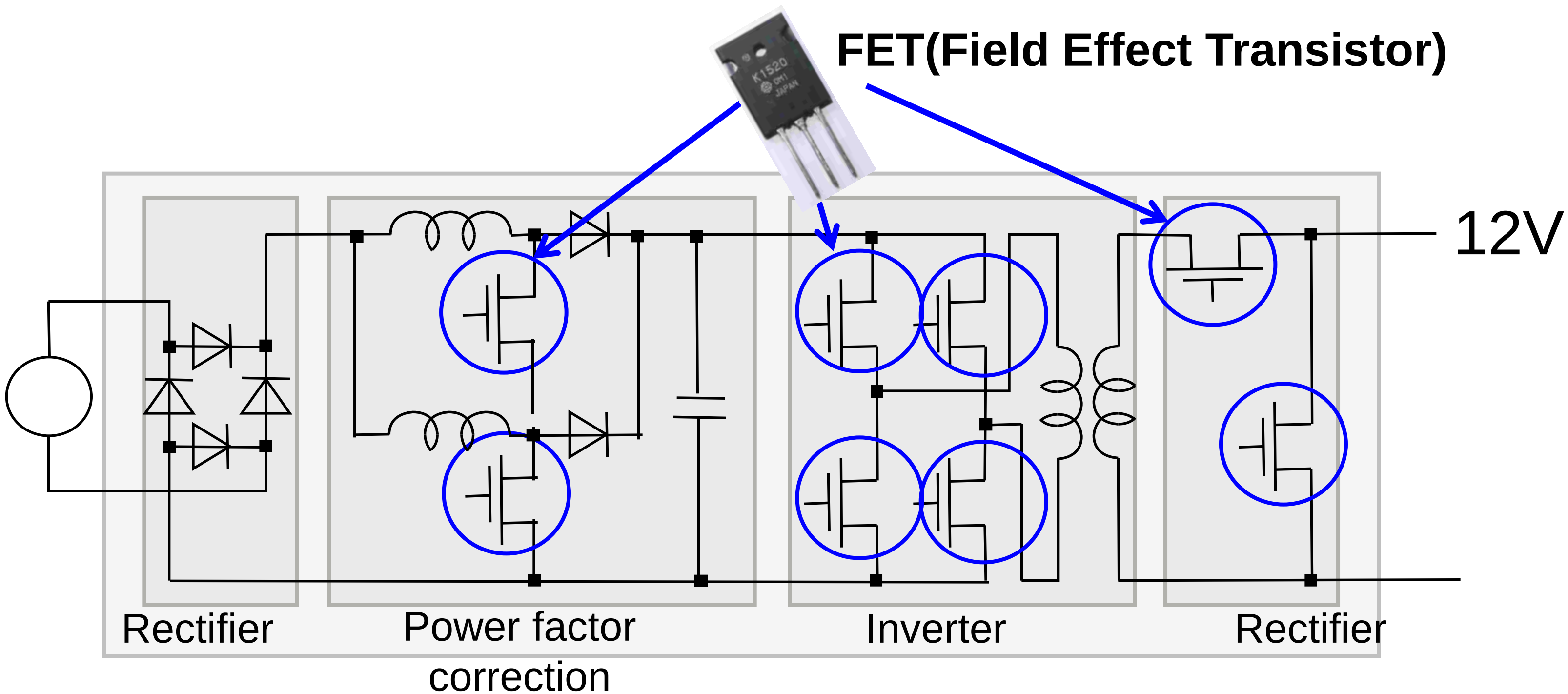


■As servers have grown more powerful, their energy requirements have increased more

➔ High-power and high efficiency PSU are required.

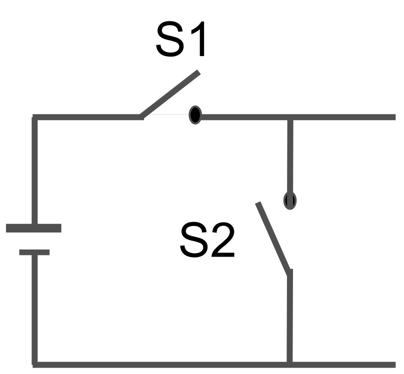
Technical issue of high-power PSU

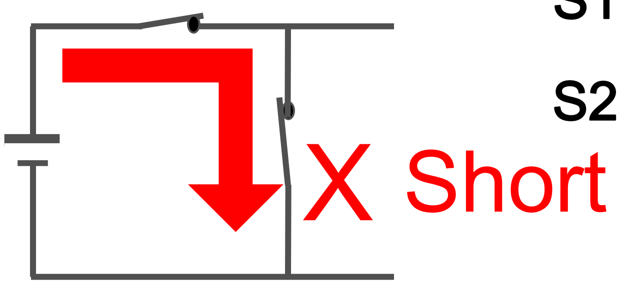
- A power supply performs voltage conversion with field-effect transistors (FET), which are cycled on and off.
- As the PSU capacity increases, the loss in the power supply's FETs increase much more, making high-efficiency power supply units that much more difficult to produce.



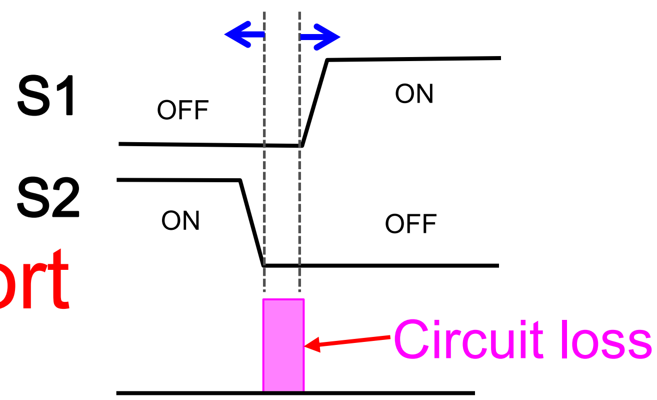
Technical issue 1: Dead-time loss

- To avoid shorts, a power supply unit's circuitry will control one FET to cycle on shortly after another FET has cycled off
- This interval (Dead time) is fixed, but with large currents, each FET's switching speeds up, causing a longer interval when both FETs are off, which increases loss ("dead-time loss").





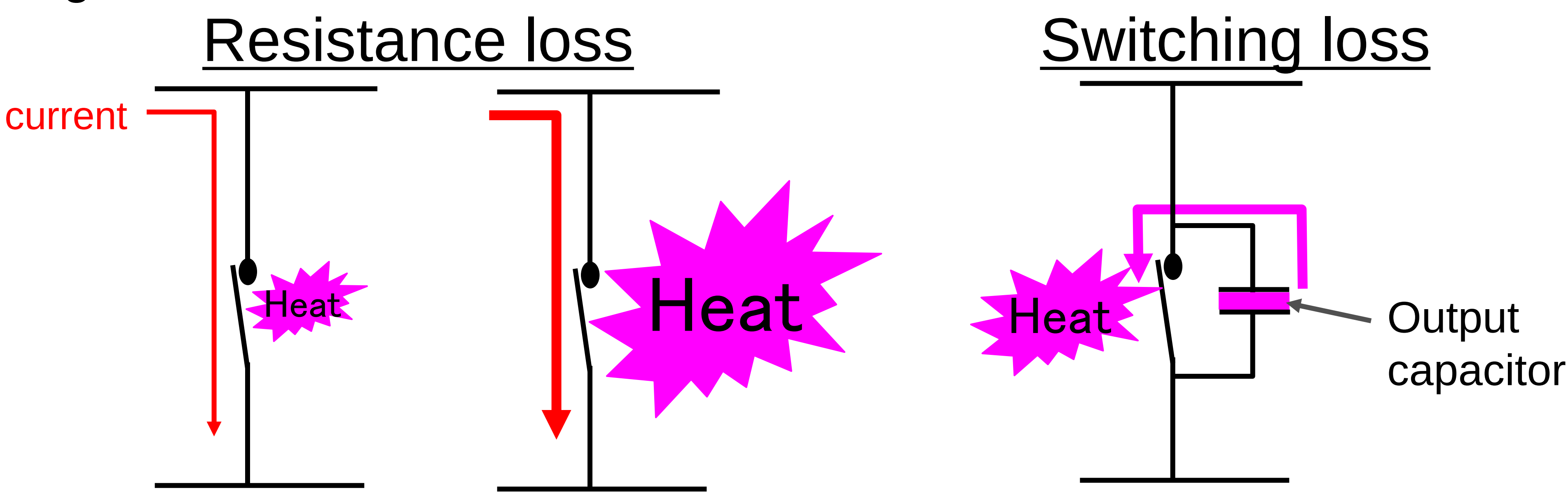
Short should be avoid



FET's switching speeds up, causing a longer dead time and circuit loss

Technical issue 2: Switching loss

- In high-capacity power supplies, larger FETs (the switching elements) are used to supply high current.
- But with larger FETs have higher output capacitance, the current loss at the moment when the FET is switched on is greater.

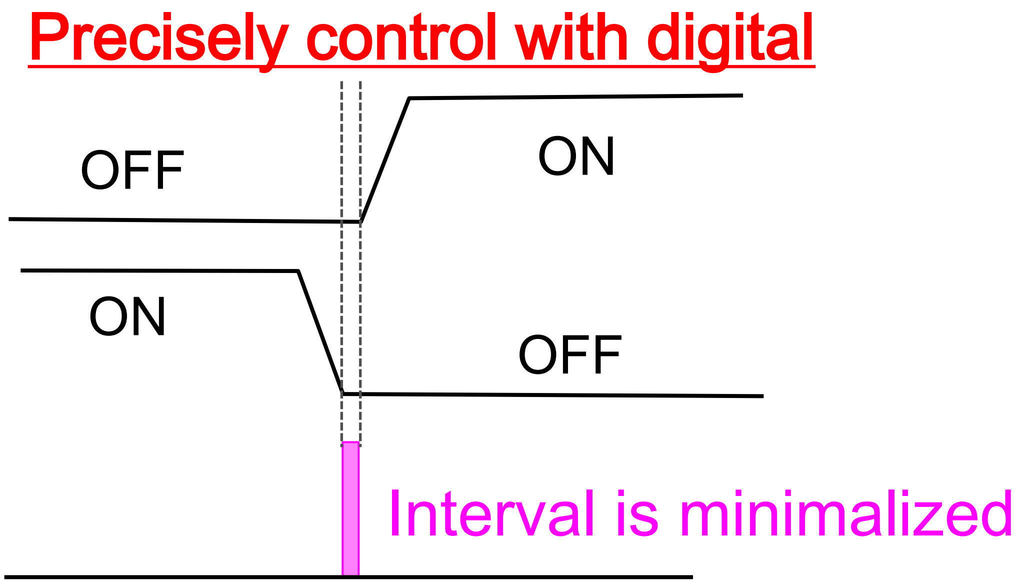


2 times current causes 4 times loss
Current^2 x Resistance

Rush current flow through the switch

Newly Developed Technologies 1. Digital control

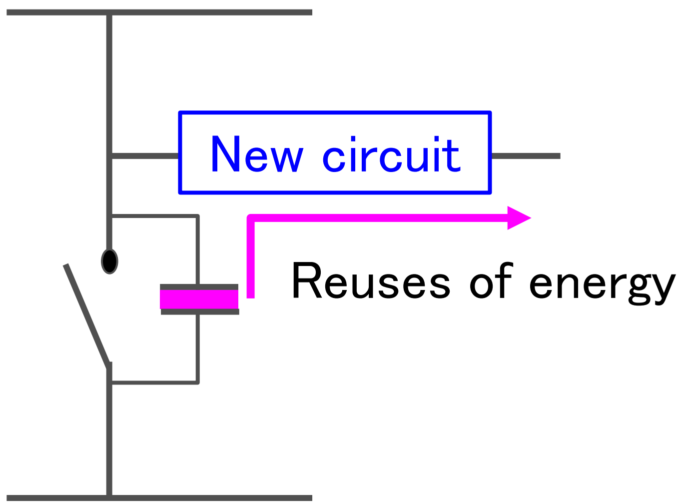
- Digital control adjusts the on and off intervals for two FETs. On and off intervals are controlled with output current change.
  - This technology will present at the Power Electronics and Drive Systems Conference (PEDS) 2013.

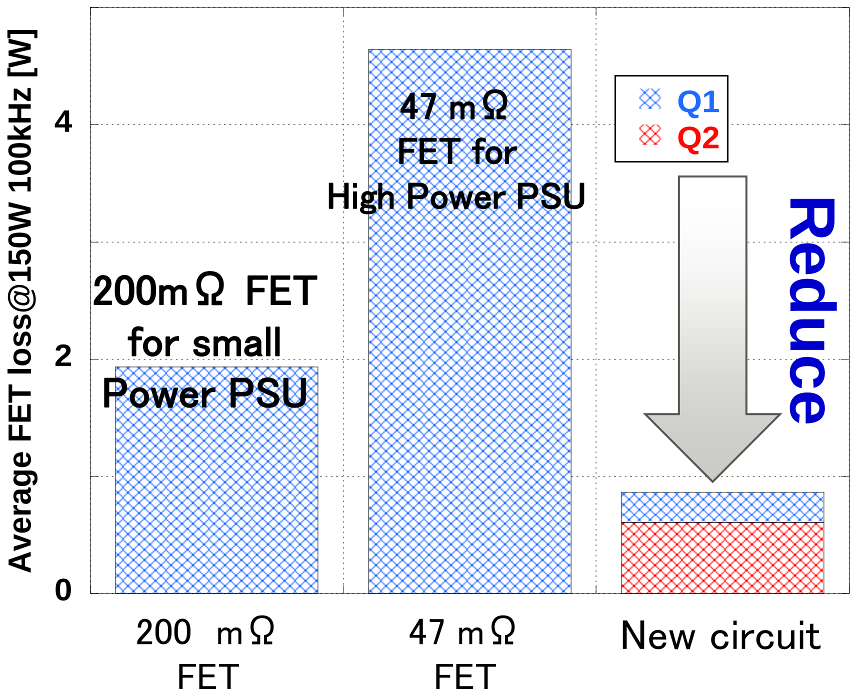


  - Minimize the interval that both are off, as when there is a high current, which reduces dead-time loss

2. New circuitry to reduce switching loss

- A new type of circuit that reuses energy stored in a FET's internal output capacitance.
  - This technology were presented at the Power, Electronics, Machines, and Drives Conference (PEDM) 2012.





Reuse the energy before switch on

PEMD：Power Electronics, Machines and Drives Conference

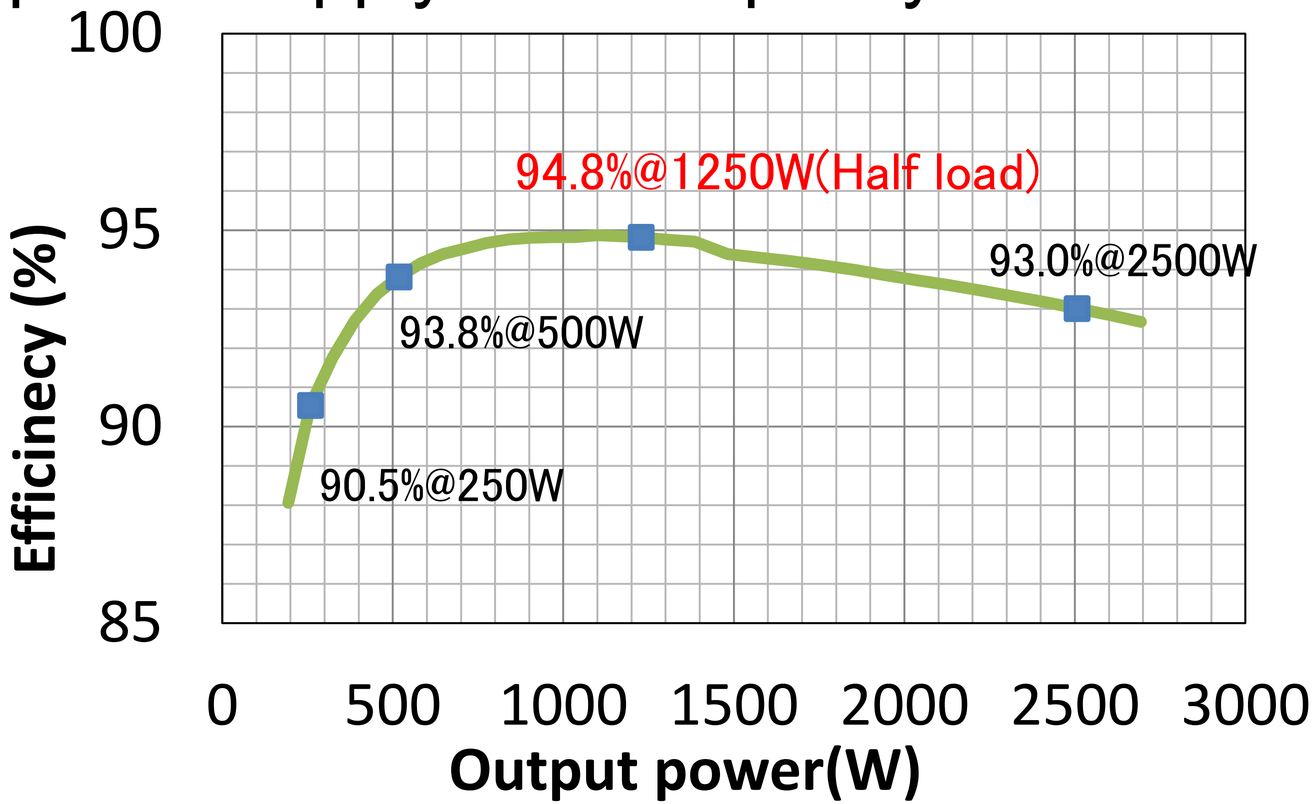
Future Plans

- Further improving the efficiency, reliability and productivity
- Consistency of these technologies with an eye toward debuting servers equipped with power supply units using these technologies in 2014

Efficiency of the power supply

FUJITSU

- We achieved world-leading conversion efficiency rate of 94.8% on our 2.5kW prototype.
- Our new circuit technologies reduced loss increases as the power supply unit's capacity increases.



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