

# Electronics for Efficient Use of Energy

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- Infineon Technologies – Short company overview
- Energy efficiency and its major role in CO2 reduction
- Electronics as a main driver of Energy efficiency improvement
- Examples for Electricity savings enabled by Power Electronics
- Resulting Goals for Industrial Research




## Infineon at a Glance

### The Company

- Infineon provides semiconductor and system solutions, focusing on three central needs of our modern society:  
Energy efficiency, Communications and Security
- Revenue in FY 2009: 3.027 billion EUR
- Some 26,000 employees worldwide (as of Sept 2009)
- Strong technology portfolio with about 22,900 patents and patent applications
- More than 30 major R&D locations
- Germany's largest semiconductor company

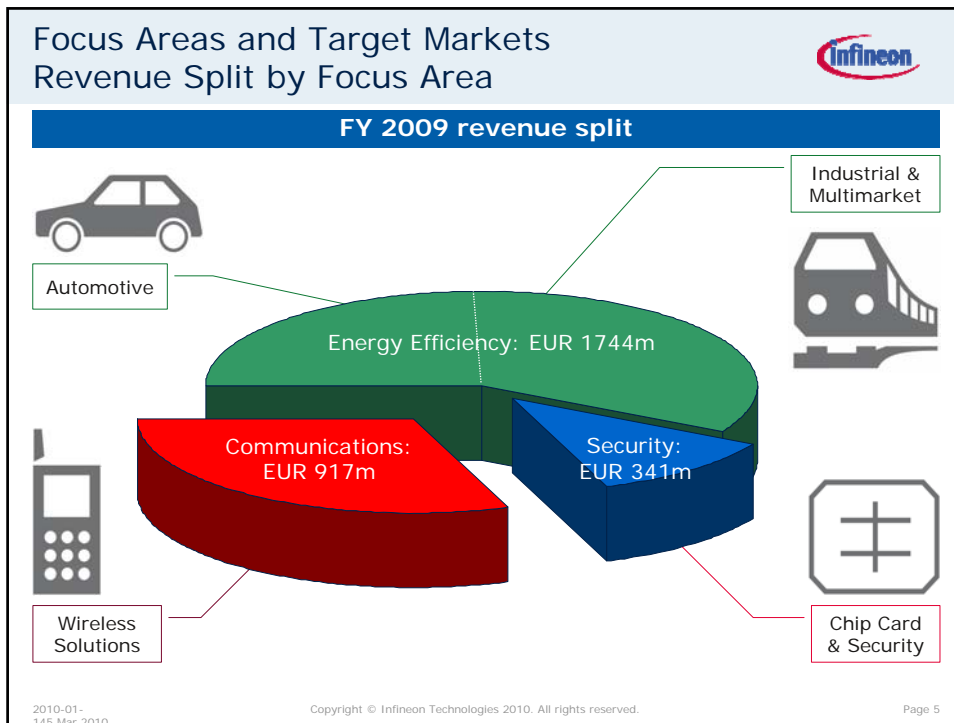
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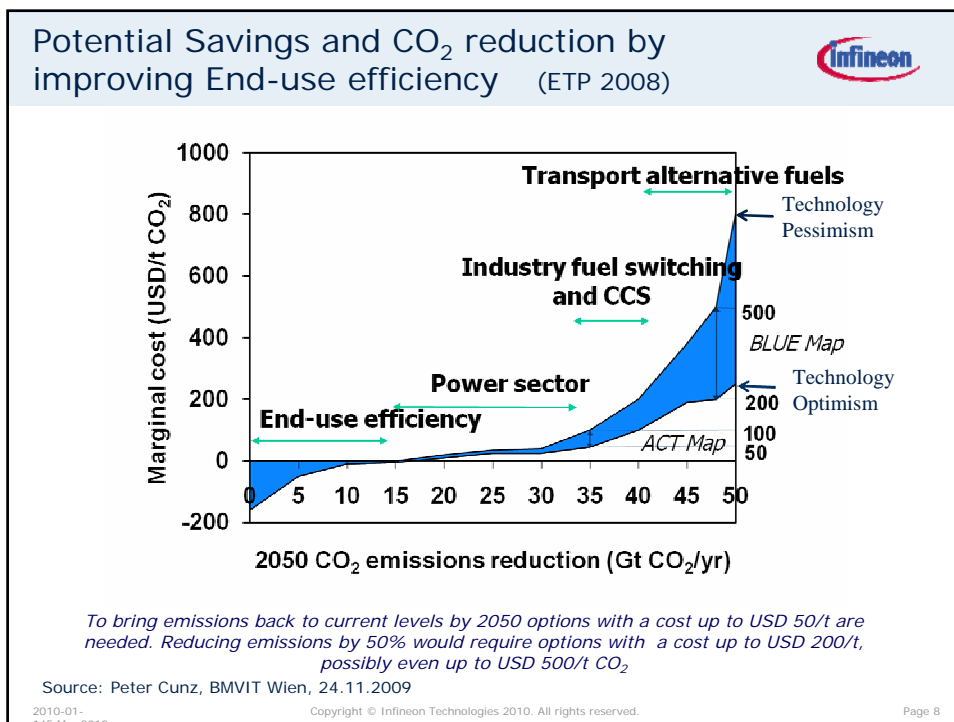
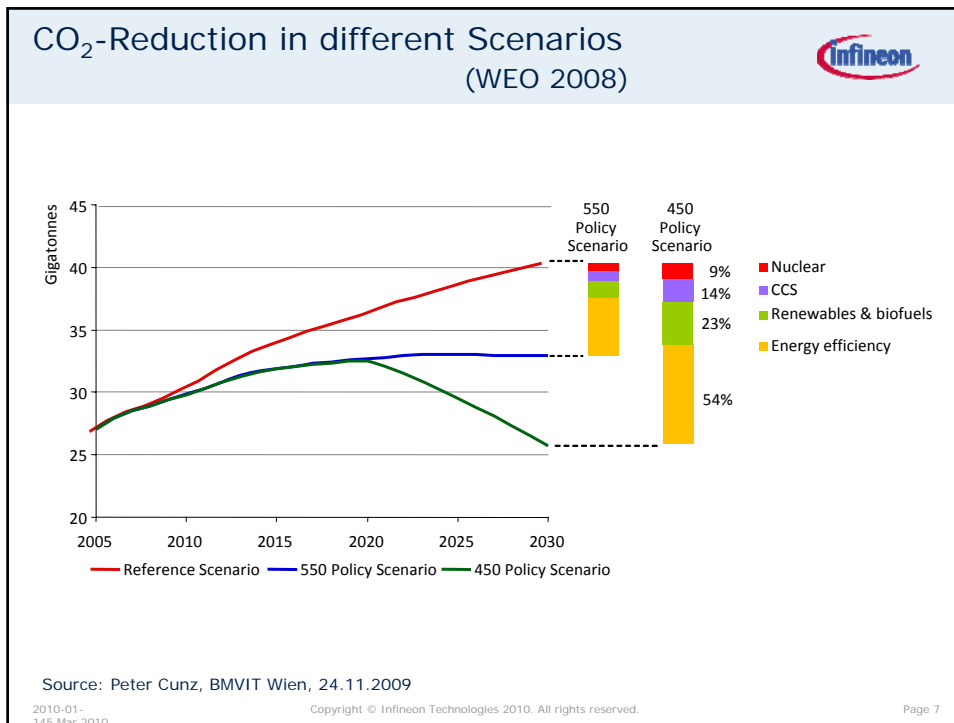


## Infineon's Rankings

Power	Industrial	Chip Card	Auto-motive	Wireless ASSP
#1	#1	#1	#2	#4
Market share 10%	Market share 8%	Market share 26%	Market share 9%	Market share 6%
IMS Research, July 2009	Semicast, May 2008	Frost & Sullivan, October 2009	Strategy Analytics, July 2009	iSuppli, March 2009

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### Examples: PC power supply

Conventional power supplies achieved efficiency of around 70%-80%

Today, we are able to achieve >90% efficiency, with an additional expense of ~ 5€

Add. semi investment: 5 €\*

\* Infineon estimation at system level for a 300W power supply

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### New circuit topologies and advanced power technologies are necessary (e.g. CoolMOS™ ...)

**PFC stage**

- ensures current to follow voltage sine wave, PF=1
- hard sw., 64..100 kHz
- CoolMOS 500V/600 V, 199 mOhm
- SiC Schottky diode 600V
- CCM PFC IC

**PWM stage**


- Galvanic insulation
- hard or resonant sw., 100..200 kHz
- CoolMOS 500V/600 V, 199 mOhm
- PWM IC and Half Bridge Driver

**Secondary rectification**

- synchronous rectification for 12V
- hard commutation, 100..200 kHz
- OptiMOS 60..100 V, 5..10 mOhm
- Buck Stages for 3.3V and 5V

○ Indicates Power Semiconductor content

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## Huge savings and CO2 reduction potential

In EU alone, :

- Approx. 40 mio<sup>1)</sup> new PCs are sold per year
- 300W silverbox running at average load of 50%;
- For 8h per day:
  - ⇒ Electrical energy consumption would be **17,5 TWh per year**
  - ⇒ 10% efficiency increase ≡ saving of **1,75 TWh per year**



Applying:

- 0,13 €/kWh<sup>2)</sup>
- 500g CO<sub>2</sub>/kWh<sup>3)</sup>

Would result in:


228 mio € in electricity consumption savings and subtracting additional expense of €5 per power supply per new PC (200 mio €) would result in :

- ⇒ **Net savings of ~ 28 mio € per year &**
- ⇒ **875.000 tonnes CO<sub>2</sub> per year**
- ≡ elimination of 300.000 cars<sup>4)</sup> per year !**

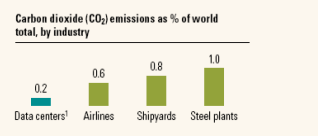
Sources: 1) Infineon estimate based on external analyst figures (Gartner 2008)  
 2) estimate based on mix for Households and Industry for 2007 in EU-27 (Eurostat yearbook 2008)  
 3) average based on values from literature ranging from 375g CO<sub>2</sub>/kWh (EU-commission) to 750 g CO<sub>2</sub>/kWh (Solar World)  
 4) 150g CO<sub>2</sub>/km, 20.000 km per year

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## Data centers' global emissions approach those of Argentina or Netherlands

### Data centers account for 1-2% of global electricity consumption

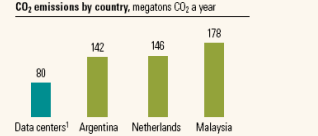


Industry	Percentage
Data centers <sup>1)</sup>	0.2
Airlines	0.6
Shipyards	0.8
Steel plants	1.0

### Raising number of servers



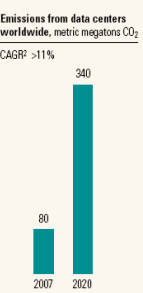
### CO<sub>2</sub> emissions by country, megatons CO<sub>2</sub> a year



Country	Emissions (Megatons CO <sub>2</sub> a year)
Data centers <sup>1)</sup>	80
Argentina	142
Netherlands	146
Malaysia	178

### Emissions from data centers worldwide, metric megatons CO<sub>2</sub>

CAGR<sup>2)</sup> >11%



Year	Emissions (Metric megatons CO <sub>2</sub> )
2007	80
2020	340


<sup>1)</sup>Including custom-designed servers (eg, Google, Yahoo), consumed and embedded carbon.  
<sup>2)</sup>Compound annual growth rate.

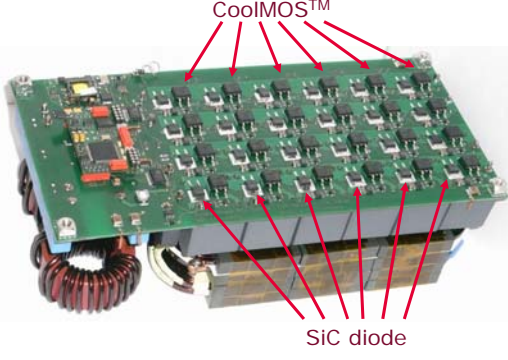
Sources: Advanced Micro Devices; Financial Times; Gartner; Stanford University; Uptime Institute; McKinsey analysis, 2008; iSuppli, 2009

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## Ultra-efficient 3.3kW demonstrator in SMD technology for Servers





CoolMOST™

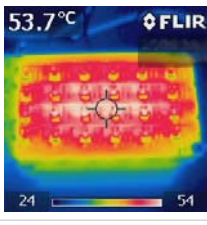
SiC diode

World record efficiency achieved!

Input: 195...254V  
 Output: 365V, 3.3kW  
 Dimensions: 275 x 130 x 85mm<sup>3</sup>  
 Power Density: 1.11kW/dm<sup>3</sup>  
**Efficiency: >99%**


Due to low losses in the semiconductor devices neither heat-sink nor fan is required

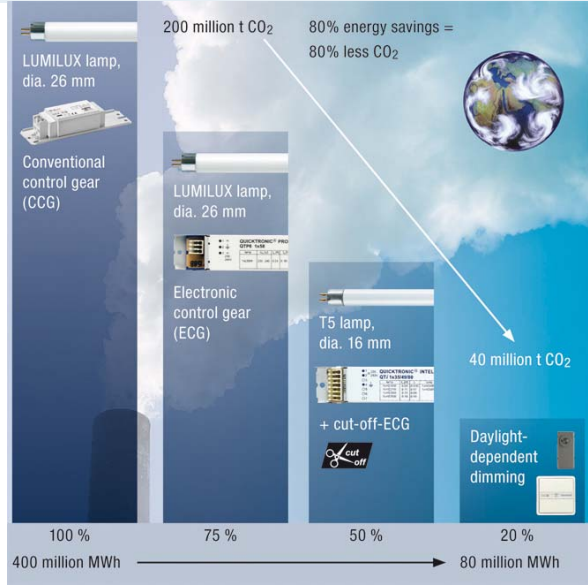
Thermal image after 1 hour full operation



Sources: ETH Zurich, PES Laboratory, 2009  
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## Lighting Applications Energy Saving Potential Electronic Control of Lighting Reduces Energy





Control Technology	Energy Consumption (MWh)	CO <sub>2</sub> Emissions (million t)
Conventional control gear (CCG)	400	200
LUMILUX lamp, dia. 26 mm	300	150
Electronic control gear (ECG)	200	100
T5 lamp, dia. 16 mm + cut-off-ECG	100	50
Daylight-dependent dimming	80	40

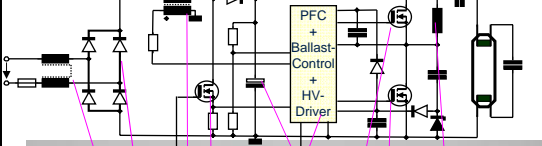
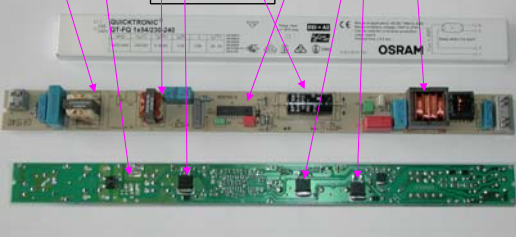
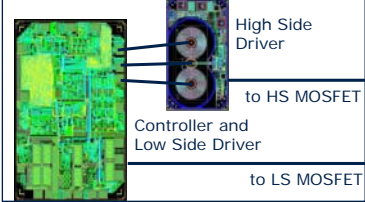
80% energy savings = 80% less CO<sub>2</sub>

15% of worldwide electrical energy is used by lighting

Source: Osram GmbH, evj-spot 1/2007  
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### System integration with multi-chip in a Package enable "intelligent control" of Lamps

#### Lamp Ballast Inverter

- Supports Restart after Lamp Removal and End-of-Life
- End-of-Life (EOL) detection
- Adjustable Inverter Over current Shutdown
- Self-adaptation of Ignition Time from 40ms to 235ms
- Parameters adjustable by Resistors only

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### LED-bulbs are ready to replace incandescent

Coming soon!


60W replacement will be presented at „Light & Building“ by LEDON

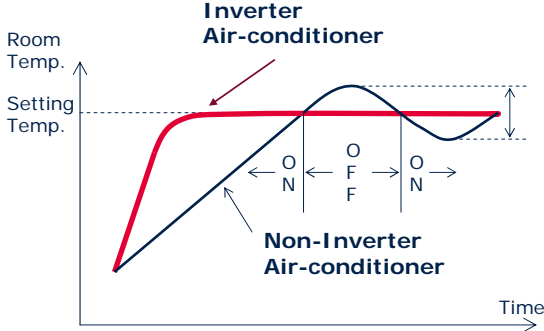
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### Air-conditioners – Infineon products enable improved efficiency and convenience








- Takes 1/3 less time to achieve the desired temperature
- Energy savings up to 30 – 40%
- Permanent control without disturbing noise and constant draft

Source: eupec GmbH, 2005

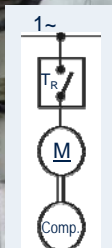
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### Energy Saving with High Efficient Variable Speed Controlled Motor



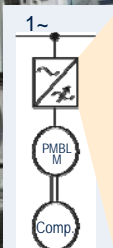
Typical aircon system

Old



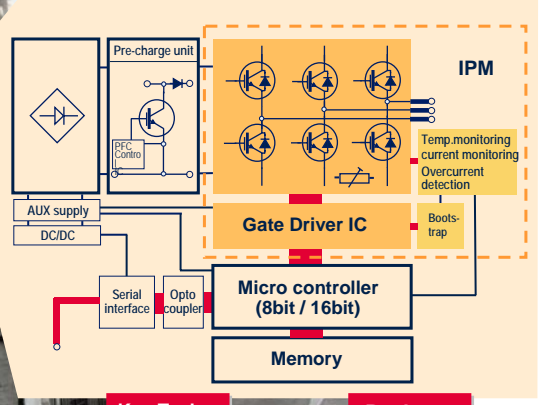
$\eta << 60\%$

New



$\eta > 75\%$

Power converter needed




**Key-Techn.**      **Package**

**IGBT, EMCON, CoolMOS,  $\mu$ C, Smart control IC, CT**

Source: ZVEI, NRDC

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Conclusions for the future of Power Electronics 

- Many energy saving opportunities are not used because of a purely price driven market
- Research has to be done to achieve Higher Energy Efficiency at Lower System Cost
- Energy efficient products become relevant for the climate only after acceptance by the mass market
- We are contributing to an efficient energy management future

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COMMUNICATIONS  
SECURITY

Innovative semiconductor solutions for energy efficiency, communications and security.

