

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

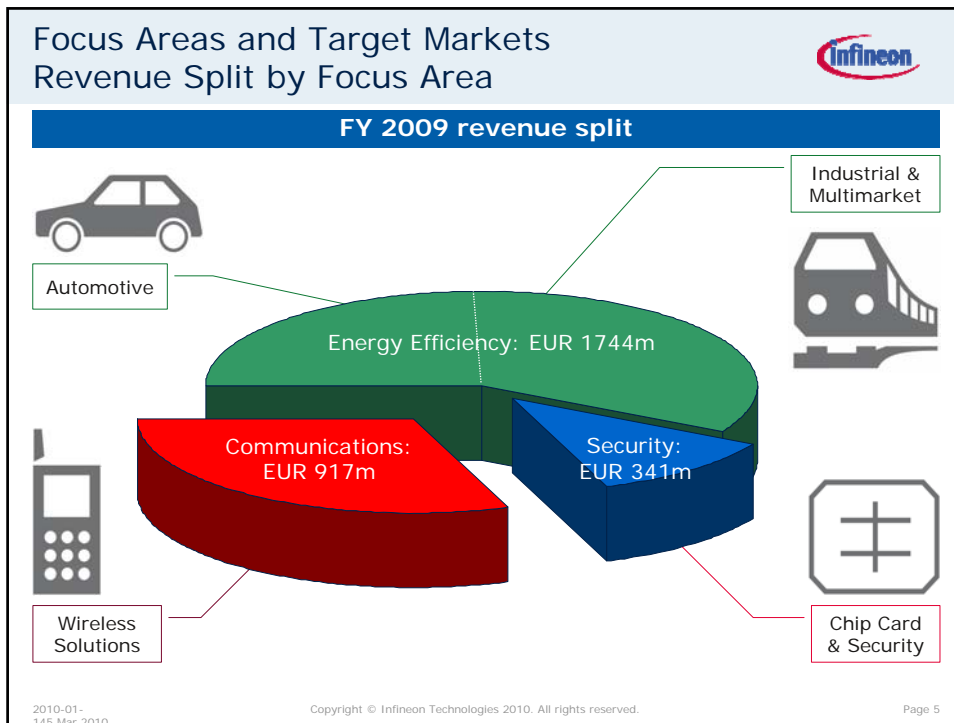
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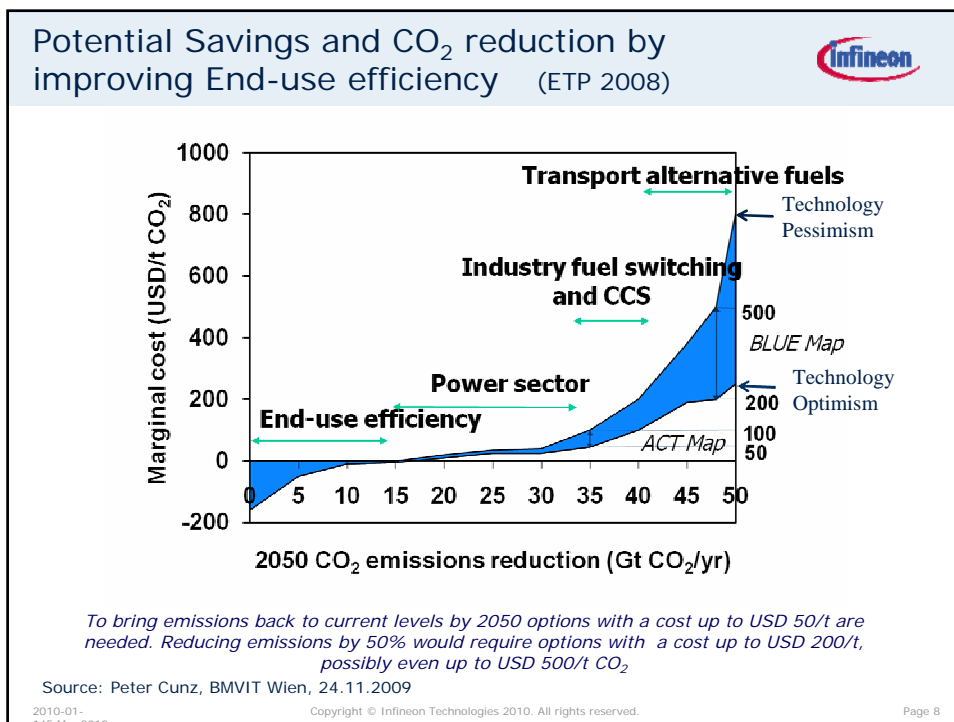
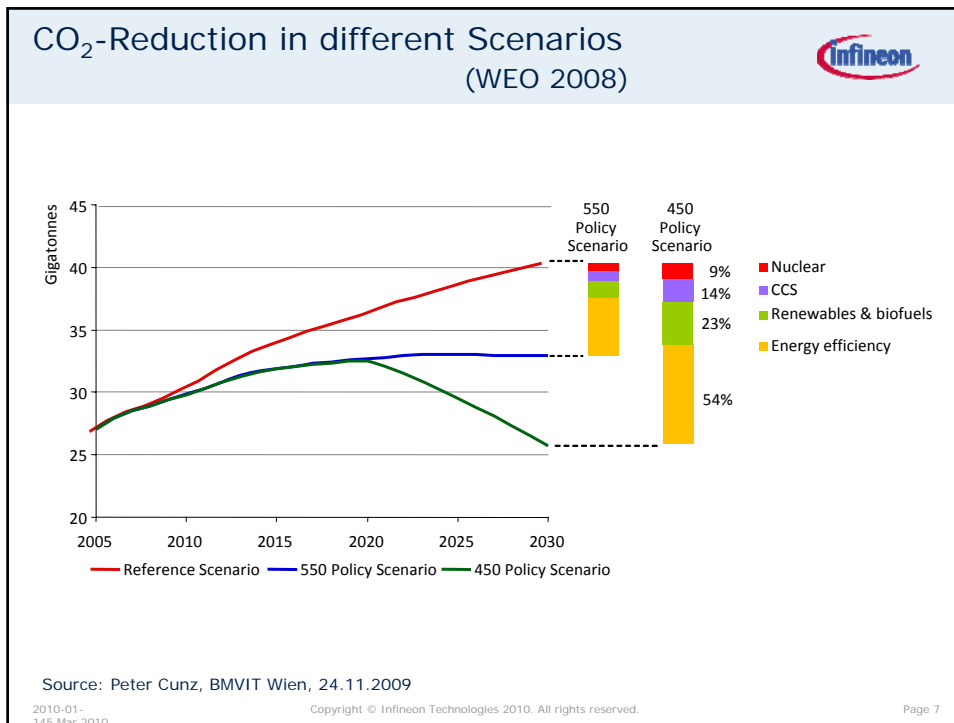


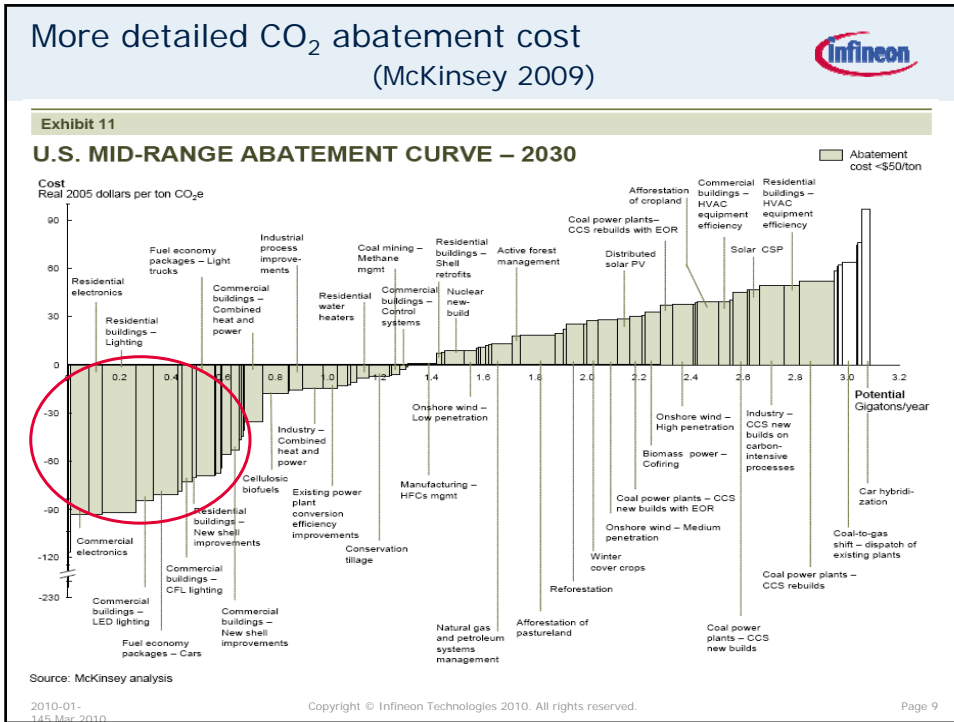
Infineon's Rankings

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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Usage of electrical energy per application



Energy Split: ww		Energy saving potential		Key technology	
Consumers electrical energy (ww)	Con. power supply: - stand-by, - active, ...	Others 14%	- stand-by - active	>90% >>1%	CoolMOS, SiC Smart control IC CoolSET
	I&C, Computing power supply, ...	Internet 10%	80+ / 90+	>>1%	CoolMOS, SiC, Smart control IC, Low cost µC
	EC-Ballast Daylight dimming HID, LED, ...	Lighting 21%	Electronic control	>25%	CoolMOS Smart ballast IC Low cost µC
	Factory autom. Process engineering, Heavy industry, Light industry, ...	Motor control 55%	Variable Speed Drive (VSD)	>30%	IGBT Modules CIPOS EMCON CoolMOS CT
	Transportation: Train, Bus, Car, ...		VSD + Bi-directional energy flow	>25%	Optimized µC 8 bit / 16 bit / 32 bit
Home appliance: Fridge, WM, HVAC, ...		VSD	>40%		

Source: ZVEI, Siemens, CEMEP, CPES, EPA, NRDC

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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€

* 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 mio¹⁾ 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 \cong saving of **1,75 TWh per year**



Applying:

- 0,13 €/kWh²⁾
- 500g CO₂/kWh³⁾

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 CO₂ per year**
- \cong elimination of 300.000 cars⁴⁾ per year !**

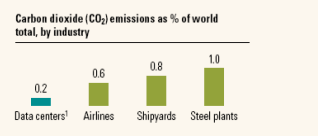
Sources: 1) Infineon estimate based on external analyst figures (Gartner 2008)
 2) estimate based on mix for Households and Industry for 2007 in EU-27 (Eurostat yearbook 2008)
 3) average based on values from literature ranging from 375g CO₂/kWh (EU-commission) to 750 g CO₂/kWh (Solar World)
 4) 150g CO₂/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

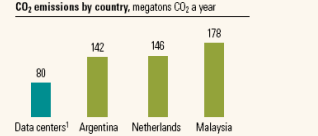


Industry	Percentage
Data centers ¹⁾	0.2
Airlines	0.6
Shipyards	0.8
Steel plants	1.0

Raising number of servers



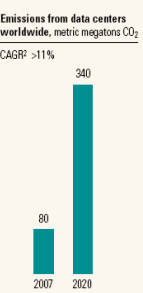
CO₂ emissions by country, megatons CO₂ a year



Country	Emissions (Megatons CO ₂ a year)
Data centers ¹⁾	80
Argentina	142
Netherlands	146
Malaysia	178

Emissions from data centers worldwide, metric megatons CO₂

CAGR²⁾ >11%




Year	Emissions (Metric megatons CO ₂)
2007	80
2020	340

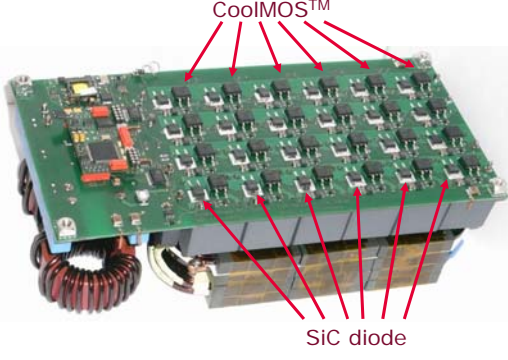
¹⁾Including custom-designed servers (eg, Google, Yahoo), consumed and embedded carbon.
²⁾Compound annual growth rate.

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™

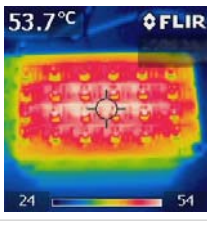
SiC diode

World record efficiency achieved!

Input: 195...254V
 Output: 365V, 3.3kW
 Dimensions: 275 x 130 x 85mm³
 Power Density: 1.11kW/dm³
Efficiency: >99%


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

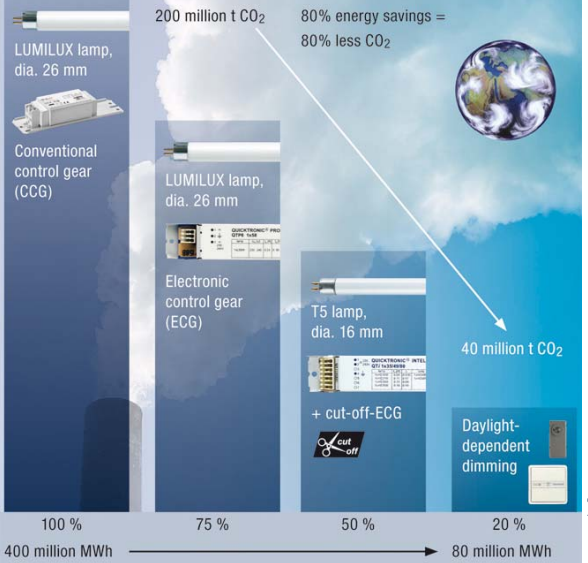
Thermal image after 1 hour full operation



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



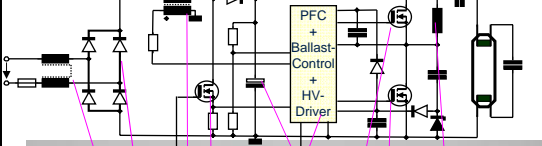
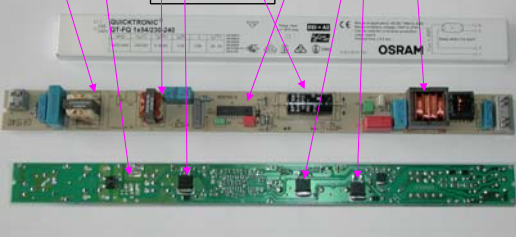
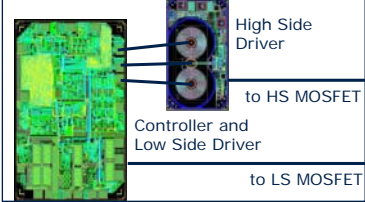


Control Technology	Energy Consumption	CO ₂ Emissions
Conventional control gear (CCG)	100%	400 million MWh
LUMILUX lamp, dia. 26 mm	75%	200 million t CO ₂
Electronic control gear (ECG)	50%	80% energy savings = 80% less CO ₂
T5 lamp, dia. 16 mm + cut-off-ECG	50%	40 million t CO ₂
Daylight-dependent dimming	20%	80 million MWh

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

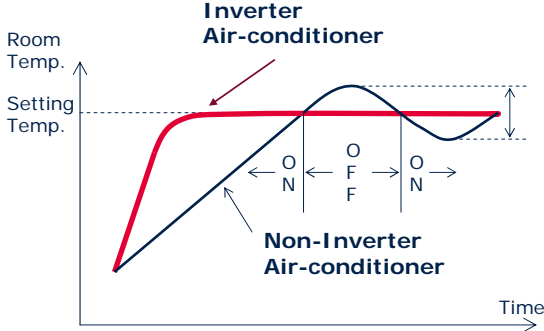
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Air-conditioners – Infineon products enable improved efficiency and convenience








- 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

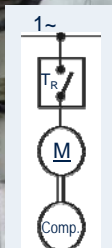
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Energy Saving with High Efficient Variable Speed Controlled Motor



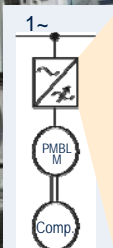
Typical aircon system

Old



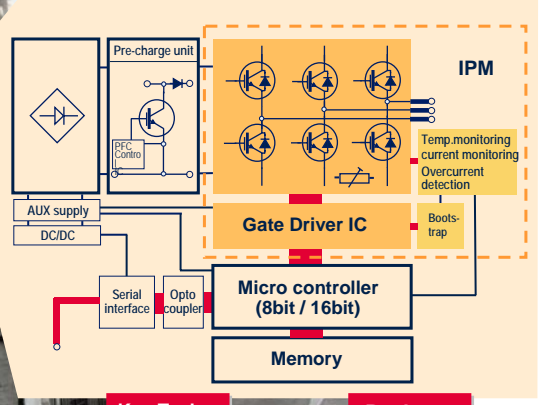
$\eta << 60\%$

New



$\eta > 75\%$

Power converter needed




Key-Techn. Package

IGBT, EMCON, CoolMOS, μ 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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ENERGY EFFICIENCY
COMMUNICATIONS
SECURITY

Innovative semiconductor solutions for energy efficiency, communications and security.

