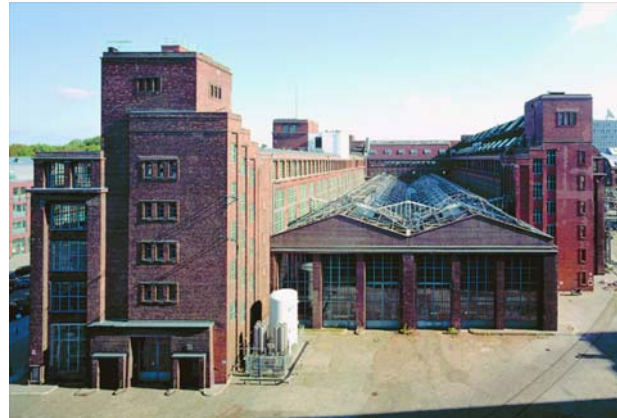




Forschungsschwerpunkt
Technologien der Mikroperipherik



Fraunhofer
Institut
Zuverlässigkeit und
Mikrointegration

Karsten Schischke, Harald Pötter, Karl Heinz Zuber, Andreas Middendorf, Hansjörg Griese

Environmental Challenges of Future ICT Trends - Creating a Green Backbone for the Information Society -

Side event „Sustainability in the Information Society“
at the World Summit on the Information Society, December 10, 2003, Geneva

Creating a smaller future

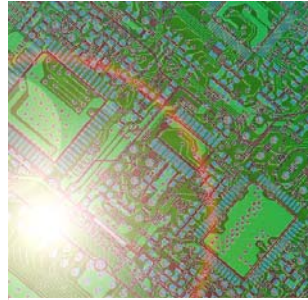
Geneva, December 10, 2003



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Outline



- Introduction: The Society We Want – the Research We Do
- Global Technology Trends for future ICT Hardware
- Responsibility of Technology R&D for Sustainable Development

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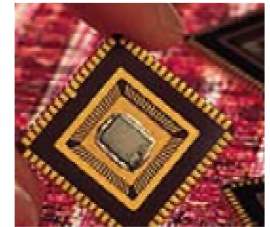
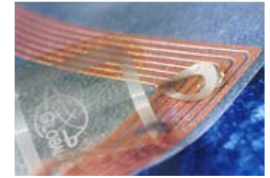
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Introduction: The Society We Want – the Research We Do

Fraunhofer IZM...

- ...focuses on applied research in cooperation with industry
- ...researches electronics packaging and interconnection technologies
 - ⇒ the basis of miniaturisation and system integration
 - ⇒ pace-maker for advanced microsystems
 - ⇒ creating the (hardware) backbone of the information society
- ...researches for environmentally benign and sustainable technologies for electronics
 - ⇒ acceptance of later products is the basis for successful technology development



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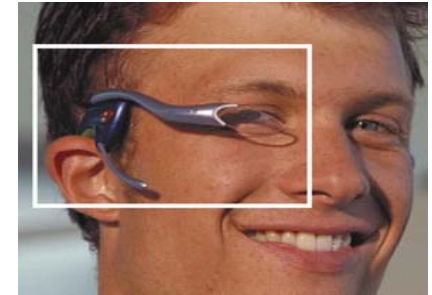
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Today



Tomorrow



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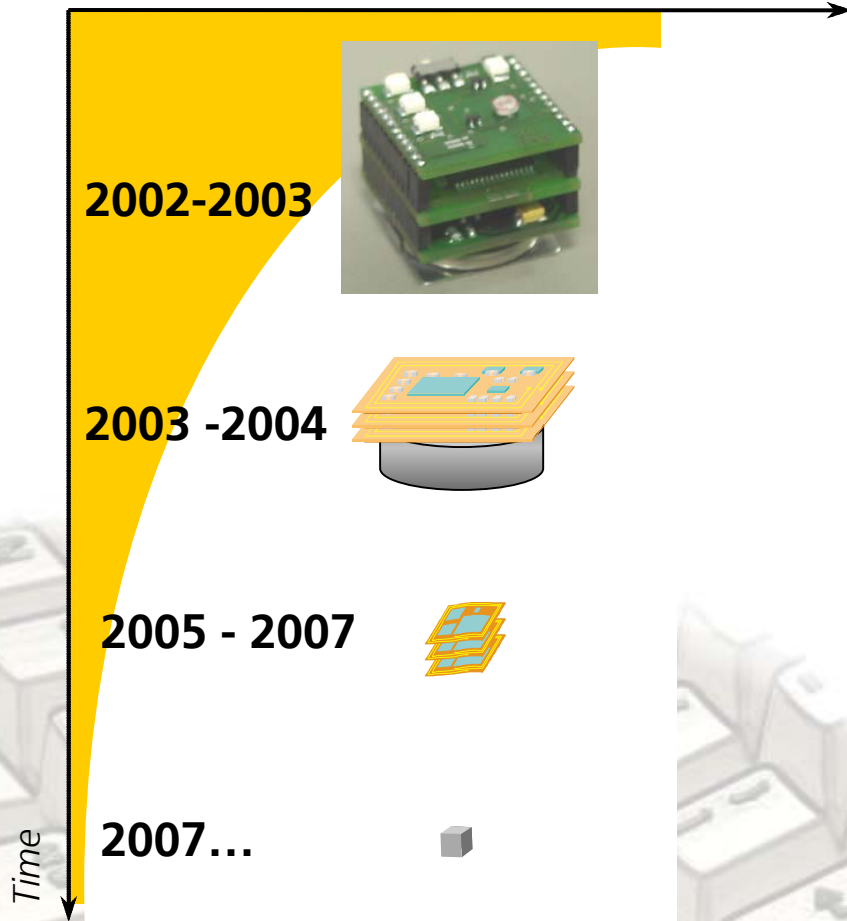
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Future Packaging Tasks



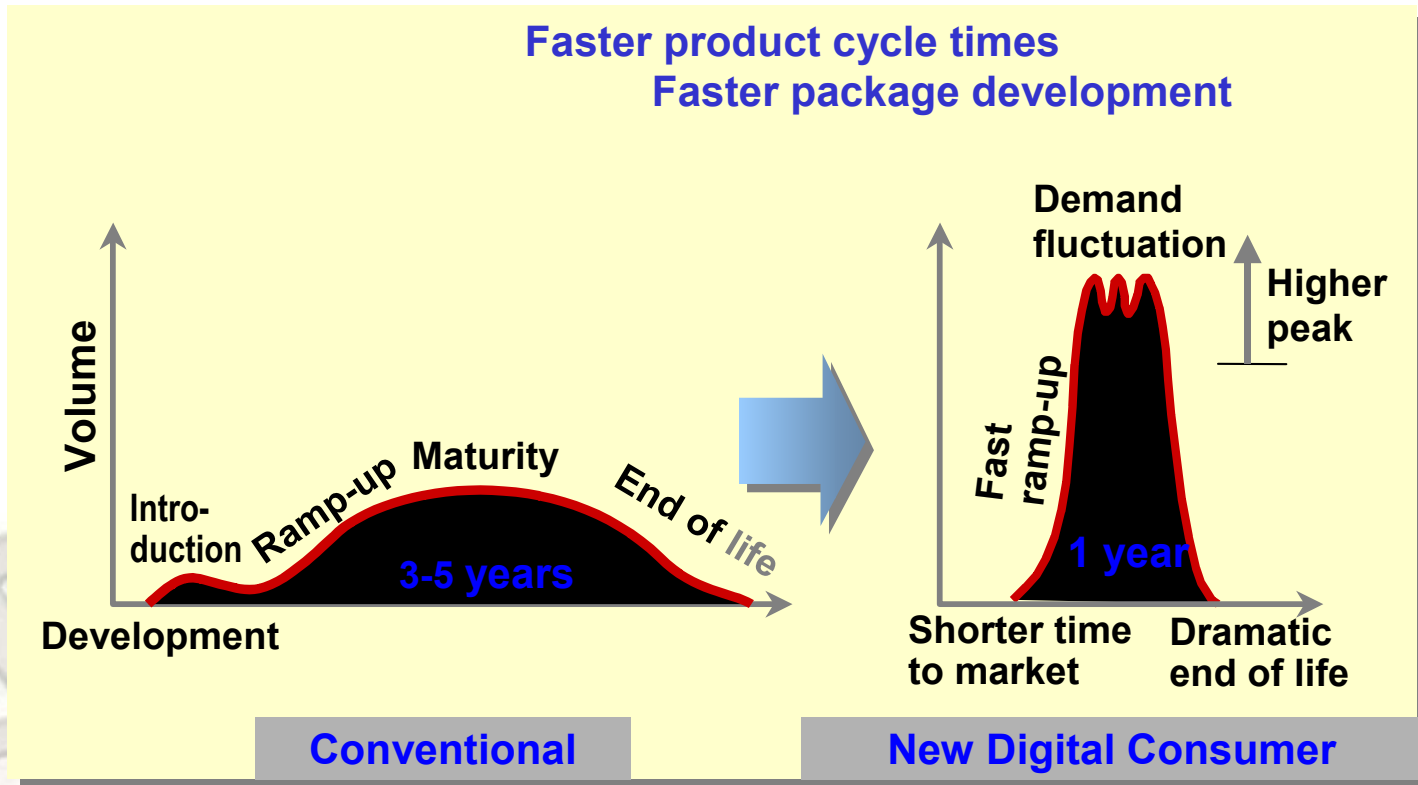
- Vision „e-grain“: grain size electronics, connected via software / wireless transmission, adaptable for a broad range of applications
- The trend for miniaturisation will rapidly go on for the next years
- New products, new applications, which will change the interaction with our environment dramatically

"In the 21st century the technology revolution will move into the everyday, the small and the invisible ...

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

Mark Weiser (1952 - 1999, Xerox Corporation)

Shorter Product Life Cycles



- Changing use patterns

Shorter Product Life Cycles

Globalisation of Use Cascades

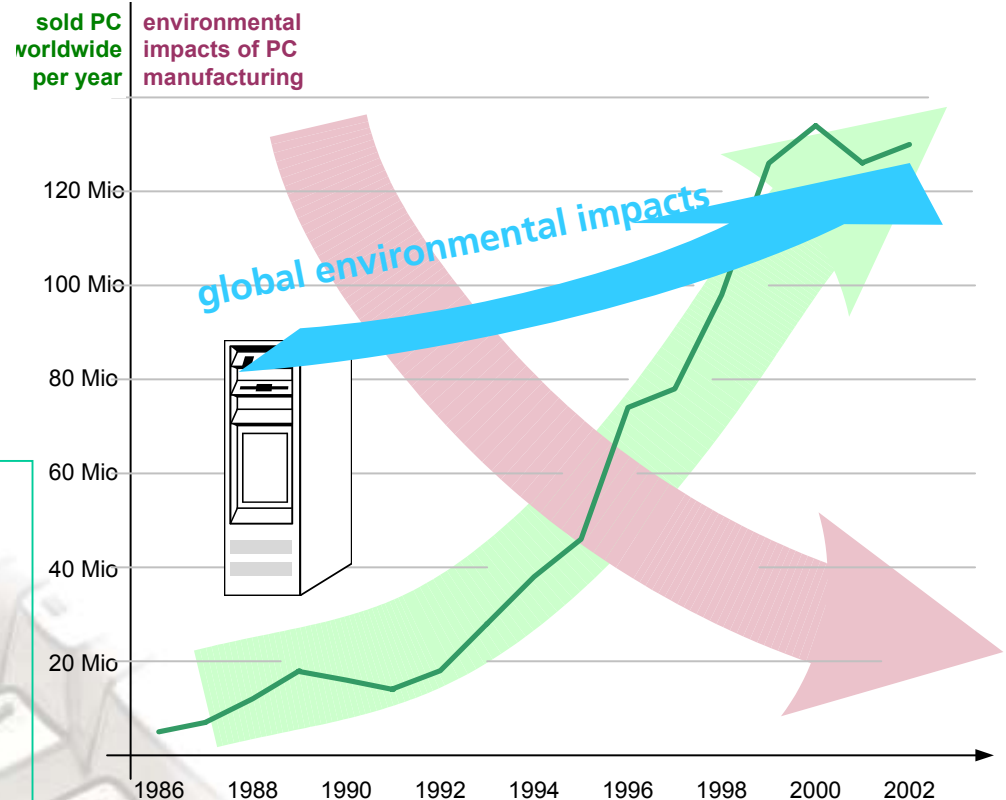
- Take-back of mobile phones is a question of „green image“
 - ⇒ all major mobile network operators established take-back systems in Germany in 2003
 - ⇒ „green“ and charity, sending still working mobile phones to developing countries
- Europe develops strict environmental regulation for electronics waste management, but sends electronics devices to countries, where such regulations do not exist
- Controversy:
 - the right to have **access to information technology** ⇔ **environmental implications** due to missing waste management
- Approach e.g. followed by Thailand: Copy European legislation (infrastructure still missing)
 - ⇒ discussion and strategies urgently needed!



The Rebound Effect

Tendency

- number of ICT units steadily increasing
- environmental impact per unit (manufacturing) decreasing
- In total: increasing environmental impact



Number of PCs per 100 inhabitants

- **United States** 65.89
- **Switzerland** 58.03
- **Germany** 43.13
- **Brazil** 7.48
- **China** 2.76
- **India** 0.72
- **Nigeria** 0.71 (ITU, 2002)

- bridging the digital divide means an even heavier ecological „rucksack“

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The Infrastructure for the Information Society

Mobile Communication and Energy Demand

Data for Germany:

Infrastructure

2002: 1500 GWh/a

2010*: 4000 GWh/a

Cellular Phones

2002: 500 GWh/a

2010*: possibly constant

Mobile Services

2002: ?

2010: ???

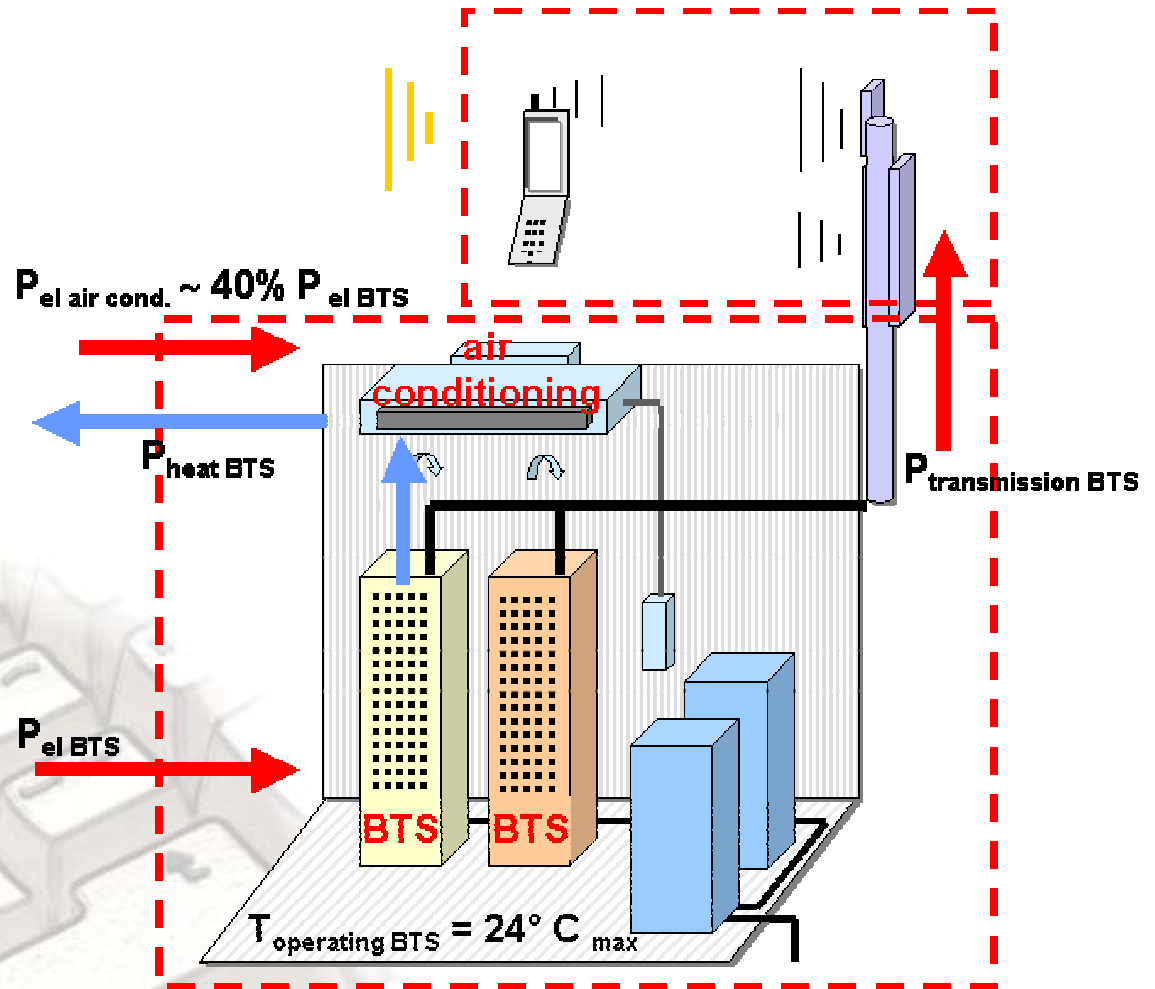
*source: Fraunhofer ISI

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Energy Supply for Mobile Devices

■ Conventional Power Supplies

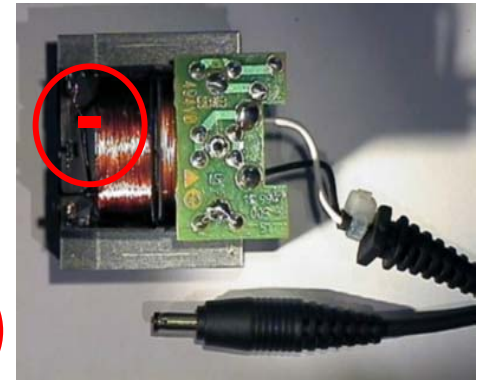
- efficiency factor (full load) ~**30%**
- very high stand-by losses, **ca. 1 W** (3 W - Module)
- market volume 2,7 billion US\$ (2000)
- growth rate 11,4% p.a.

■ Switching Power Supply

- efficiency factor (full load) > **80%**
- high stand-by losses
ca. 0,3 - 0,6 W (3 W –Module)
- manufacturing costs
~ 2-4 times higher
- market share < 30%

■ Potential for energy savings

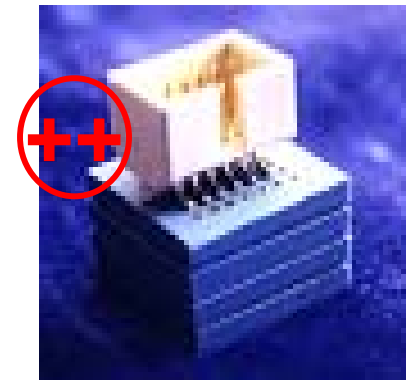
- > **300 GWh/a** (Germany)



Transformer Power Supply



Switching Power Supply
(Board)

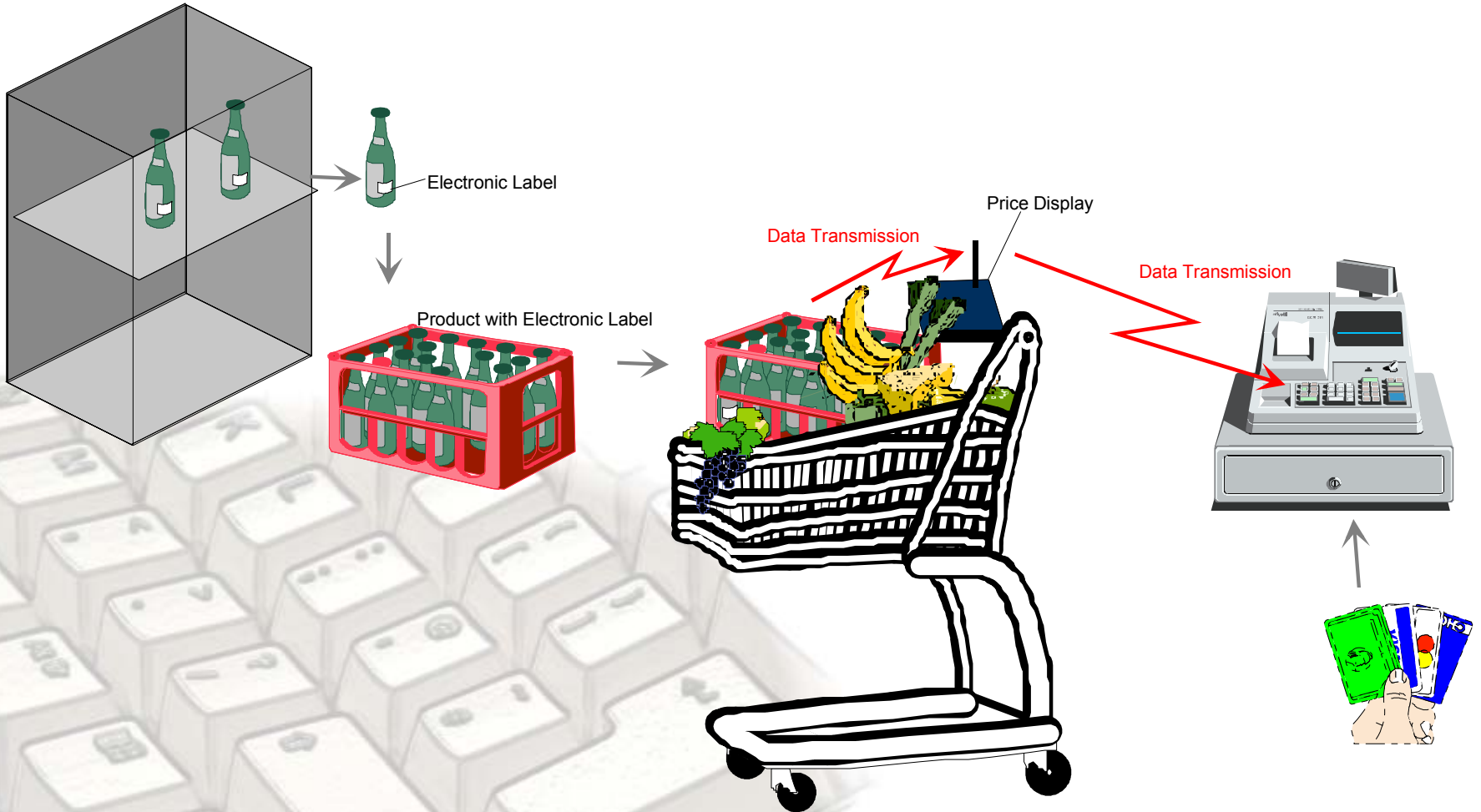


Advanced Power Supply
(under IZM Development)

Energy Supply for Mobile Devices

- ...and on a global scale we urgently need new concepts for energy supply of ICT devices
 - ⇒ as environmental impacts of energy demand is and will be critical
 - ⇒ as access to information in remote areas needs an independent power supply (e.g. success of hand-crank radio in South Africa)
 - ⇒ development of low-cost high-efficiency renewable energy supplies required

Smart Supermarket



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Smart Supermarket

Environmental Impacts of Passive Tags



Passive Tag

Units needed for packagings

(estimated for D based on DSD- data)

2 billion packagings / year
=> 2 billion tags

Resource consumption

0,0017 g silver per tag
=> 340 t silver per year (D)

Technology adaptation needed

- Replacement of silver by copper: much more metal needed due to lower conductivity
- Polymeric tags: much more energy needed in the use phase

Germany Context

Silver demand in Germany

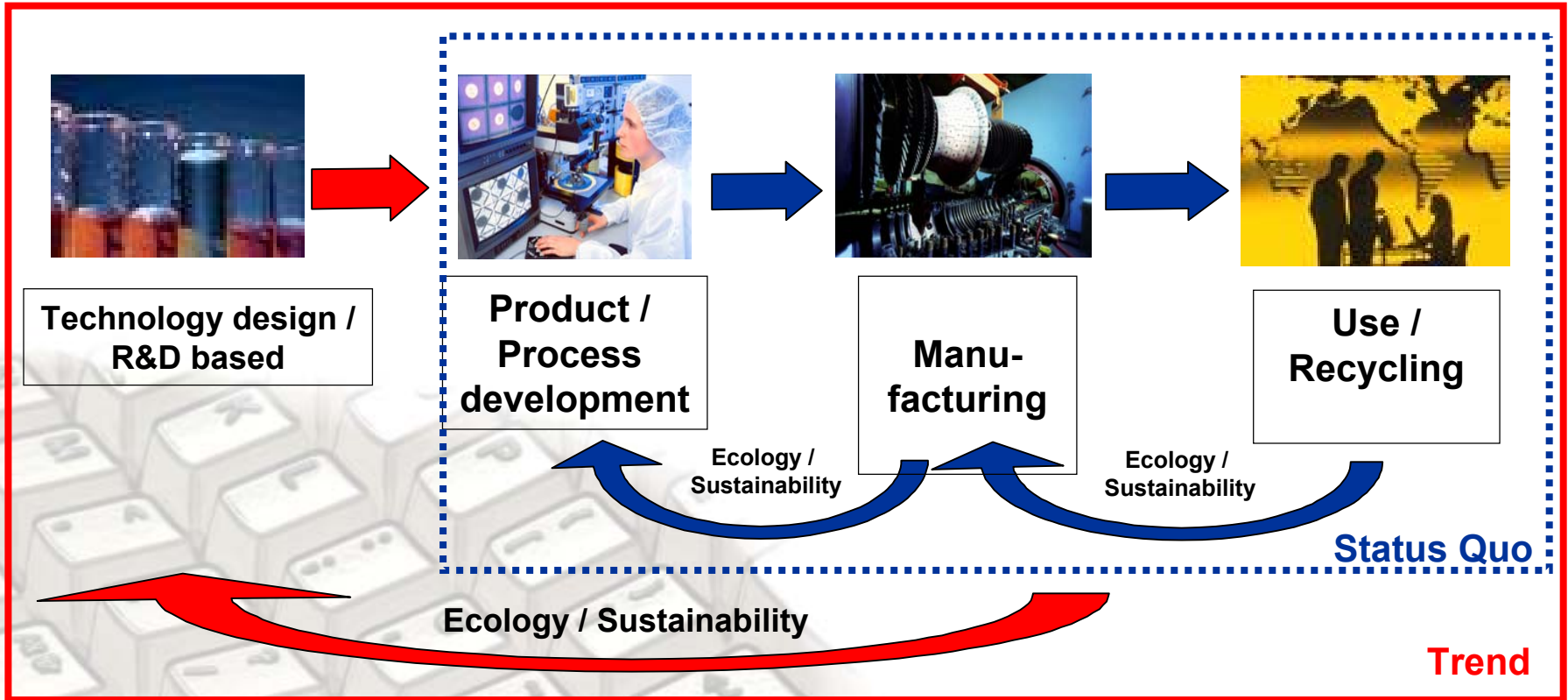
470 t per year
=> Increasing silver demand by 70%

- silver recovery from tags will hardly be feasible

Further Trends in Information and Communication Technology

- Critical substances used due to performance reasons
 - ⇒ e.g. GaAs for opto-electronics (LEDs) and high performance
- Electronics goes nano
 - ⇒ bio-availability of nano particles
- Electromagnetic radiation
 - ⇒ health issues of EMR still hotly debated,
 - ⇒ further reseach needed
 - ⇒ radiation will increase through UMTS and a „smart environment“

From Product Eco-Design to a System Focused Approach for Sustainable Technology Development



Responsibility of Technology R&D for Sustainable Development

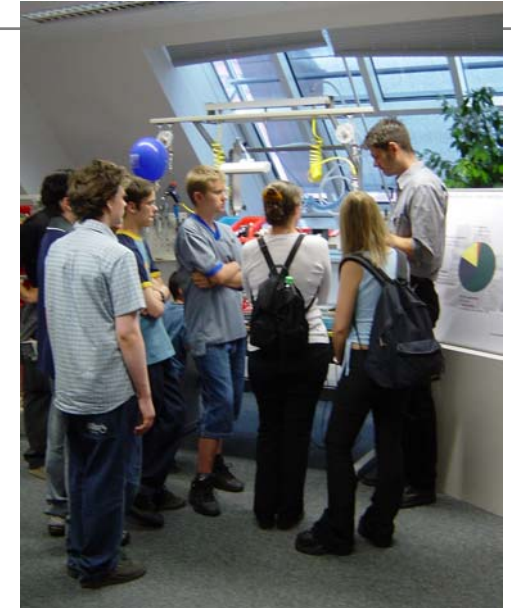
①

- Technologies should not be developed without a **rough understanding of future applications**, as the later application can make a technology either a pace-maker or an obstacle for sustainable development.
- Technology development should **not** take place **solely for technology's sake**.
- A **life cycle focus** is needed to establish a radar screen to identify life cycle implications in advance. And **to react accordingly**.

Responsibility of Technology R&D for Sustainable Development

2

- Politics is always slower than science: Science has to **start the discussion** on pros and cons of a technology to create a public and political climate for an **appropriate risk management**. That is the prerequisite for a responsible application of sophisticated technologies.
- Therefore, the public has to be informed regularly about ongoing research activities to **stimulate a discussion on consequences and benefits of new developments**.



Responsibility of Technology R&D for Sustainable Development

3

- A major task is to **find a common tongue for technologists and environmentalists** to create an understanding of each others developments and concerns.

- Fraunhofer IZM will organise the Electronics Goes Green Conference in Berlin, September 2004 (halfway between Geneva and Tunis) to bring together technology experts and environmental experts.

**Going Green Initiative
Electronics Goes Green 2004+**

**Joint International Congress and Exhibition on
Green Design and Manufacturing of Electronics**
– The Challenge beyond Eco Design –

6. – 9. September 2004, Berlin, Germany

Location: Estrel Residence & Congress Hotel Berlin

Organized by: Fraunhofer Institute for Reliability and Microintegration, Berlin

In Cooperation with: CARE Electronics, Europe
IEEE Computer Society, USA
IEEE Component, Packaging and Manufacturing Technology Society, USA
EcoNet, Japan

Conference Chair: Prof. Dr.-Ing. Dr. E.H. Herbert Reichl

Steering Committee: Members of



IEEE COMPONENTS, PACKAGING, AND MANUFACTURING TECHNOLOGY SOCIETY

Fraunhofer Institut Zuverlässigkeit und Mikrointegration

ISEE Steering Board USA

Care Electronics Steering Board EU

Eco Design Program Committee Japan

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4

- Knowledge is the basis for acting in a responsible manner.
- **Sustainability and environmental understanding** has to be integrated into **education of technologists** who create tomorrow's ICT backbone.

5

- High tech R&D takes place in the developed countries. A **pro-active focus** has to be set on the **consequences for developing countries**:
 - Is the hardware compatible with the usual end-of-life scenarios of developing countries?
 - How to share technologies – especially cleaner production technologies – with developing countries, taking into account specific regional circumstances?
- The chance is great to create a win-win situation, where cleaner production technologies and adapted management strategies are exported and **developing countries will be enabled to create an environmentally benign information society.**

Contact:

Karsten Schischke
Berlin Center of Advanced Packaging
c/o Fraunhofer IZM
Gustav-Meyer-Allee 25
13355 Berlin
Germany

Phone: +49 / (0) 30 / 464 03 – 156
E-mail: schischke@izm.fhg.de
Homepage: www.pb.izm.fhg.de/ee