

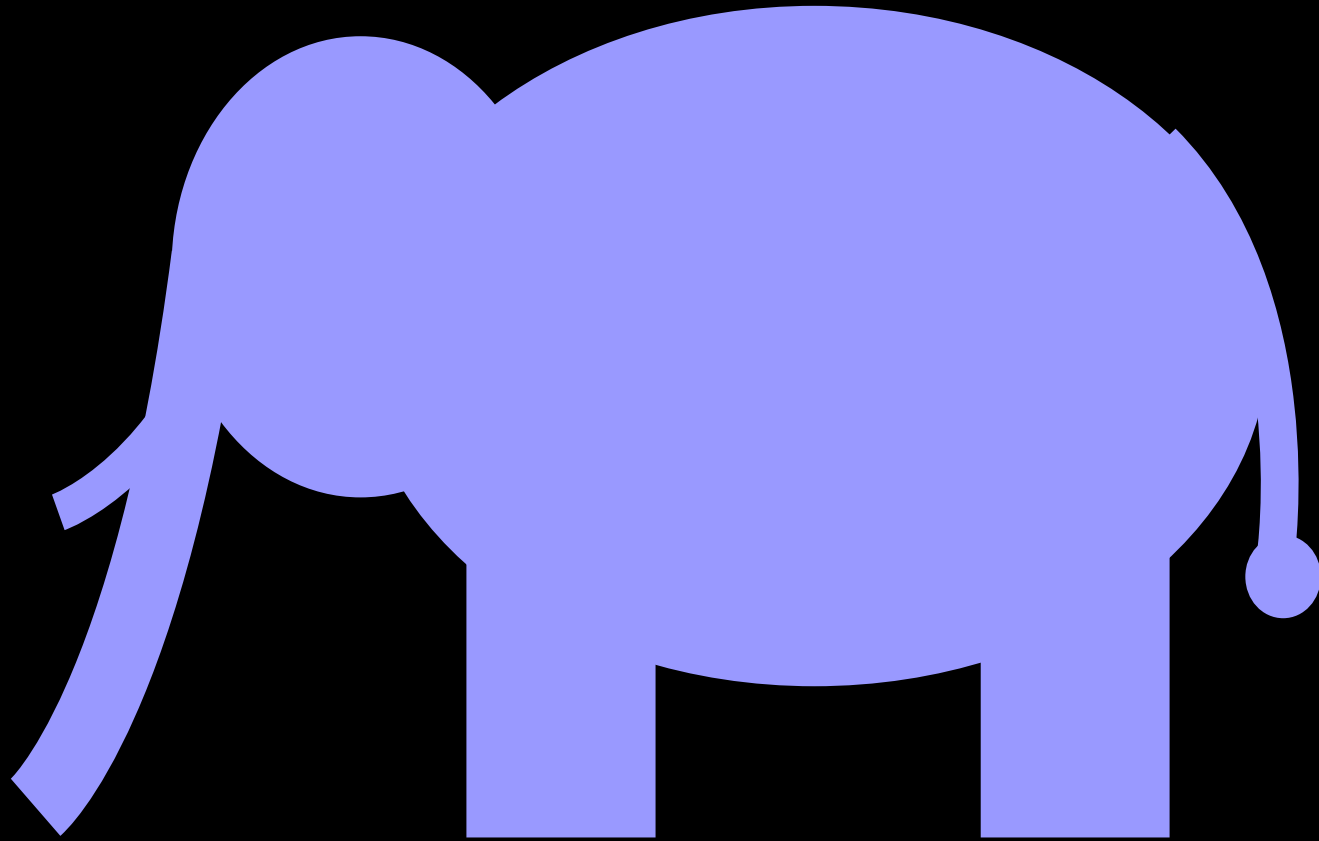
How Green Are Digital Media?



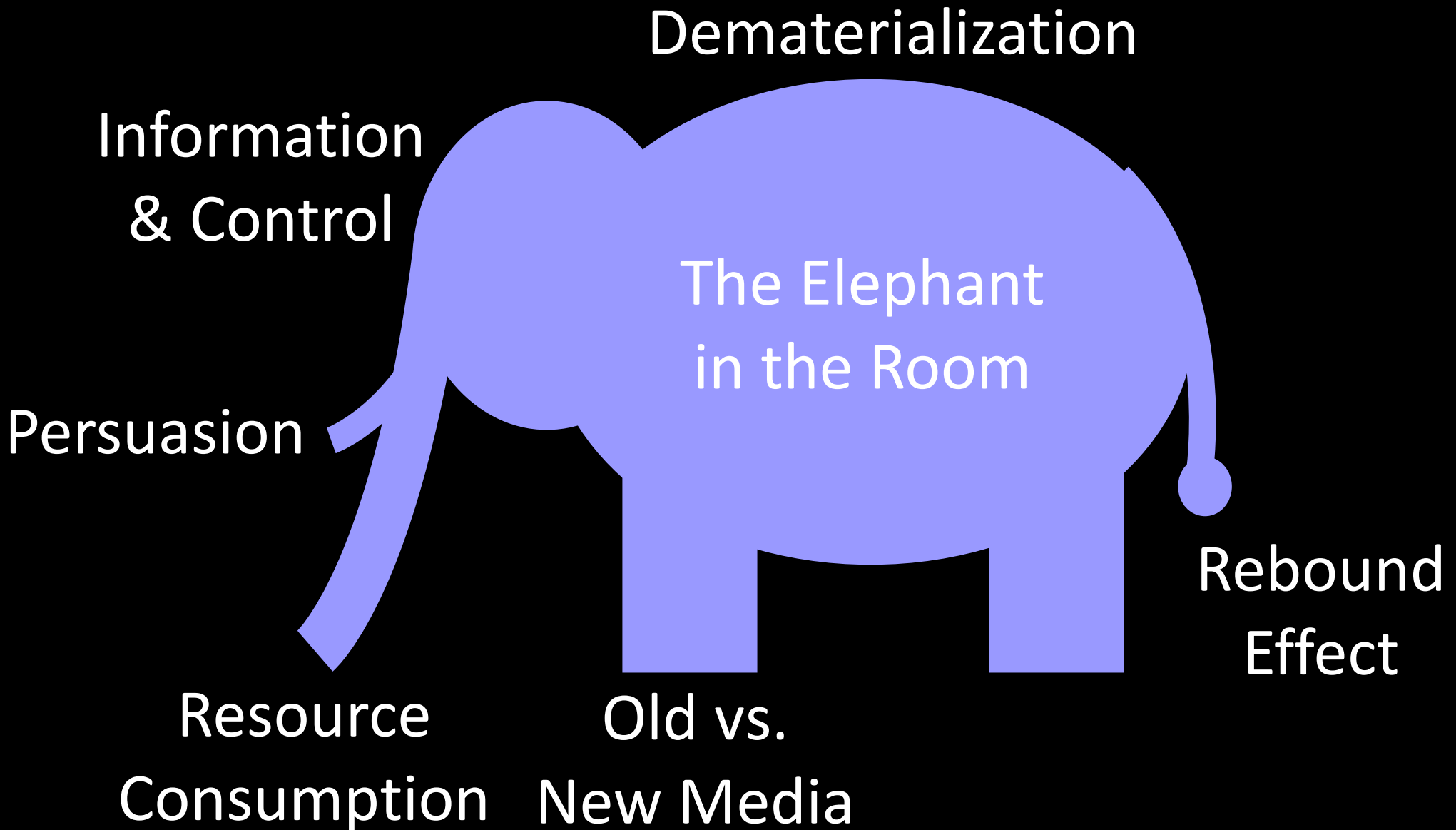
Jörn Loviscach

Fachhochschule Bielefeld, Germany
University of Applied Sciences

Aspects of a Complex Problem



Aspects of a Complex Problem



Dematerialization

Information
& Control

The Elephant
in the Room

Persuasion

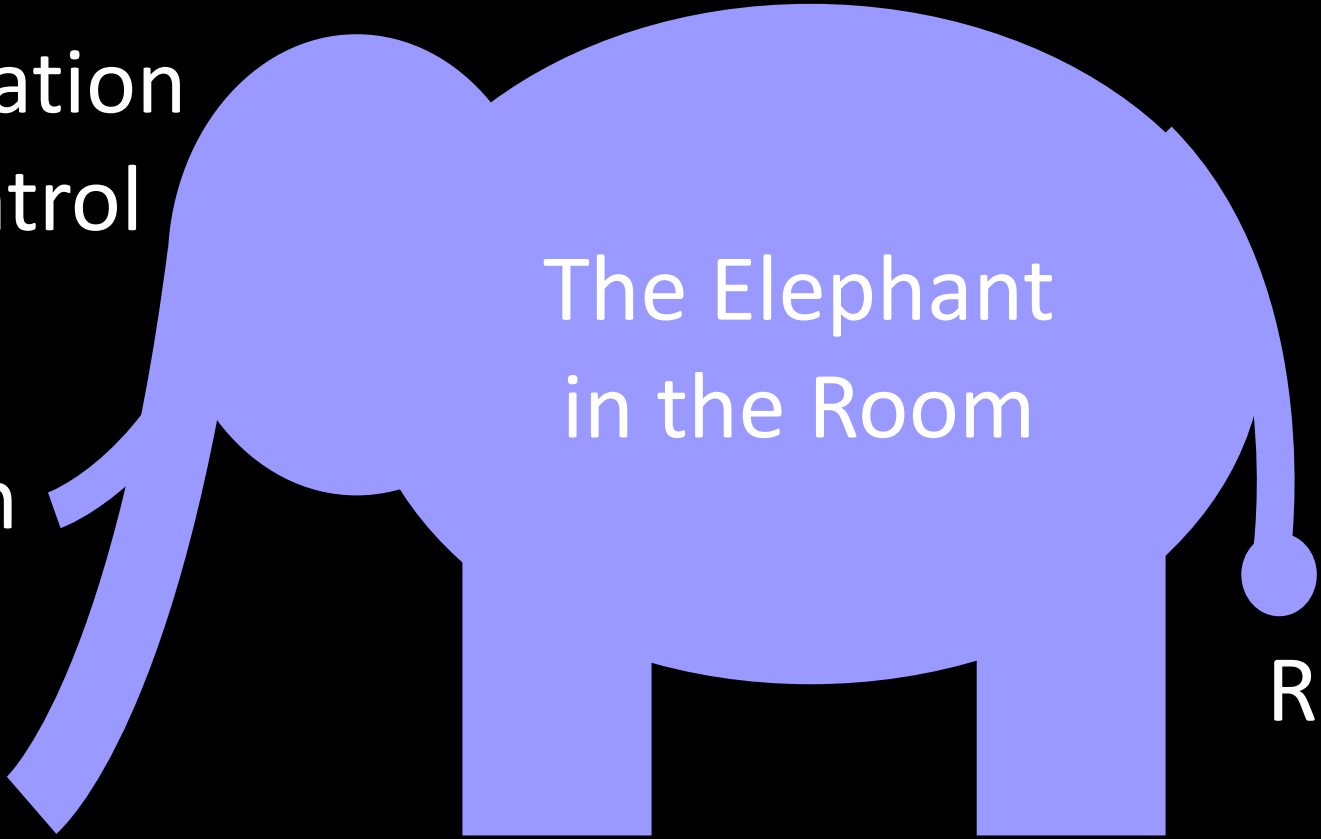
Rebound
Effect

Resource

Old vs.

Consumption

New Media



The total cost of computer hardware

PC + 17" CRT:

6400 MJ = 1800 kWh

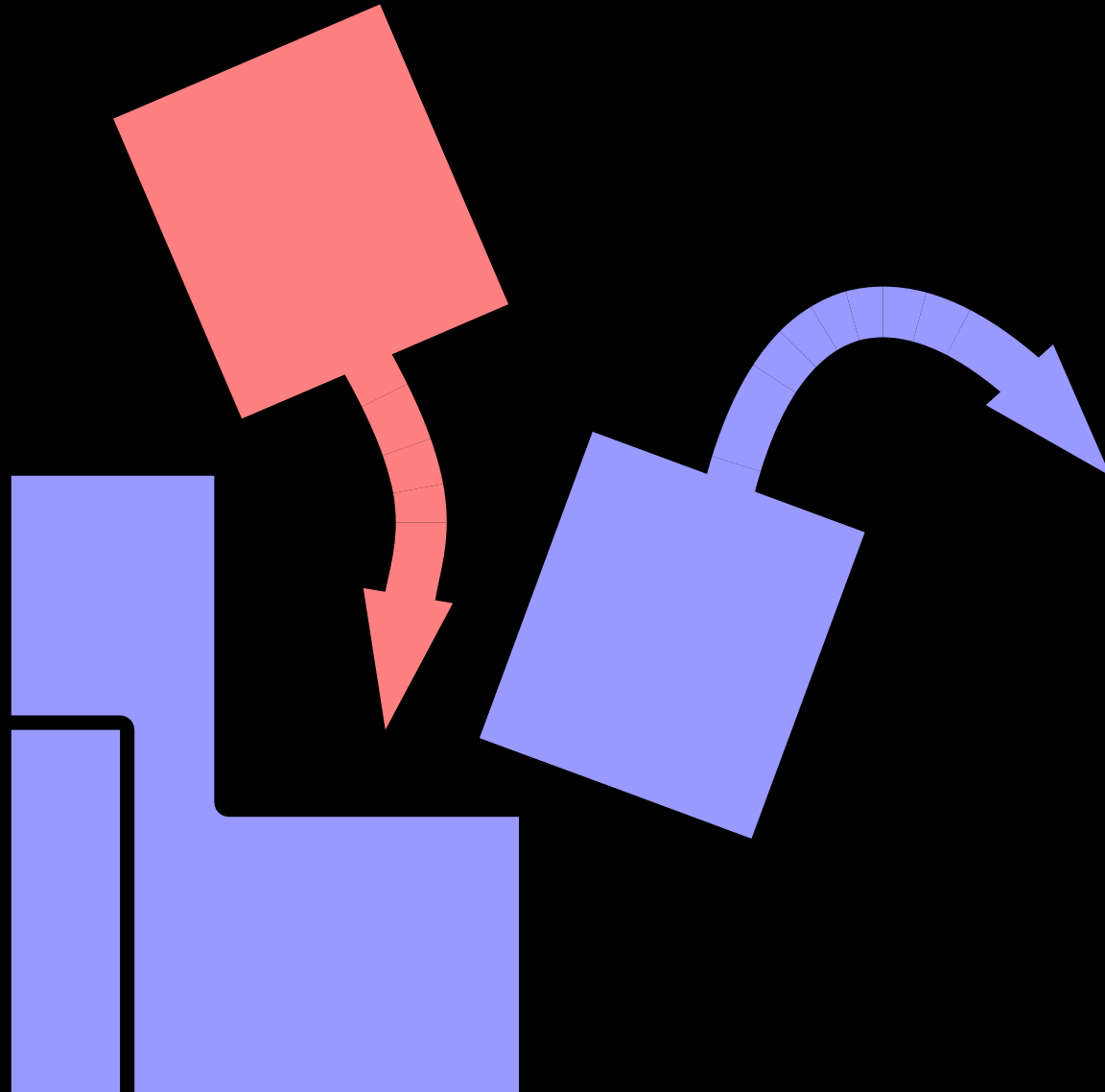
or 260 kg of fossil fuels

E. Williams, Energy Intensity of Computer Manufacturing,
Environ. Sci. Technol. 2004, 38, 6166-6174

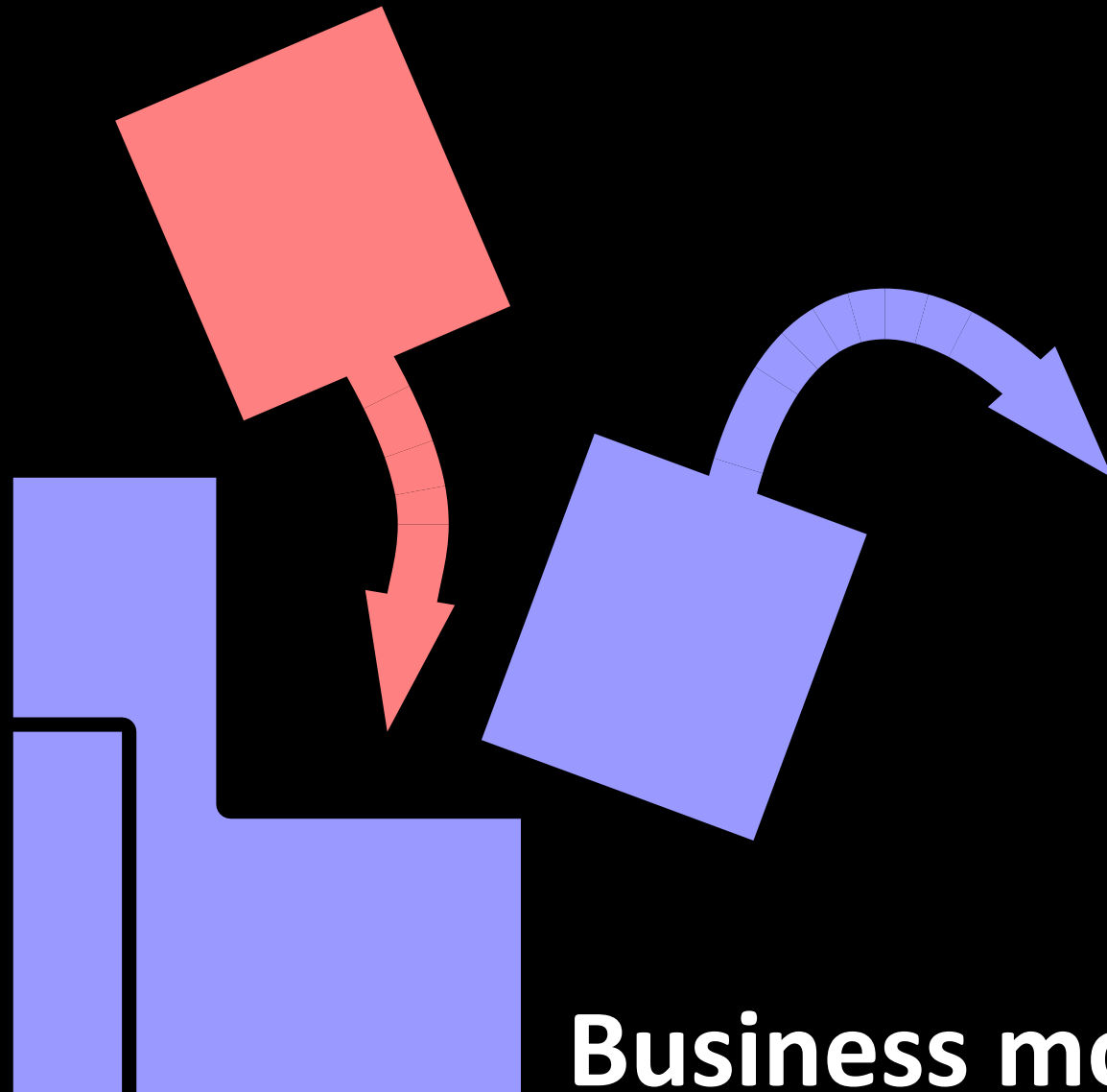
At 100 W and 40 h/week:

same energy as nine years of use

Can we reuse more stuff?



Can we reuse more stuff?



Business model?

The energy cost of data centers

- 61,000,000,000 kWh in 2006
- 1.5 % of total U.S. electricity consumption
- Total electricity cost of about \$ 4,500,000,000
- More power than U.S. color TV sets
- Similar to electricity consumed by five percent of the U.S. Households

U.S. Environmental Protection Agency, Report to Congress on Server and Data Center Energy Efficiency, 2007

Improvements for data centers

- Server virtualization
- Cloud services for outsourcing
- Compiled, not interpreted programming languages
- Dedicated 110 V power supply units
- ...

Software issues to look into

- Google searches (Google: 0.2 g CO₂)
- Spam (McAfee: 0.3 g CO₂)
- Blue-ray copy protection (c't: 15 W)
- File formats
- Mobile devices:
Bigger impact from smaller number of batteries wasted? (rechargeable or not)

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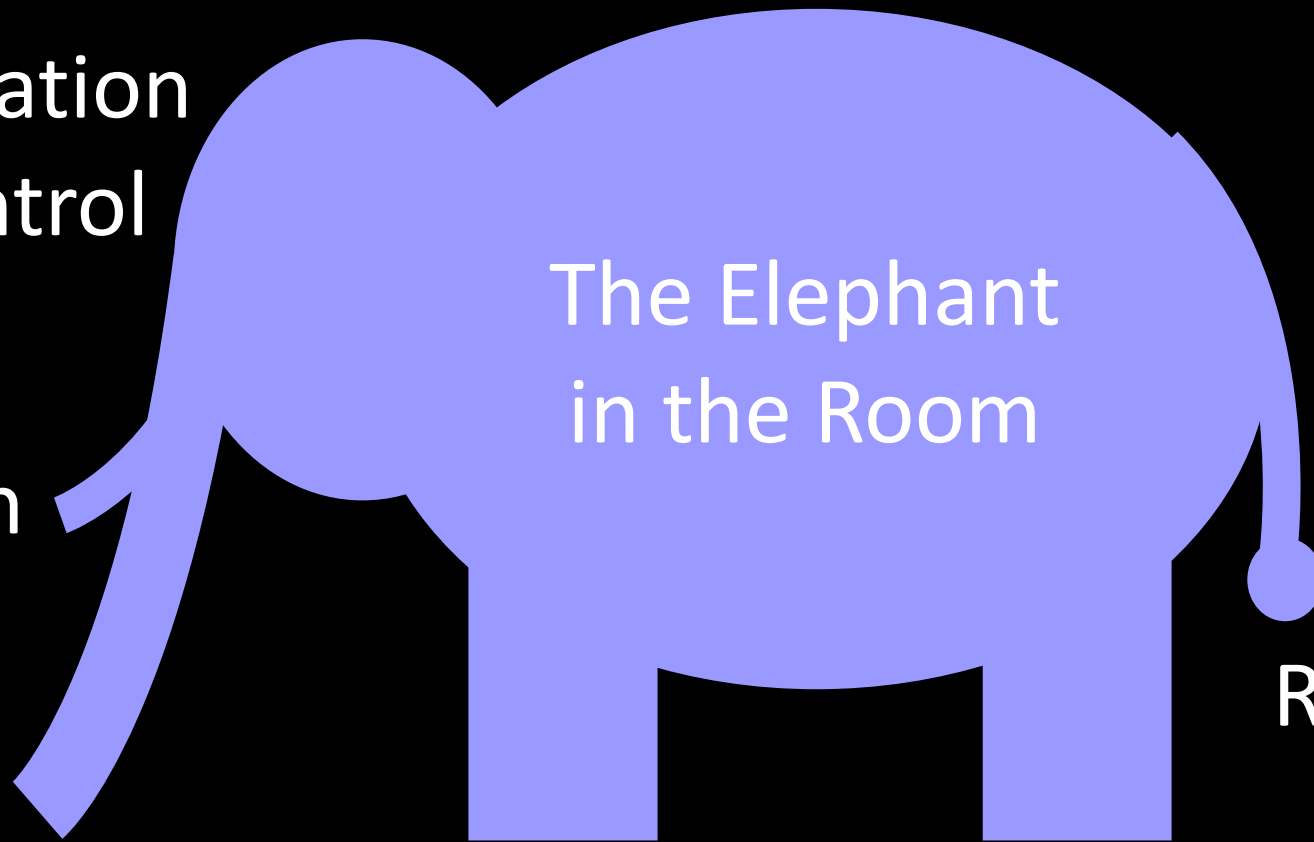
Rebound
Effect

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Old vs.

Consumption

New Media



Some comparisons to make

- CD vs. MP3 vs. streaming
- Radio vs. podcast vs. streaming
- TV via satellite/terrestrial/cable vs. streaming
- Cinema vs. DVD/Blue-ray vs. streaming
- Newspaper vs. Web on PC vs. e-reader
- Book vs. computer printout vs. e-reader

Some studies, rarely conclusive

see e.g. R. Hirsch, I. Reichart, Multifunctional Electronic Media – Traditional Media, The Problem of an Adequate Functional Unit, Int J LCA 8 (4) 201 –208 (2003)

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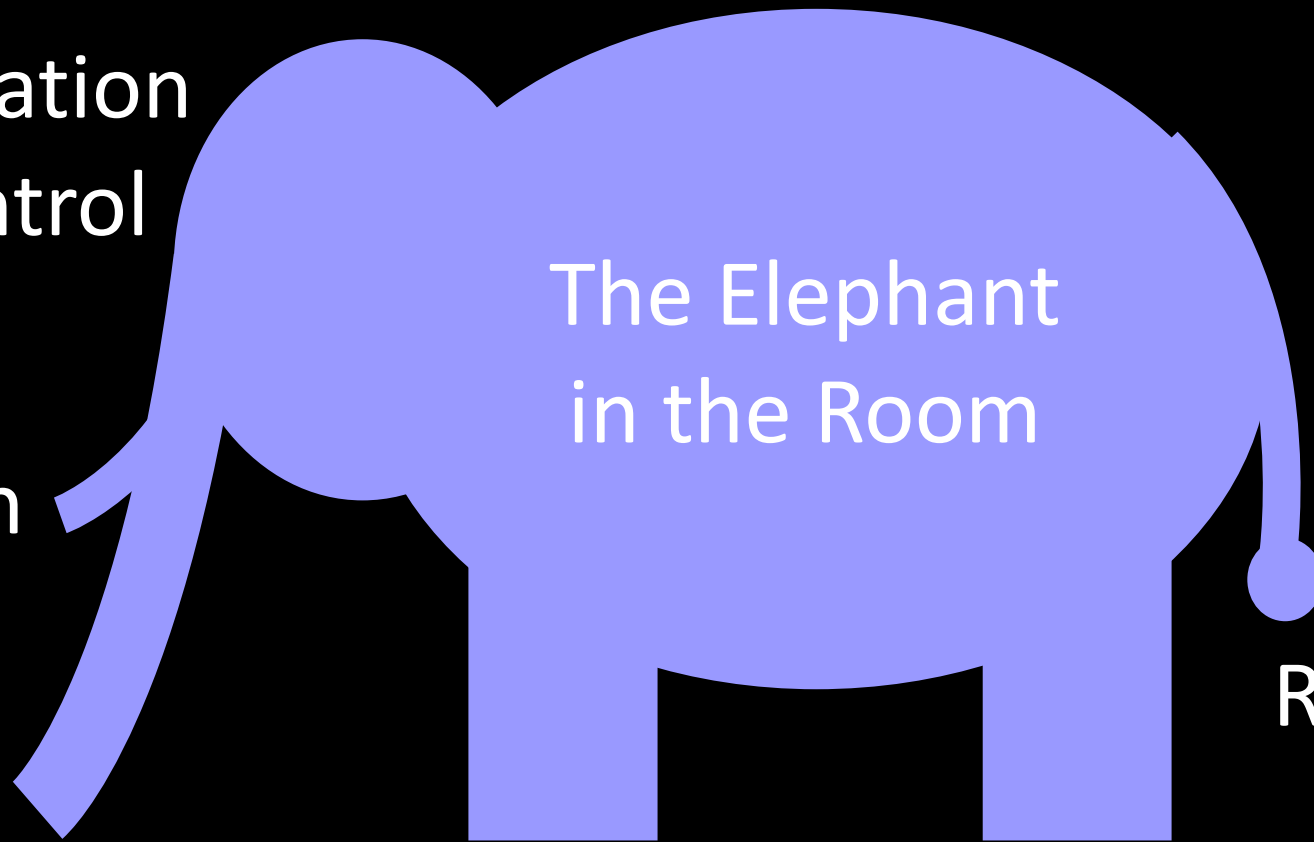
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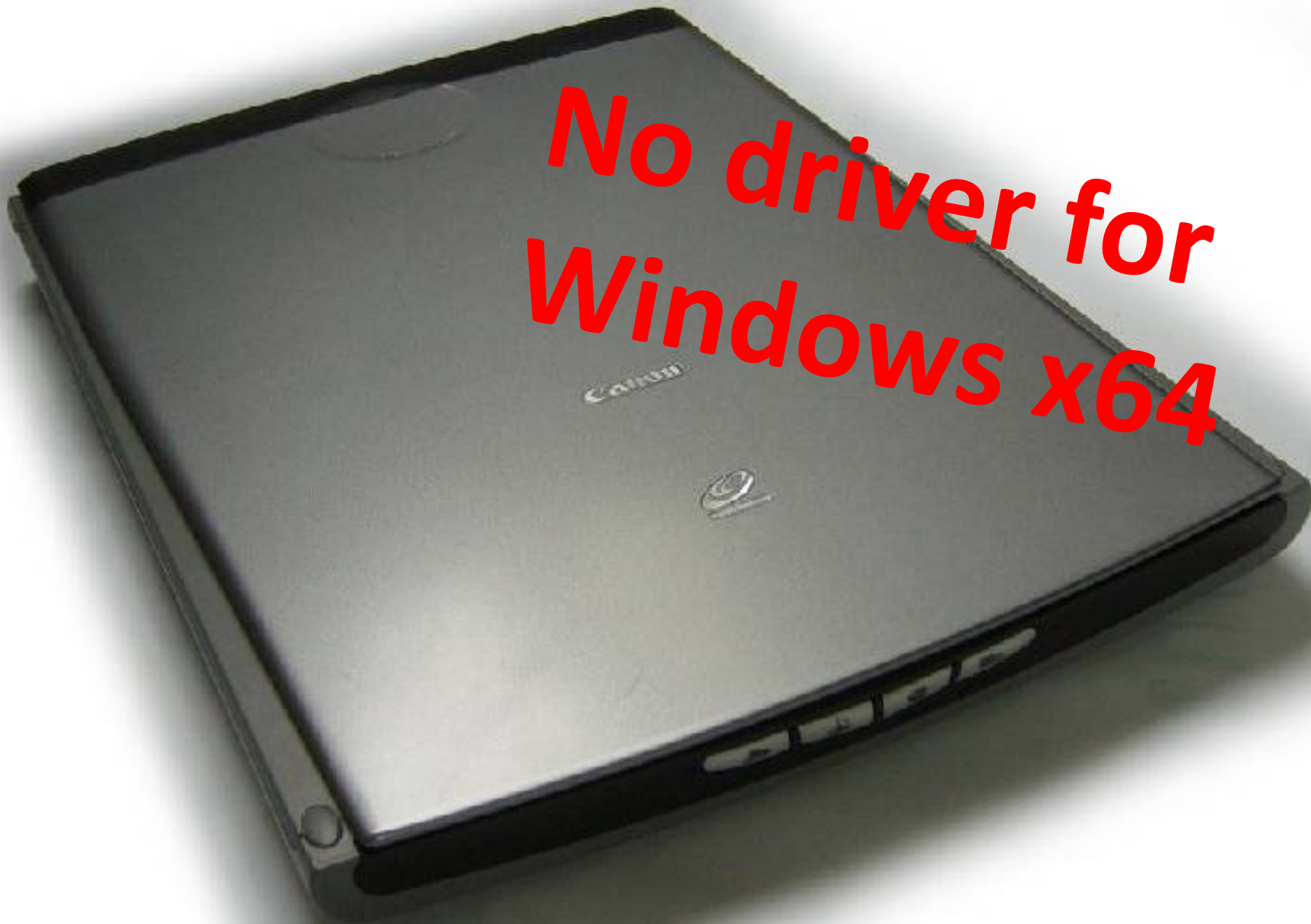
From physical to virtual

- From CD to music download
- Virtual bookstores for real books
- Virtual bookstores for virtual books
- Video conferencing?
- Shared documents?
(Google Docs, Google Wave)
- Teleworking?
- Tourism?

From virtual to physical?!

Software-induced hardware obsolescence
(Lorenz Hilty)

**No driver for
Windows x64**





No driver for
Windows x64

Dematerialization

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& Control**

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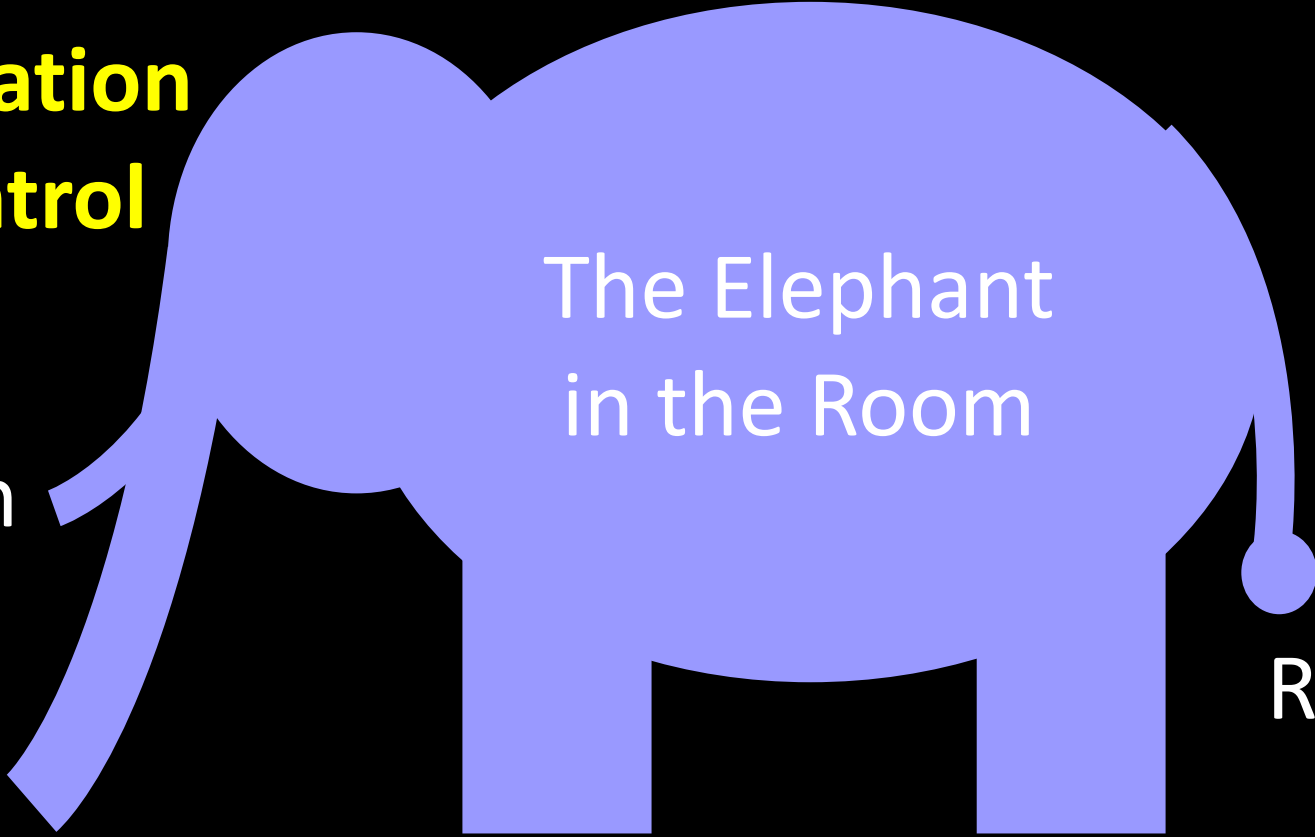
Rebound
Effect

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Old vs.

Consumption

New Media





Choose your unit

- LIGHT BULB
- CUPS OF TEA
- LAPTOP
- MOBILE CHARGES
- FRIDGE
- TELEVISION
- HEATING
- CO2
- APPLES
- BANANAS
- CARROTS
- TOMATOES
- MILK
- BEEF
- SALMON
- RICE
- SHRIMPS
- BREAD
- BEER
- FLIGHT
- FLIGHT DISTANCE
- TRAIN
- UNDERGROUND
- CAR

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- SHRIMPS
- BREAD
- BEER
- FLIGHT
- FLIGHT DISTANCE
- TRAIN
- UNDERGROUND
- CAR



305.4HT
6.0NT

9-1-1

CE
M300-101111
WARNING: Do not use for weighing hazardous materials.



Startseite

[powerMeter](#)

[powermeter](#)

Updates

Friends

Chat

Search, add, or invite

[muespe@yolloc](#)
Set status here ▼

Chat with friends in iGoogle!

[Add contacts now!](#)

Google PowerMeter: Your Home

Electricity used Nov 26–Nov 27

Test Apartment: 1665947

Day Week Month

Weekend, in kW

12a 6a 12p 6p 12a 6a 12p 6p 12a

Previous day

Thursday Nov 26	Friday Nov 27
20 kW h used	5.1 kW h used
Approx. €1456/year	Approx. €451/year
Always on: 14 kW-h used	Always on: 4.7 kW-h used

Compared to others

Your usage on Nov 27: 11.1 kW-h

1-bedroom apartment	2-bedroom apartment	3-bedroom house	4-bedroom house
---------------------	---------------------	-----------------	-----------------

Compared to past usage

3% under expectation as of today

night	morning	afternoon	evening
0.5 kW-h	1.5 kW-h	2.5 kW-h	2.3 kW-h

[Manual](#) [Usage](#) [Data](#)

SMB-GH - DM-IMP - Schlagzeilen

[Bekämpfung von Kinderarmut: "Selbstverpflichtungen sind sinnvoll"](#)

[Neu im Kino: Wendie, Vampire und Karrierefrauen](#)

[Leute in der Falle: Was kommt danach?](#)

Wetter

Remscheid, NRW

7°C Current: Mostly Cloudy
Wind: SW at 3.7 km/h
Humidity: 67%

Fri	Sat	Sun	Mon
5° 9°	7° 10°	6° 11°	2° 11°

Date & Time

Fri NOV 27

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Wikipedia, die freie Enzyklopädie

Suche in der Wikipedia (de)

Artikel des Tages:
[Brijuni-See](#) (27. November 2009)

Google News

Schlagzeilen | International | Deutschland | Wirtschaft | Welt

Ausbruch aus der JVA Aachen: Die spektakuläre Flucht der Schwerebrocher...

WDR Nach... [Wie übernahm ein Mann Wachen und den Pörmel, arbeiteten eine...](#) [View related stories](#)

Erfinder - UN - EU Wettbewerbskommission übernahm UN-Richtlinien - WELT ONLINE

DCSaldorf (altfisch.de AG) - Der Chemiekonzern E.ON AG [View related stories](#)

SKA fürchterlichste Kriminalität - Transnational

Google PowerMeter



Ihr aktueller Verbrauch.



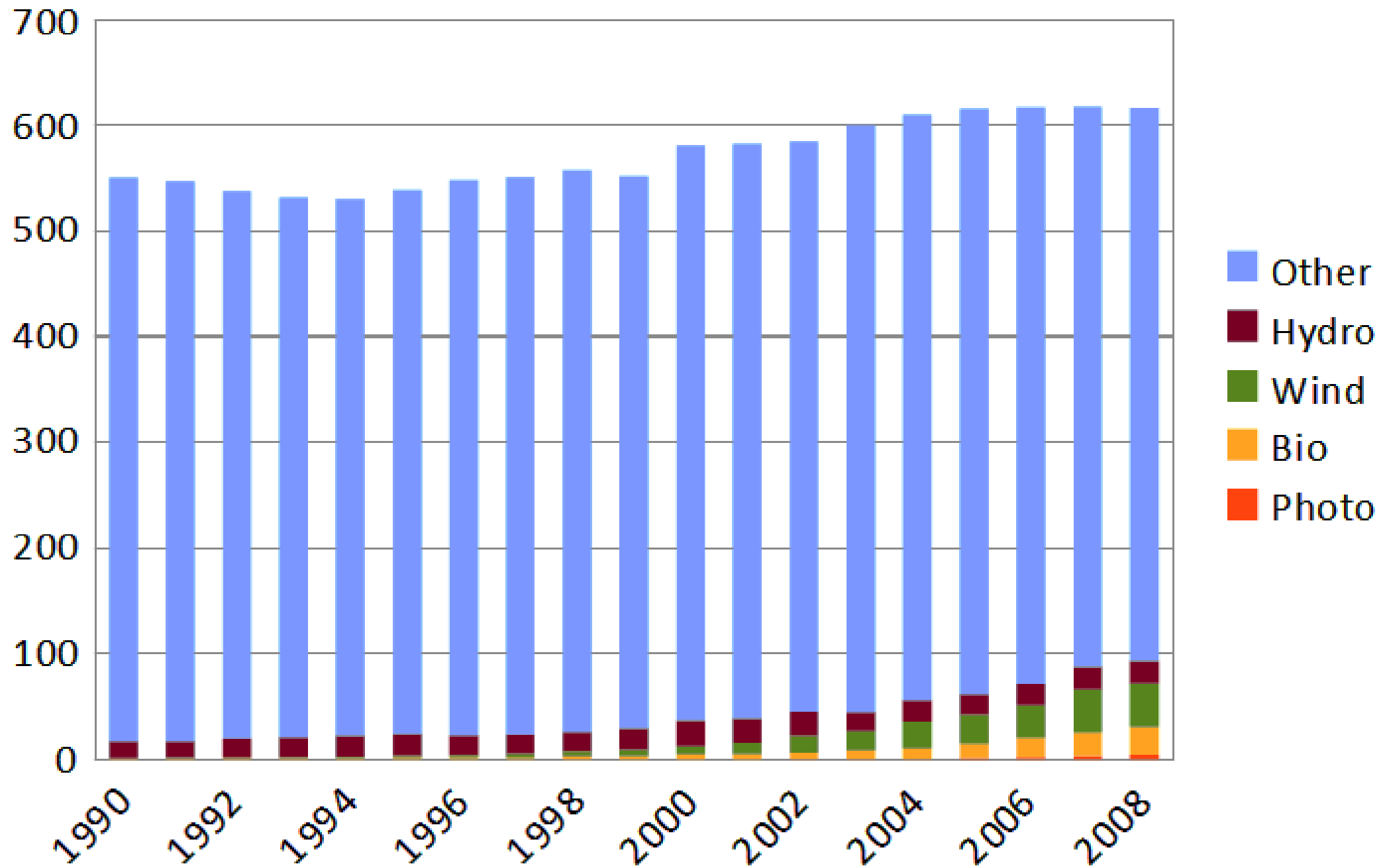


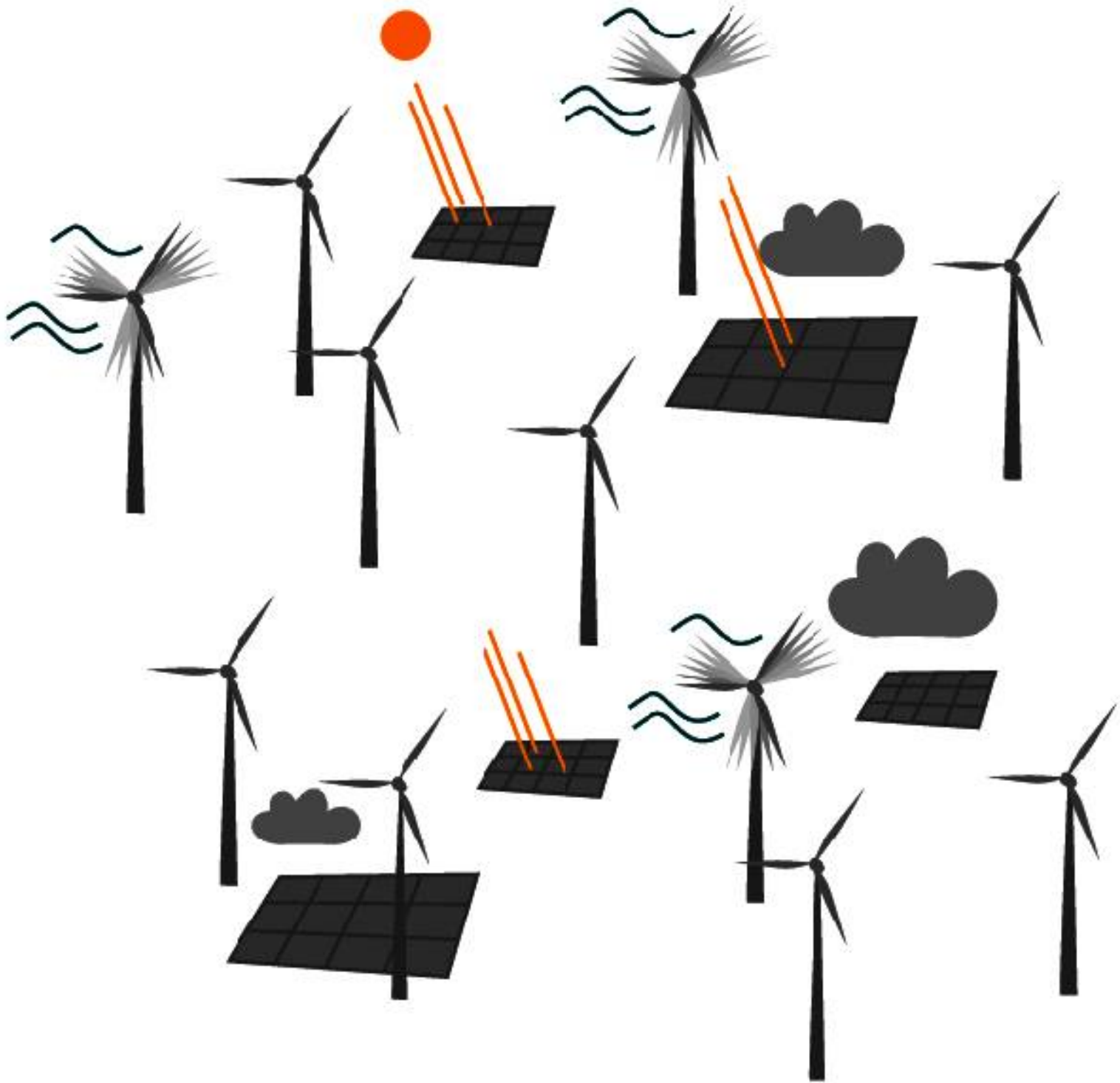
No

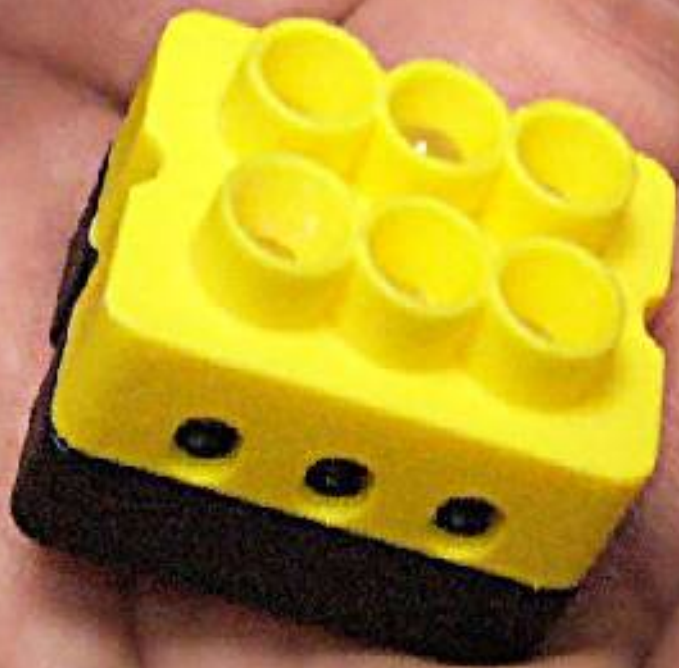
The frequency of our electricity supply is 49.948Hz,
which means that the grid is under strain.

© [tom dyson](#) | [background](#)

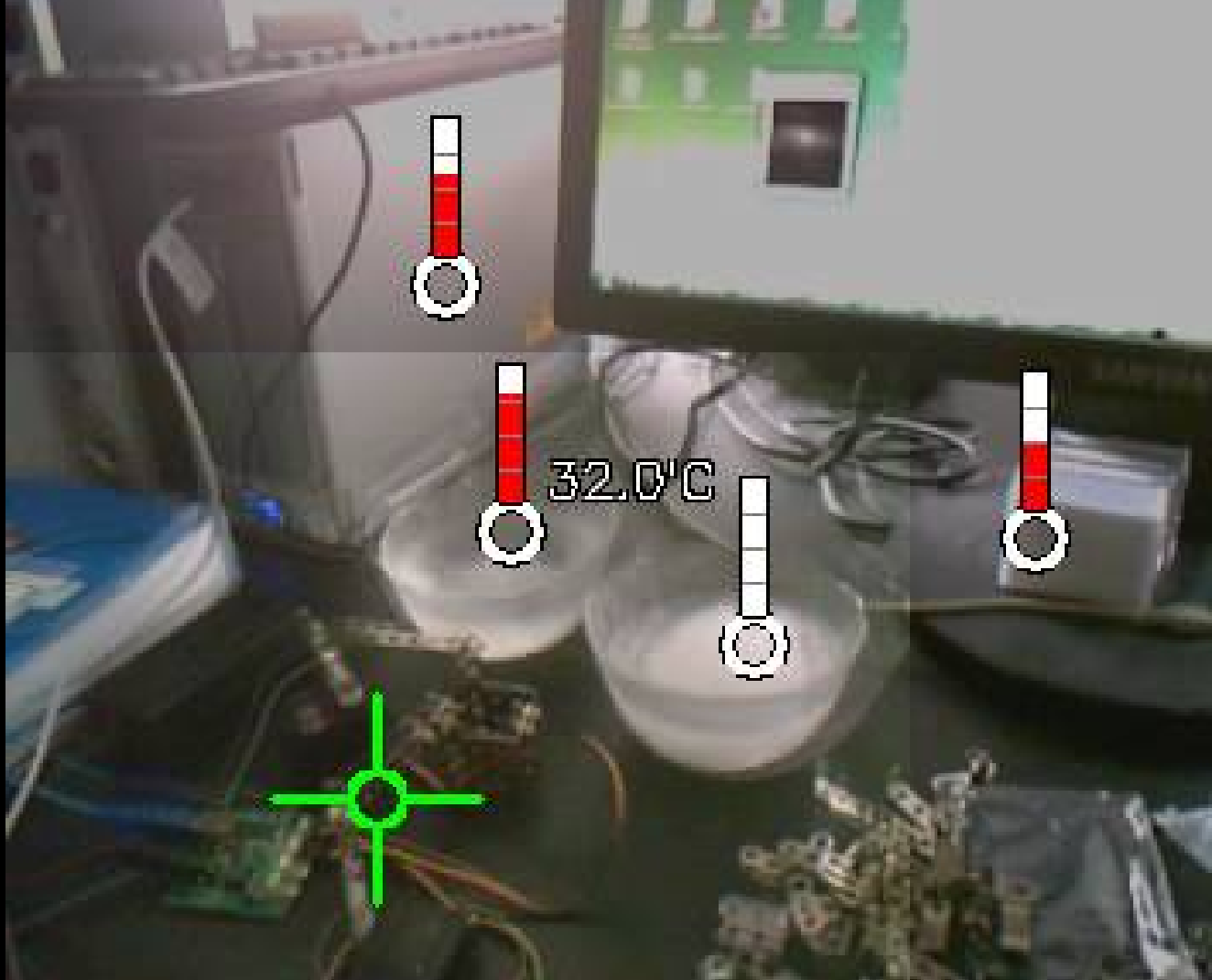
Generation of Electrical Power (TWh) in Germany

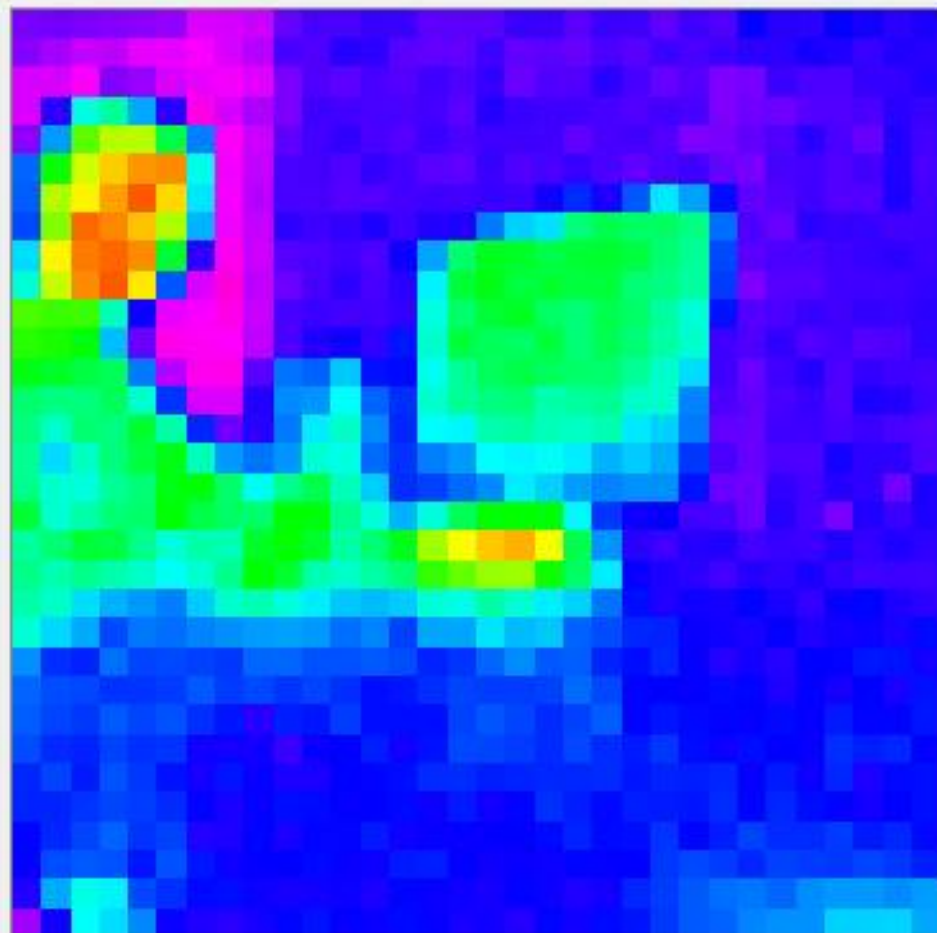












Preparation



Angle

Horizontal angle: °Vertical angle: °

Quality

Horizontal step quality: [%]Vertical step quality: [%]Delay time: [ms]

Paths

 Up and down Hilbert curveLevel:

Raw Image

Horizontal resolution: [px]Vertical resolution: [px]Overall scanning time: [s]

Interpolation (final image)

 Enable interpolationHorizontal resolution: [px]Vertical resolution: [px]

Start

Cancel



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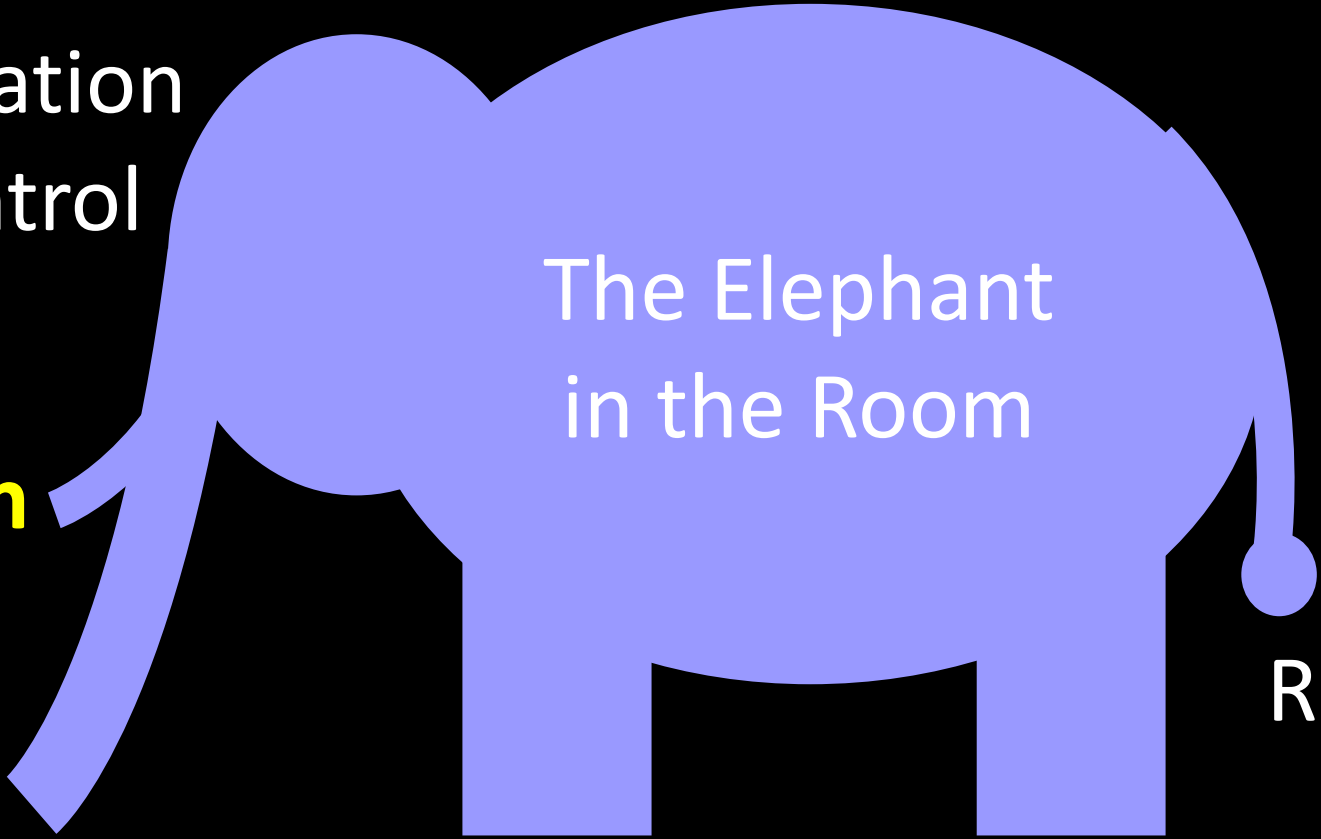
Rebound
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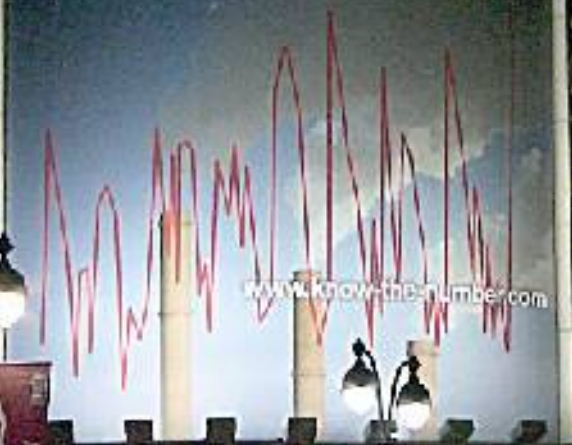
DO Climate Change Affects Everyone

Climate Change Affects Everyone

3,646,136,374,435

Metric tons of CO₂

Greenhouse Gases In Our Atmosphere



www.know-the-number.com

JCP

Bank of America

Subway

Bank of America

Subway

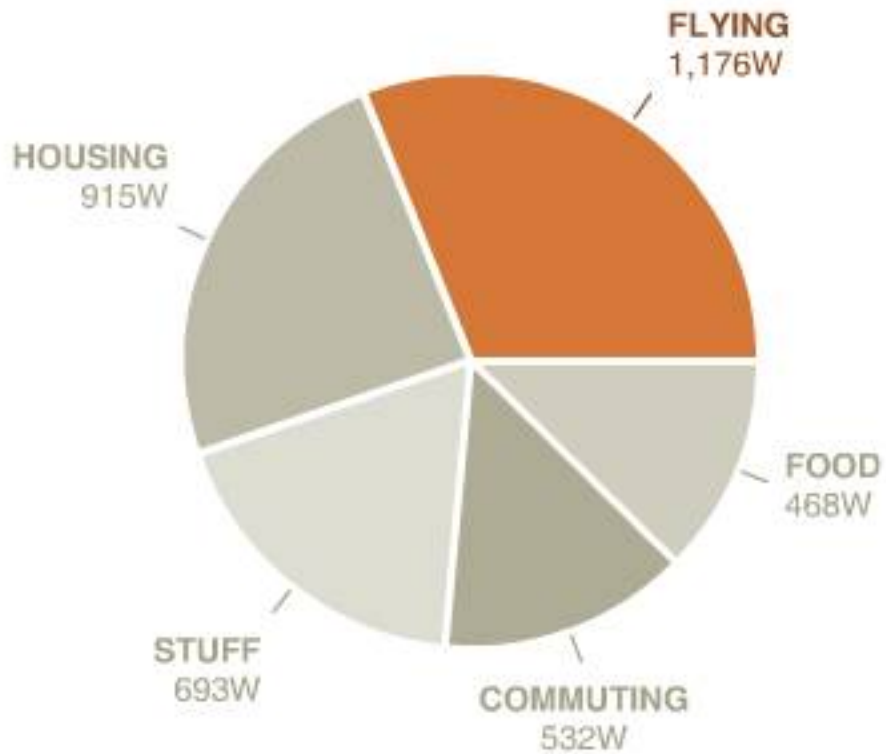


40

Passengers: 11 Score: 0



Average User Watts: **3,785W**





Group Admin

 shanna1248


Group Members (10 of 13)

 shanna1248

 ojolliet

 jasman17

 dingsli


 peter

 buffordang

 KristinDfromda513

 prosej

 juliands

 pjvaldez

[View all members ▶](#)

Recent Discussions

None

[View all discussions ▶](#)

Counterproductive persuasion

“While 71% of our participants [undergrads] prefer to purchase a used 3 year old car to a brand new car, only 28% said they would prefer a one year old laptop to a new one.”

K. Hanks et al., Sustainable Millennials: Attitudes towards Sustainability and the Material Effects of Interactive Technologies, CHI 2008

Dematerialization

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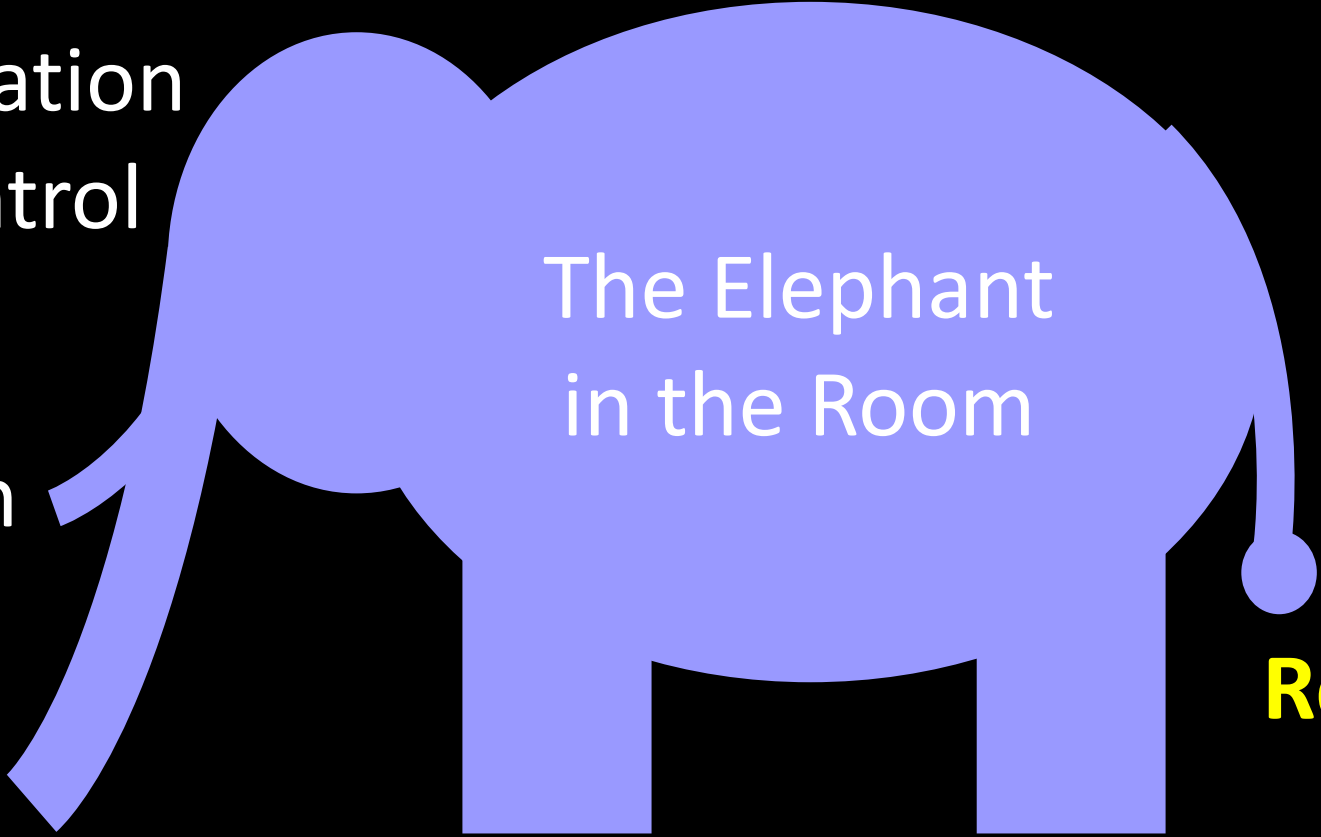
**Rebound
Effect**

Resource

Old vs.

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New Media



Enhanced efficiency doing harm

- Drowning in e-mail
- Faster PCs require more work

L. Hilty, Working Slower with More Powerful Computers, ERCIM News 62, July 2005

- Everybody on earth travels
70 minutes per day
- Friends on every continent
need to be visited

Dematerialization

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Persuasion

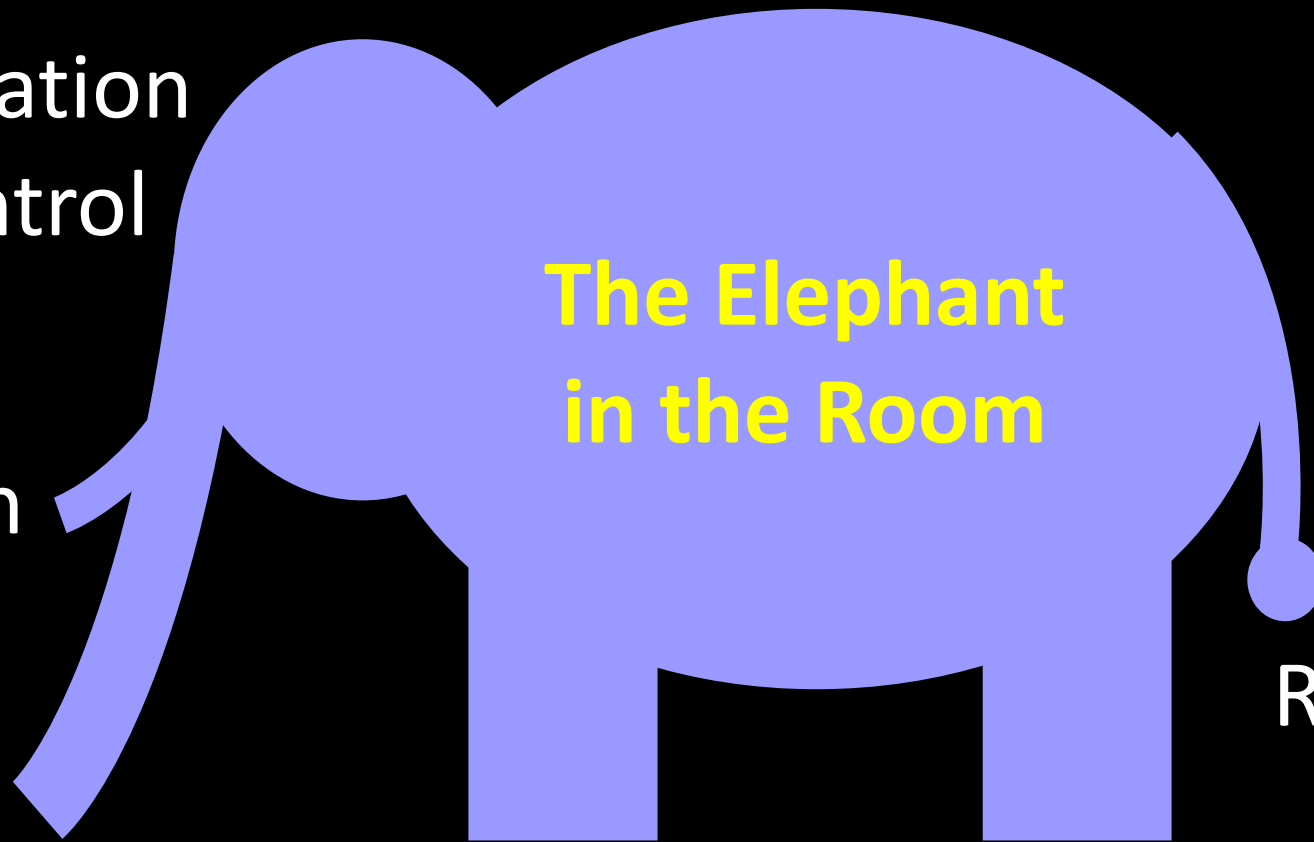
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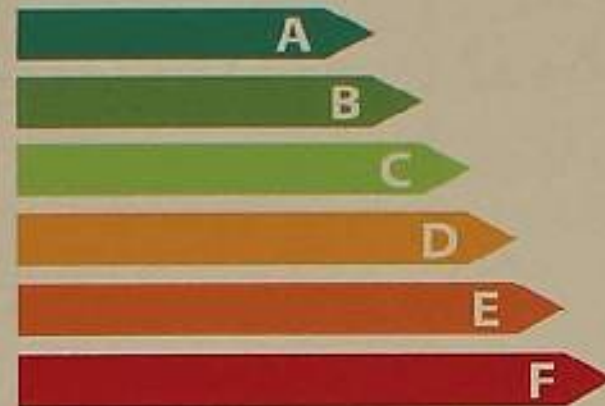
Flybe Bombardier Q400



Local Environment

Noise Rating

Less



More



Take Off & Landing CO₂ Emissions

A (817kg)

Take Off & Landing CO₂ Emissions(per seat)

10.5kg

Take Off & Landing Local Air Quality ¹

2kg

Journey Environment

Total Aircraft Fuel

Domestic (500km)

A (1044kg)

Consumption By

Near EU (1000km)

A (1896kg)

Journey Length

Short Haul (1500km)

A (2760kg)

CO₂ Emissions

Domestic (500km)

B (42kg)

Per Seat By

Near EU (1000km)

B (77kg)

Journey Length

Short Haul (1500km)

B (111kg)

Passenger Environment



Minimum Leg Room

30"

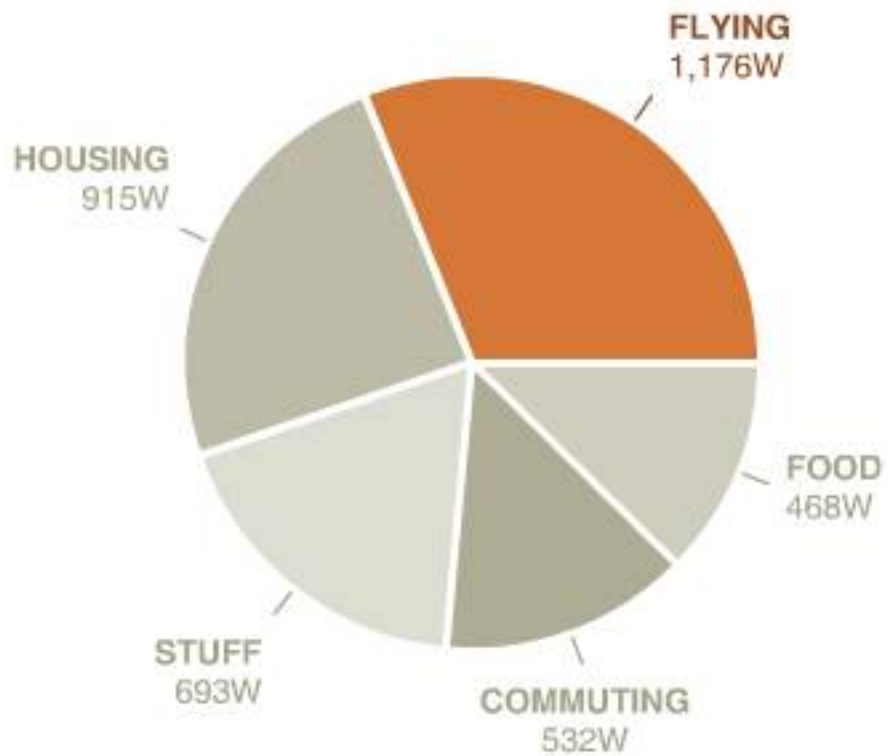
Number Of Seats

78


¹ Emissions of Nitrogen Oxides as an indicator of the effects on local air quality




Average User Watts: **3,785W**



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Recent Discussions

None

[View all discussions ▶](#)

Some first steps

- Switch the heating on
when an inhabitant gets near

J. Scott et al., Home Heating Using GPS-Based Arrival Prediction,
Pervasive Workshop on Energy Awareness 2010

- Computerized kinds of heating and a/c?
- Inform about locally produced food
and where to get it

Thank you!

www.j3L7h.de