

Ecological Production and Rebound Effects

Eva WAGINGER

*Institute for Technology and Sustainable Product
Management Vienna University of Economics and
Business Administration*

A QUICK SCAN OF THE PAST

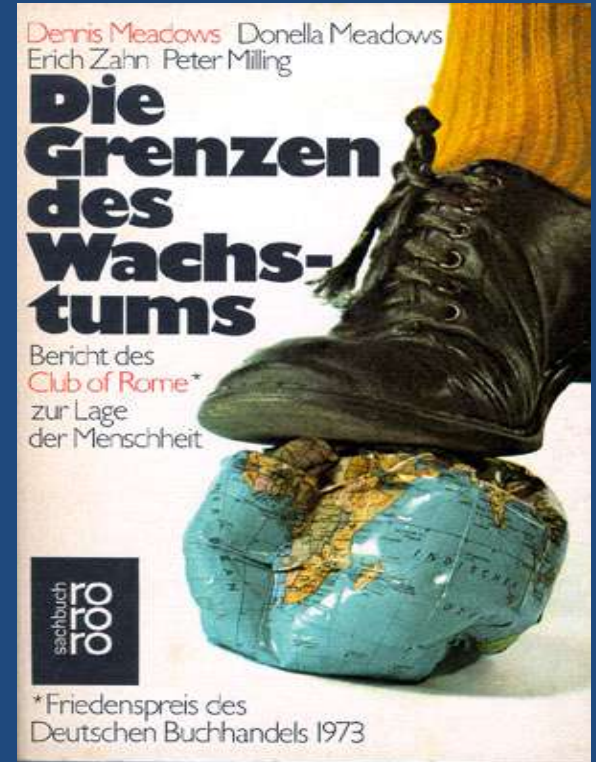
The Limits of Growth, Club of Rome, Energy Crisis during the early 70ies



Michael Gorbatschow



Hans-Peter
Dürr



Ernst Ulrich von
Weizsäcker



Vaclav Havel



Dennis Meadows

Early Highlights in SD

- Produced great trust in innovation to obtain sustainable growth
 - Brundtland Report 1987 -“Our Common Future” of the World Commission on Environment and Trade”
 - Earth Summit in Rio 1992

Sine that time we developed means and methods to calculate our influence on environment

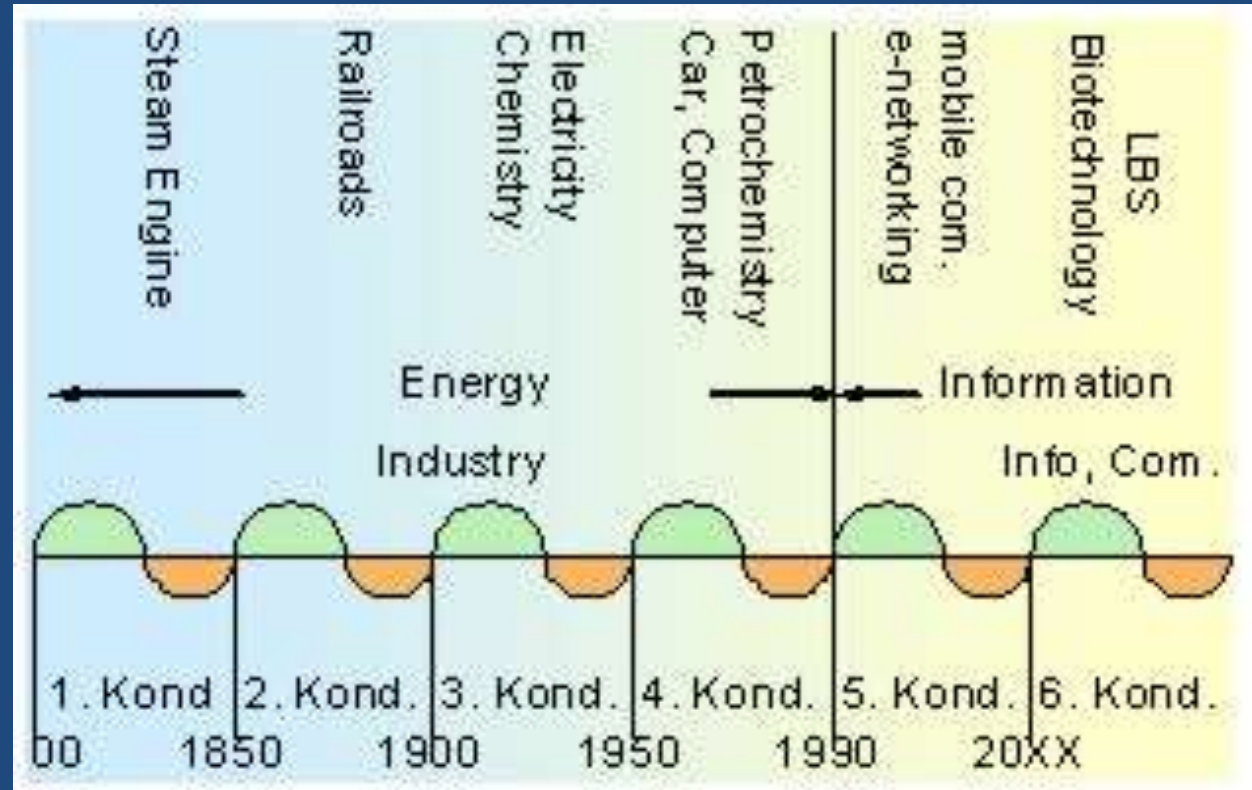


SOURCES: TRAVEL INDUSTRY WORLD YEARBOOK; AMERICAN HORSE COUNCIL; NEW YORK CITY DEPARTMENT OF TRANSPORTATION; USA TODAY; ACTAS; FEDERAL HIGHWAY ADMINISTRATION; LOS ANGELES TIMES; GUINNESS BOOK OF WORLD RECORDS; FEDERAL AVIATION AUTHORITY; PHOTOGRAPH BY JO LOWARD

Important messages of the environmental movement deduced and adopted by economics

- Win win strategies helping to perpetuate growth without need for changing economic ideology
- Innovation and technical progress to produce green products and introduce green technologies

Hope: progress in the 6th Cycle will be green

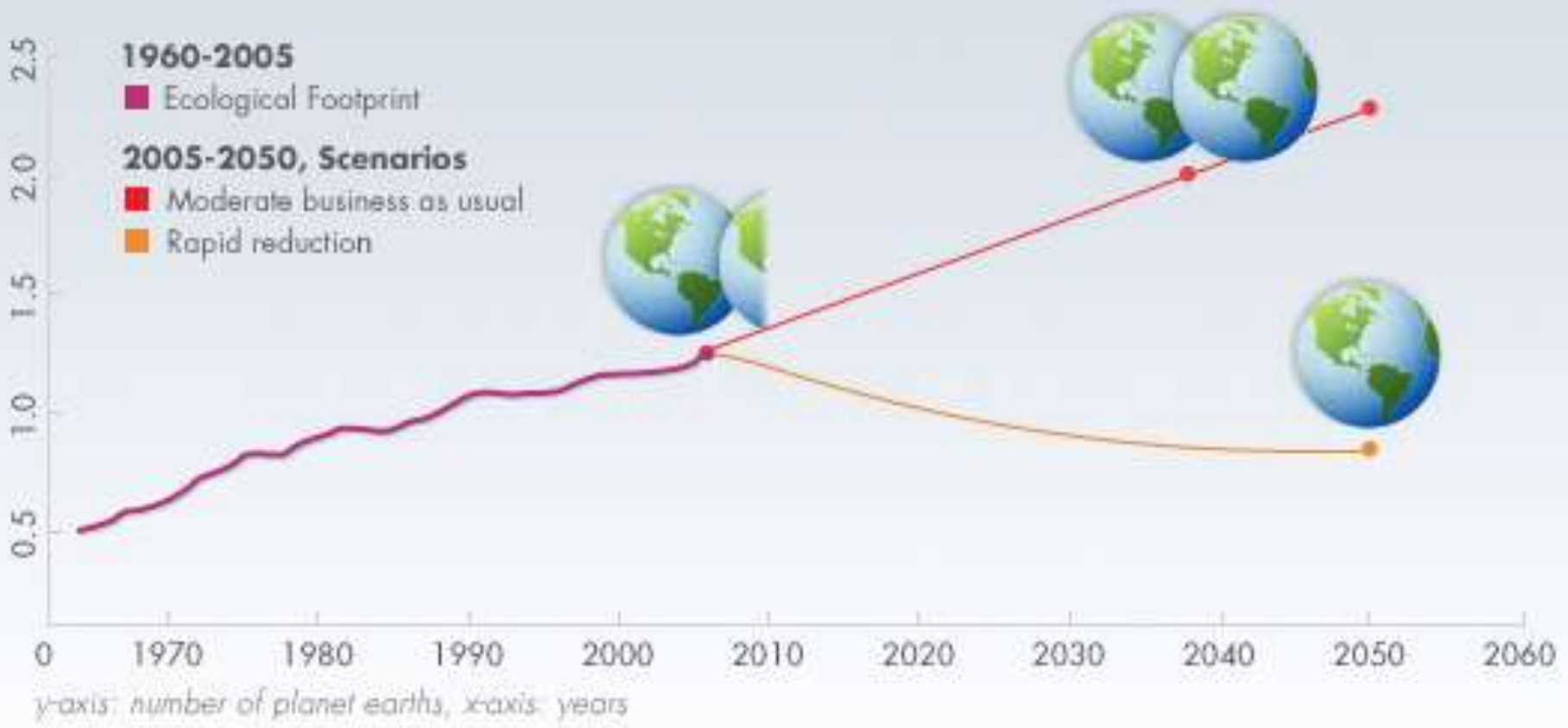


Sources: Spatial Information for Sustainable Resource Management
Gerhard Muggenhuber, Chair of FIG Commission 3 - Spatial Information Management,
Austria http://www.unigis.ac.at/ueber_uns/presse/artikel/FIG.htm
<http://www.eumed.net/cursecon/>
Photo: <http://www.eumed.net/cursecon/>: economistas/kondratieff.gif

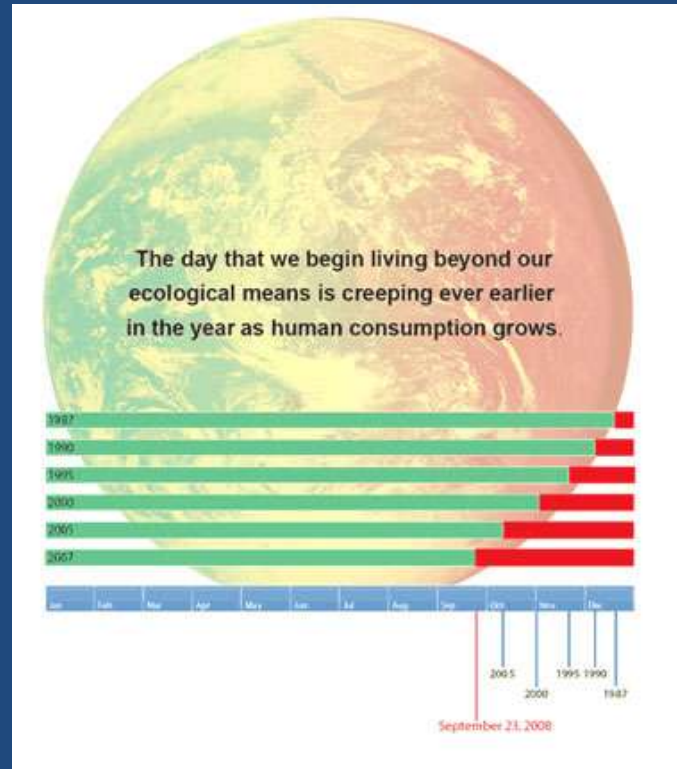
But what happened?

- Despite all honest and pretended interest in sustainable development and environment resource depletion and environmental degradation are even accelerated.
- This not only because of the rapid population growth and to fulfill the requirements of the poor but - the wealthy nations need the main share of resources and energy
- (relation 1: 4 or 5)

No Comment except: there was much ecological innovation and greening of products in this period



In 2008, Earth Overshoot Day was reached on September 23rd



For the rest of the year we are accumulating debt by depleting our natural capital and letting waste accumulate

Source: $\text{world biocapacity} / \text{world Ecological Footprint}] \times 365 = \text{Earth Overshoot Day}$

POLICIES PROMOTING GREEN PRODUCTS

EU: Integrated Product Policy

Make production processes eco-efficient by

- innovation
- Optimize resource flows and energy in the product life cycle (e.g. recycling)
- Inform consumers

Some Main Characteristics of Green Products

- Long living Products
- Use of renewable materials and energy
- Modular construction to enable recycling easily
- Shift from products to services (product service systems)
- Multiusage (e.g. packages; second hand markets)



**WHY DIDN'T IT WORK?
REBOUND EFFECTS**

What are Rebound Effects

- Improvements in eco efficiency of products and processes induce new growth going along with further exploitation and strains for environment.

In 1865 Stanley Jevons („The Coal Question“) argues that improved efficiency increased coal consumption does not lead to reduction in energy consumption



Can we avoid these effects?

- No – they are a result of complex interdependence of systems and may be even increase in future as we organize societies more and more complex and interdependent (human evolution)
- They are an everyday phenomenon, but so far they are hardly present in public awareness
- Nevertheless they have to be studied closer and to be influenced and to be assigned to compartments where they do less harm

Technical Rebound

- Technical improvement with positive effect on the environment results in negative adaptation of another component or process
 - light cars from plastic fibers are more energy efficient than from metal but the production and waste management of plastics needs more energy
 - Streamlined car design induced air conditioning
 - Miniaturization of products (mobile phone)

Rebound effect by change of behavior of individuals or society

- Due to time saving
- Due to income saving
- Due to psychological aspects – consumer does not care so much about energy efficient products (e.g. Standby)

Rebound Effects and Fashion

- In case of products with poor technical and functional innovation like dishes, cloth innovation is replaced by fashion in order to increase sales and stand competition.
- Fashion stimulates Consumer claims and needs
- But Fashion is also an old phenomenon of human culture.
- Innovation and even more fashion are responsible for disposal of products long before their life time has expired



The dream of an office without paper has not yet been fulfilled

CASE STUDY PAPER

Productivity in Paper Industry

Handicraft work - productivity was beyond 100 sheets of paper per man hour.

A flat paper making machine produced up to 21000 m paper per hour

The web working width of machines grew from 85 cm (1830) to 770 cm (1930), while production speed rose from 5 m/min (1820) to over 500 m/min (1930).

Between 1950 and 1980 paper production relied still on the old methods but progress had been achieved in web width and work speed.

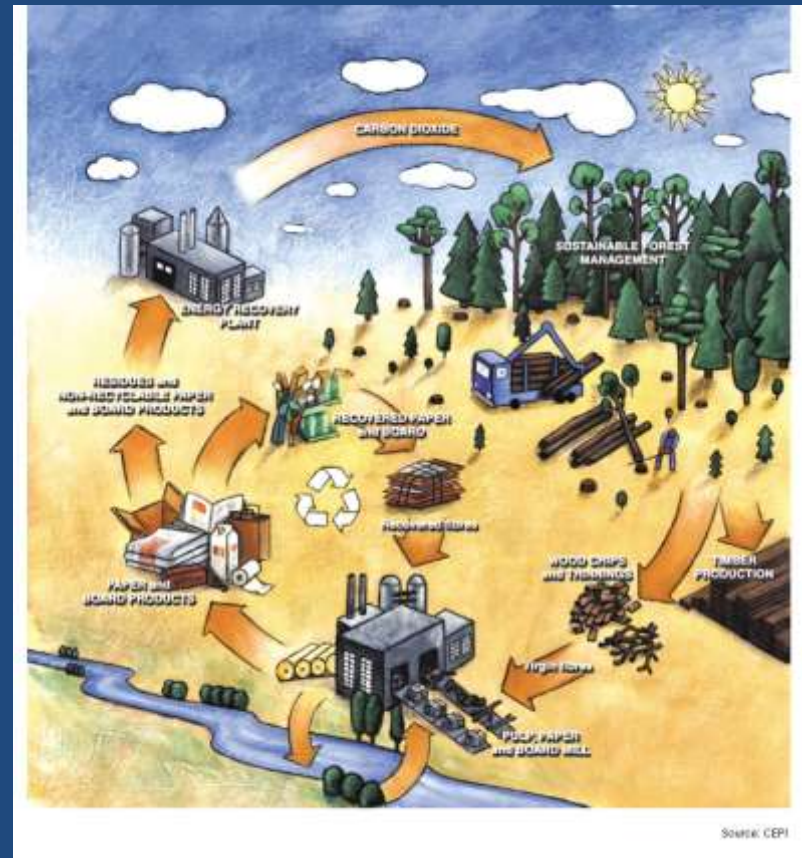
Full automation and electronic process control were introduced since the 1960is - Web width grew up to 10 m, production was **2000 m/min.**

Paper Industry – a success Story?

Paper industry in the last century was criticized because of its environmental performance

main problems were

- water pollution
- energy intensiveness (e.g. drying paper)
- Air pollution by emission like NO_x , SO_2
- Production of green house gas (CO_2 , Methane)



Innovations in Paper Industry in Europe

- Growing use of renewables from sustainable forest management
- forest area in EU increased from 25% in the last century to 29%
- Fast growing trees like eucalyptus or acacia are the most rapidly growing pulp trees
- High recycling rates up to 50 – 60 % , one particle can be recycled 6 times on an average, part of the recycling material (30%) has never been used
- Substitution of fuel by bio fuel (up to 50%)
- **No more problems with acid rain (SO_2 , NO_x)**
- **Partly reduction of chemicals in the process**
- **Remarkable advances in water treatment**

Immediate responses to the Directive 2000/60/establishing a framework for community action in the field of water policy in paper and pulp industry in Austria

- Between 2002-2004 waste water consumption was reduced by 14,8 % and water pollution by 18,44 %.
- Reduction of COD (chemical oxygen demand) relevant emissions by 91%, of BOD (biological oxygen demand) emissions by 97,3% and of nitrogen emissions by 86%

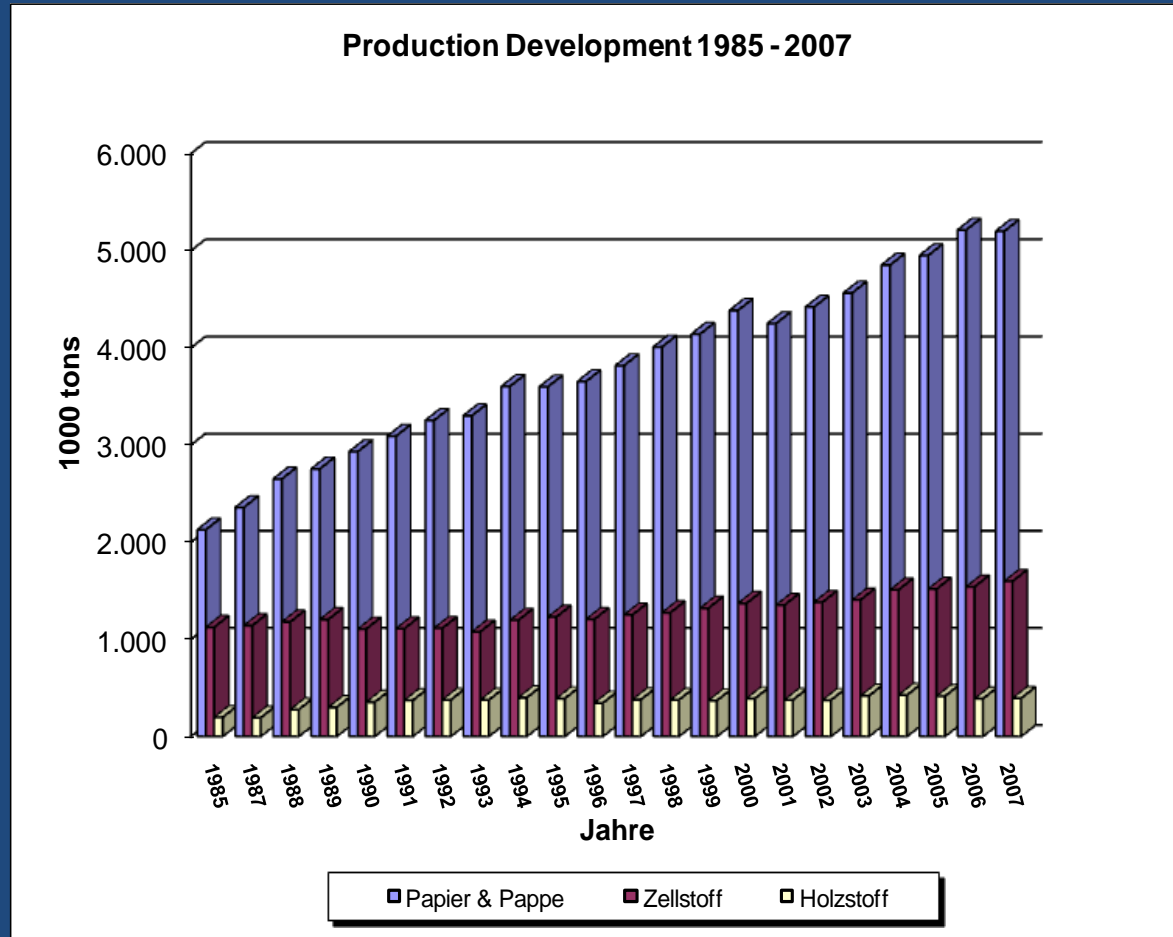
Environmental effects of subsidised measures between 2002 - 2004 in waste water management in AUT

parameter	before	after	reduction	unit
Water consumption	1.821.662	1.552.290	269.372	m ³ /a
Waste water production	13.114.384	10.696.157	2.418.227	m ³ /a
COD-Emission	13.247	1.220	12.027	t/a
BOD ₅ -Emission	5.568	152	5.416	t/a
NH ₄ -N-Emission	322	45	277	t/a

Umweltauswirkungen geförderter betrieblicher Abwassermaßnahmen im Zeitraum 2002-2004

•BUNDESMINISTERIUM FÜR LAND- UND FORSTWIRTSCHAFT, UMWELT UND WASSERWIRTSCHAFT (Hrsg.): Evaluierung der Umweltförderung des Bundes für den Zeitraum 1.1.2002 bis 31.12.2004, Wien 2005, S. 84

Output Development (AUT)

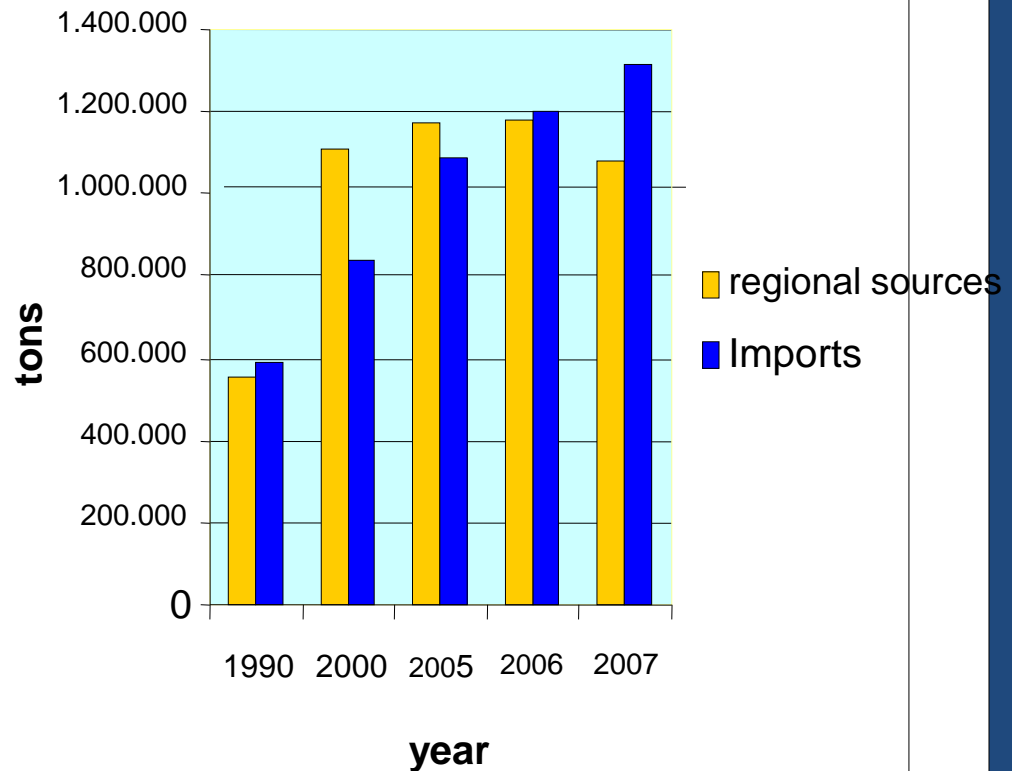


Paper production doubled between 1985 and 2007

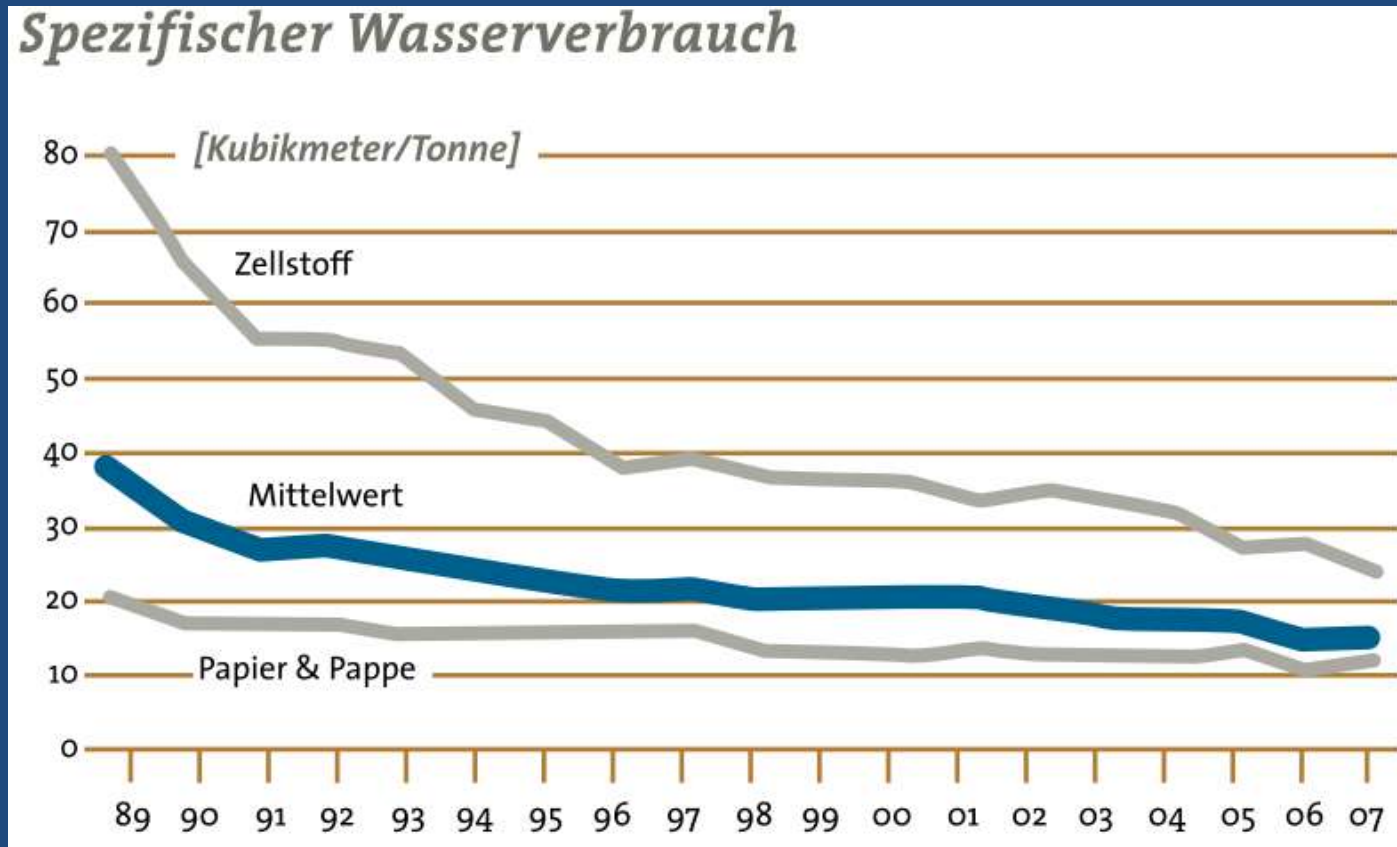
Raw Material Input development (Aut)

Input of wood increased between 1990 and 2007 by 37%

Recycling quota raised by 110%

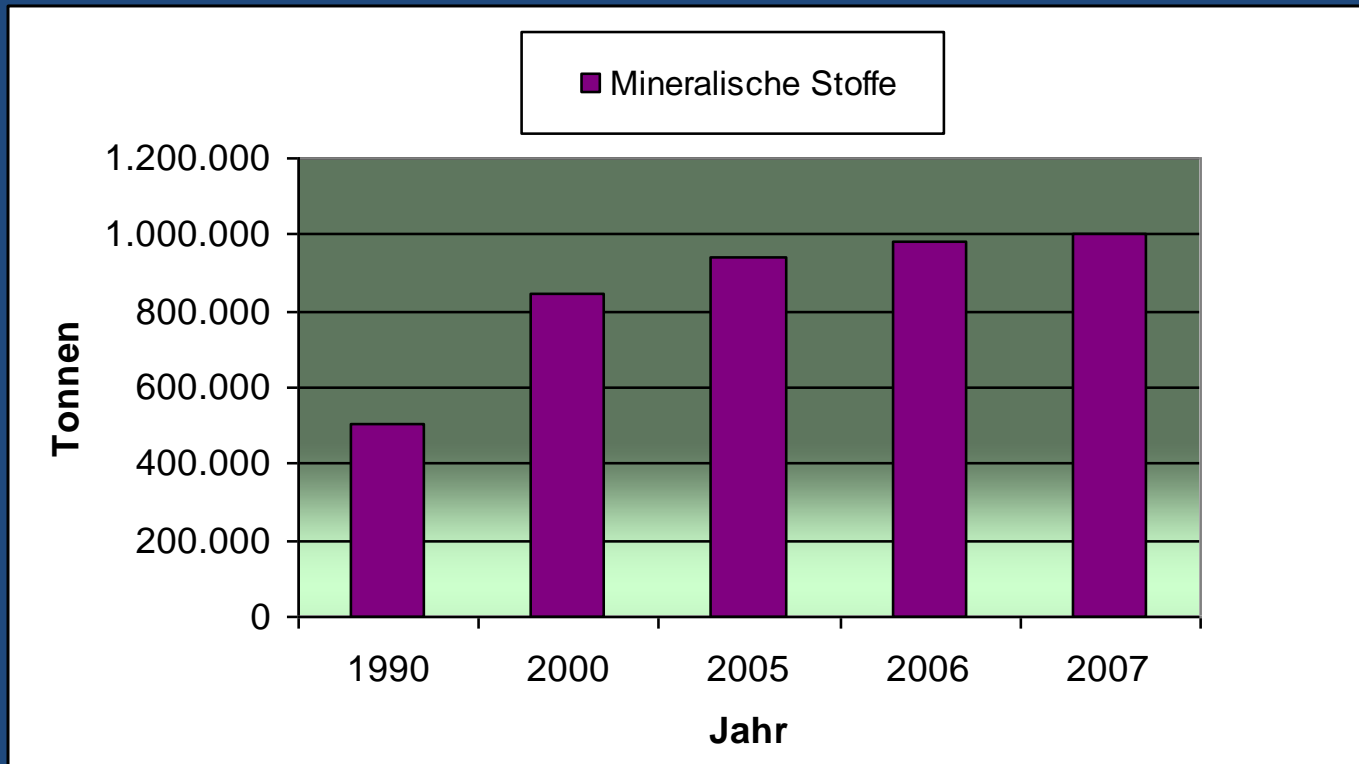


Specific water consumption (AUT)



Pulp
Average
Paper

Mineral additives

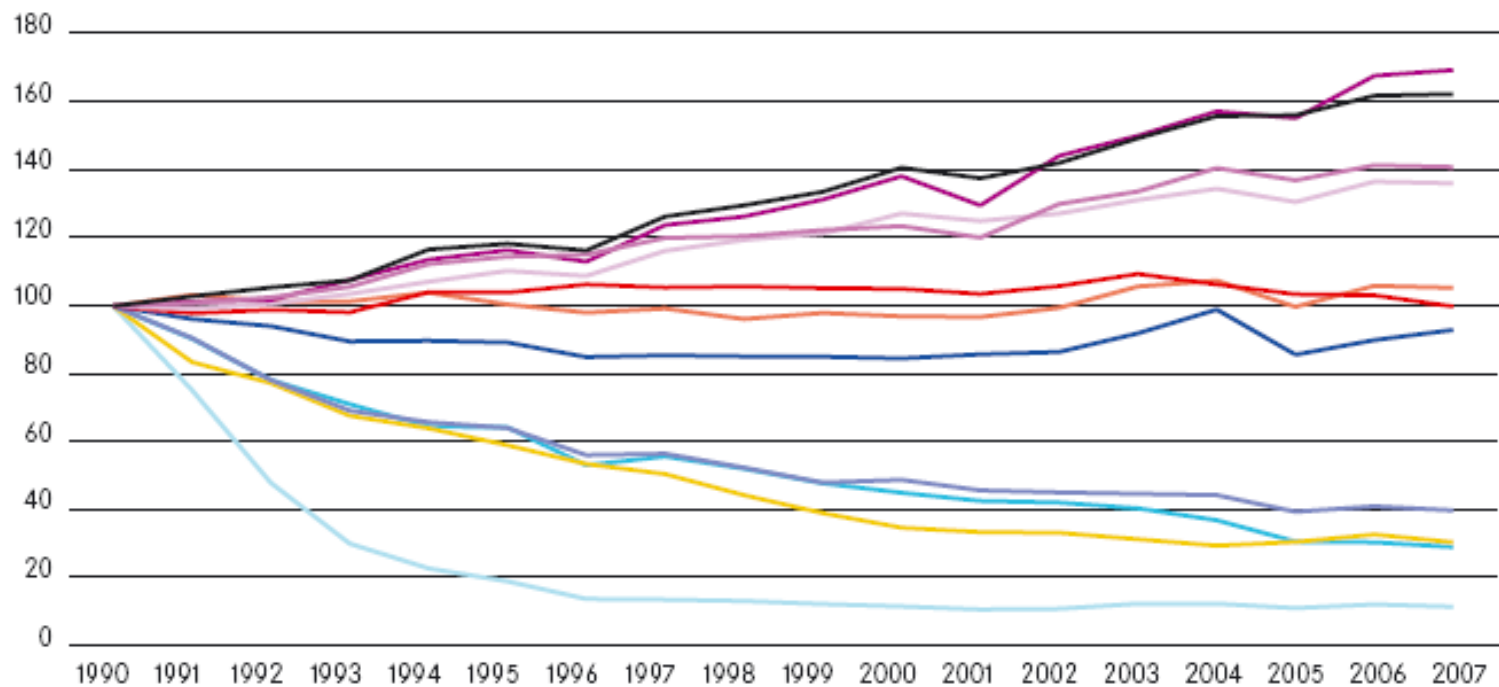


Own compilation according to AUSTROPAPIER – Vereinigung der Österreichischen Papierindustrie (Hrsg.): Der Jahresbericht der Österreichischen Papierindustrie 2007, Wien 2008:

http://www.austropapier.at/fileadmin/Austropapier/Dokumente/Jahresb_2007.pdf, vom 23.07.2008, S. 50

Evolution of Environmental Impacts of the European Pulp and Paper Industry 1990-2007

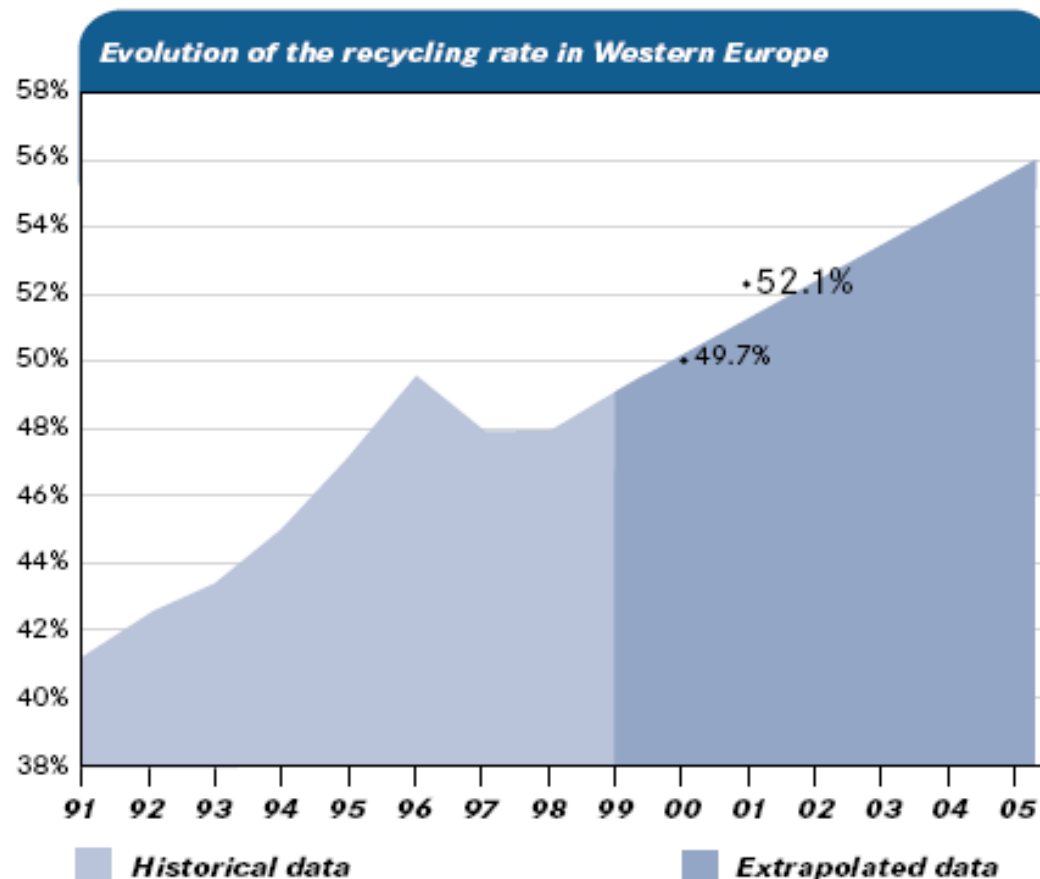
Index of Absolute Value (1990 = 100)



- Biomass Utilisation ■ Production of Market Pulp & Paper ■ Primary Energy Consumption
- Electricity Consumption ■ CO2 ■ NOX ■ Water Consumption ■ COD ■ SO2
- BOD ■ AOX

Water Emissions: COD (Chemical Oxygen Demand) - BOD (Biological Oxygen Demand) - AOX
 Air Emissions: CO2 - NOX (Azote Oxydes) - SO2

Evolution of the recycling rate as expected in the European Declaration on Paper Recovery

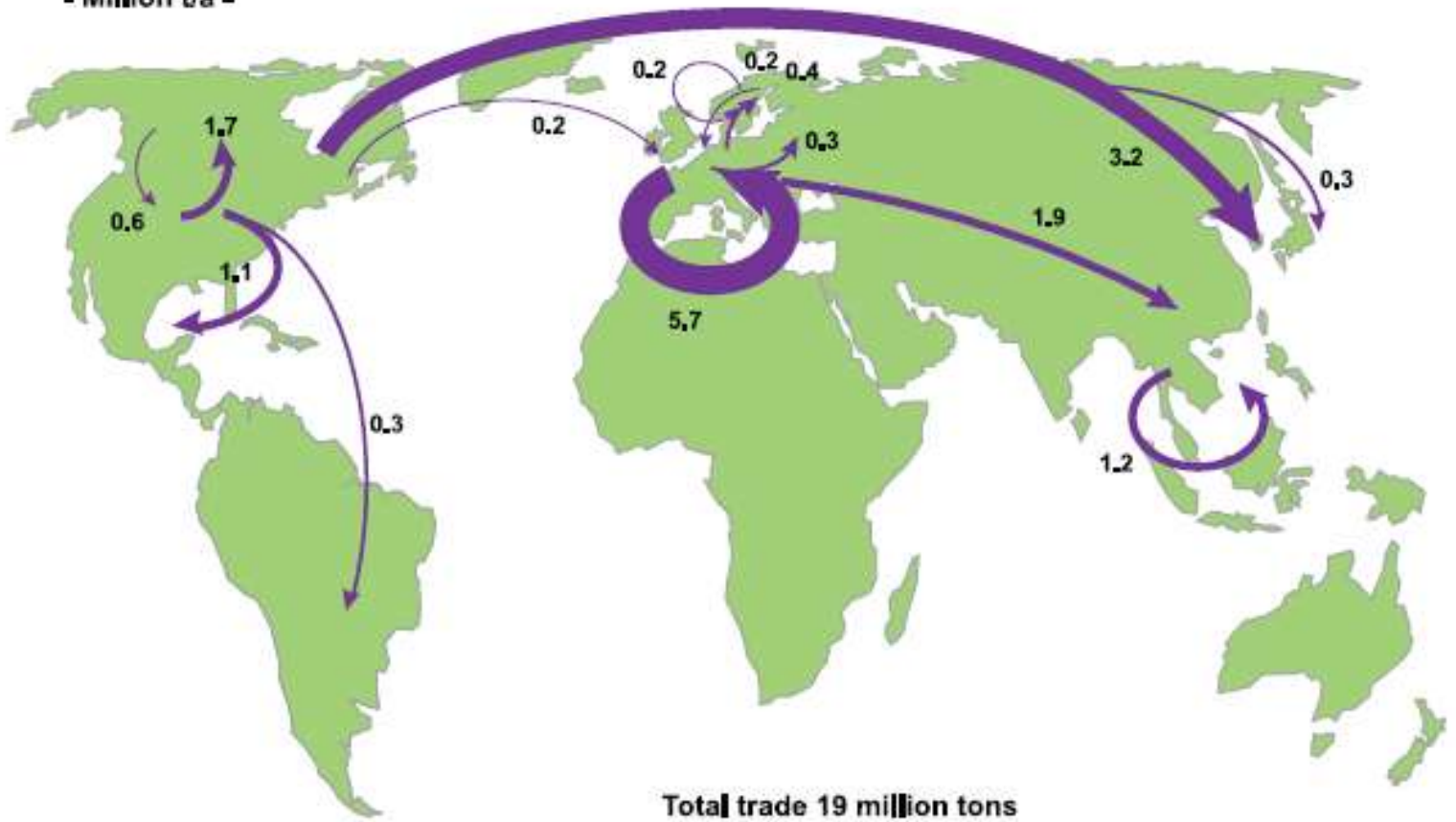


European Declaration of Resource Recovery, 2001

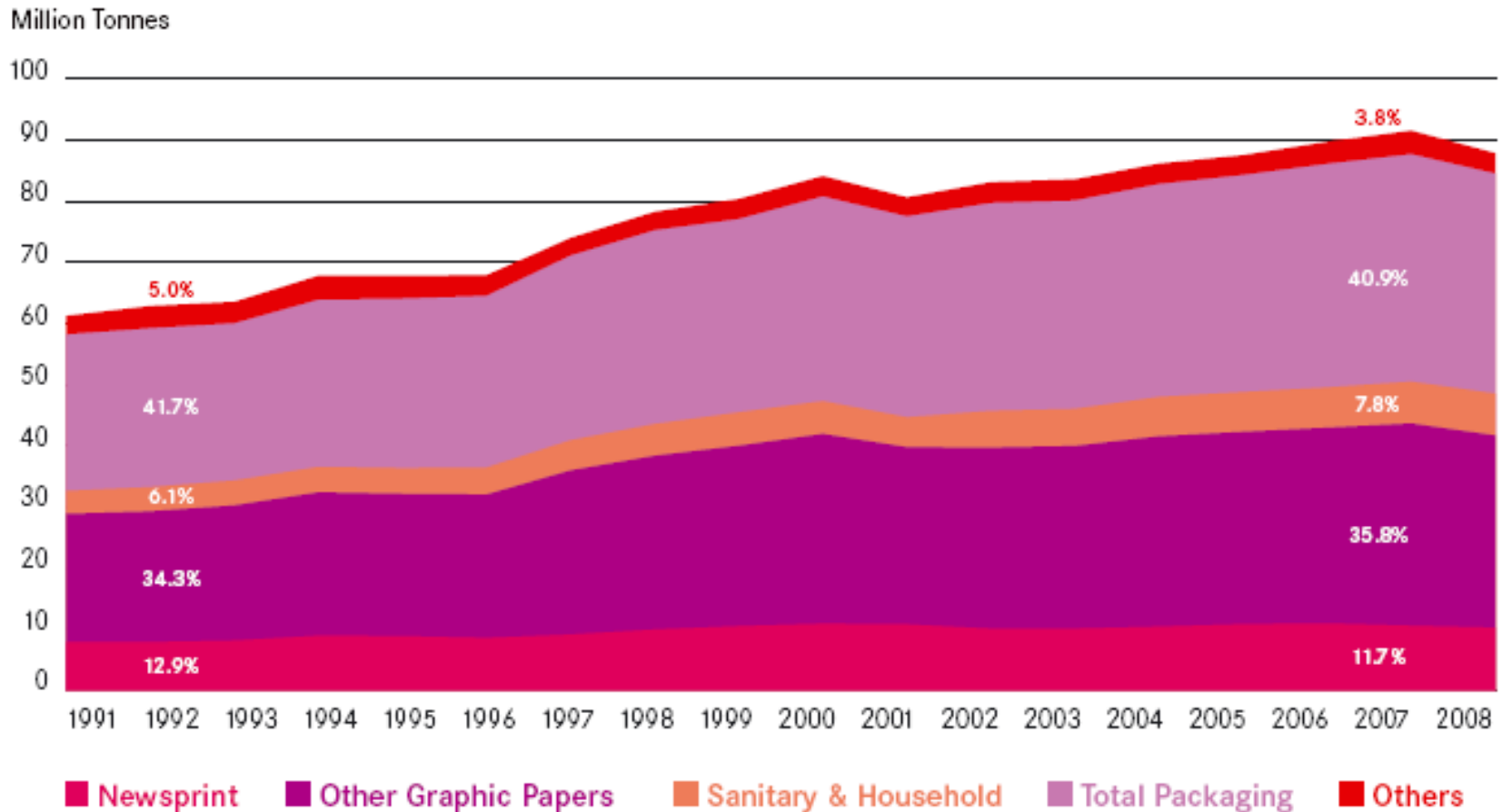
Global recovered paper flow balance

Total Recovered Paper — Major Trade Flows 1997

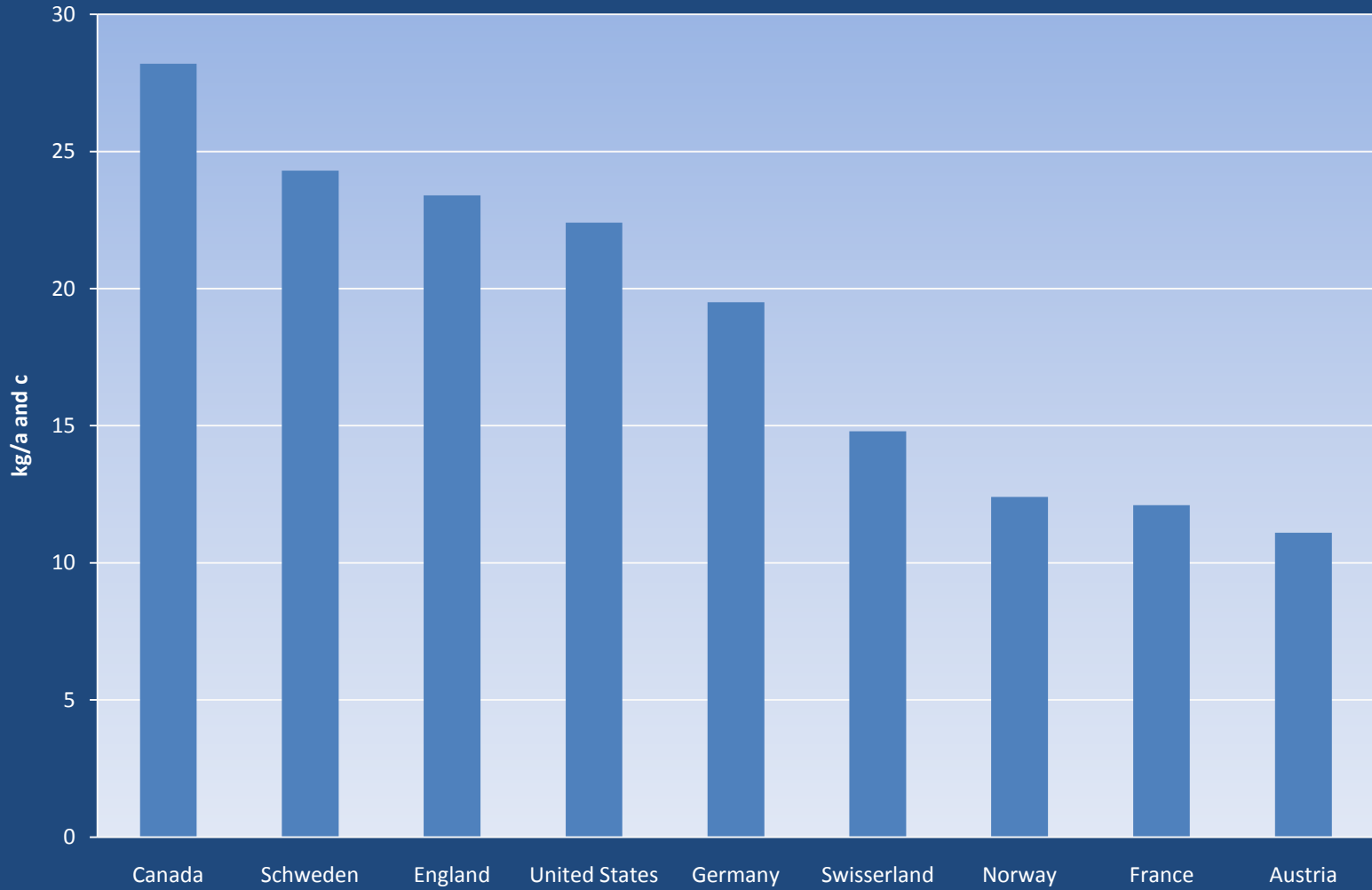
- Million t/a -



Paper Consumption by Grade in CEPI Countries 1991-2008



Paper consumption in 1910



A glance at paper consumption

- An Austrian needs 225 – 250 kg/a of paper, an American 335 kg/a
- 10 US employees need 1 t/a of paper sheets (10 000 to 20 000) corresponding 12 to 24 trees/a, 18 trees are cut for 10 employees (US)
- Every official in the EU Com (21 000 persons) uses 270 sheets of paper /d corresponding to 4 000 t
- 30% of recycled paper (6 turns of recycling are possible) have never been used products
- 1 t of paper emits 6,3 tons CO₂ equiv. GWP gases

LESSONS LEARNED

Lesson from the Case Study

- Innovation in water management was high enough to balance growing consumption of paper use
 - But: More additives were necessary to prevent mucilage due to water reduction in the process
- Improvement was really effective only in parts of the production chain: We have to consider raw material consumption which still absolutely grows , dangers of monocultures , imports, energy for recycled paper, transports of recycled material) etc

General Lessons

- Investigate complex structures far beyond micro- even macroeconomics
- calculation may help but there is the danger of simplification
- absolute values are as important as rates and ratios
- Regard carrying capacities of systems (e.g. forests for raw materials)
- Be critical on optimization – it concerns always a subsystem (thermodynamic laws, Entropy), also nature has redundancy
- Identify wastage (eg too much packaging and printing) and dissipation (chemicals in water treatment) processes

Visions

- Data on Product Lifetime
- Data on wasting
- Data Regional and detailed carrying capacities
- Training of population and esp. young people to comprehend dimensions and absolute values
- But also enriching statistics with narrative elements
- Respect nature and man: they do not function like machines and enterprise

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