• E-Mobility and the Future(s) of renewable Energies

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- **Kongress**
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- **Session „Future Technologies II: Mobility**

Fundamental Deficits in Society and Economy

- **No long-term strategies and policies**
- **Deficient thinking and handling in global perspectives**
- **No convincing future positions for practical future-oriented action**

Futures Research/Futures Studios

Futures Research is the scientific discipline that investigates

- possible
- likely
- desirable

future developments (*futures*) and options for formative action as well as their conditions in the past and present

Source : Kreibich 1996

Futures Research/Futures Studios

Future projections

Prognoses

Models of the future (e.g. simulation models)

Scenarios / future visions

General principles / guiding concepts

Visions – no closed utopian systems

self fulfilling prophecy **self destroying prophecy**

Source : Kreibich 1996

Futures Research/Futures Studios

Research Goals

For complex problems, futures research should

- provide orientation
- set targets
- develop (meaningful) knowledge about the future
- work out and assess future options and guiding concepts
- operationalize the guiding concepts
- devise strategies for action
- design measures / packages of measures.

Source : Kreibich 2005

Futures Research/Futures Studios

Wild Cards

- **Economical wild cards**
  - collapse of the global financial system
  - oil price crisis
- **Social wild cards**
  - revolution in subsistence (sustainable way of life)
  - mass migration
- **Technological wild cards**
  - cheap technologies for the storage of electricity and/or heat
  - genetic engineering for prolongation of lifespan
- **Ecological wild cards**
  - climate catastrophe
  - large-scale water pollution

Source : Kreibich 2005

Future Developments
Basic Trends (Megatrends)

- **Strength:** fundamental changes in the social system and/or natural environment
- **Global** impact and consequences
- **Long-term** impact and consequences

Evaluation: strong, medium, weak

Source : IZT 2004

Future Developments
Basic Trends

- Scientific and technological innovations
- Pollution of the environment and biosphere/excessive exploitation of natural resources
- Population development and demographic change
- Change towards a service-oriented and information-oriented society (Science Society)
- Globalisation of the economy, occupation and mobility
- Social disparity between first and third world, extremism, terrorism
- Individualisation of the living and working environment
- **Worldwide increase in personal and material flow**
- Deterioration in quality of life (according to UN and World Bank indices)
- Employment trend and mass unemployment

Source: IZT 2004

Industrial Society: Fulfilled Future Visions

Megatrend: scientific and technical innovations

	in 100 years
Increase in prosperity	
Net income	3500%
Productivity in agriculture	3500%
Productivity in production sector	4500%
Productivity in service sector	4000%
Material living standard	3500%
Life expectancy	
plus 38 years (doubled)	
Mobility	
Speed and distances: factor 100	

Source : OECD 2004/ Statist. Bundesamt 2007

Industrial Society : Destruction of the Biosphere

Megatrend: pollution of the environment and biosphere/excessive exploitation of natural resources

Daily balance – industrial society (every day)

- **80.000.000 tons of CO_2 into the atmosphere**
- **Destruction of 55.000 hectares of tropical forest**
- **Reduction of farmland by 20.000 hectares**
- **Destruction of ca. 80 to 120 species of animals and plants**
- **Oceans are stripped of 220.000 tons of fish**

The potential strain measurable on the darker side of the technical-industrial progress leads to no other conclusion than that within less than 80 years, we will have destroyed the natural foundations of life and production if we continue to tread the path of gigantic consumption of energy and raw materials with the resulting flow of pollutants.

Source: OECD 2006/ UBA 2005

Scientific Society

Scientific knowledge as Productiveness

Microchips:	70% of price through knowledge
Solar cells:	70% of price through knowledge
Pharma products:	80% of price through knowledge
Economic growth:	70% - 80% through knowledge (innovative knowledge)

Scientific Society

Future of work
Person in employment in the service sector (tertiary sector)

Sweden 75% of all employees

USA 76% of all employees

Germany 67% of all employees

Of these, in all the three countries about 2/3 are employed in the field of information, communication and knowledge services (quaternary sector).

Sustainable Development

Leading perspectives

- Improving the quality of life and safeguarding the economic development and employment
- Preserving and protecting the natural resources
- Securing social justice and equal opportunities
- Respecting and promoting cultural self-development and plurality of groups and communities
- Promoting humane technologies and avoiding super-risky technologies and irreversible destructions

Source: Kreibich 2004

Sustainable Development

Strategies of sustainability

1. Strategy of efficiency
2. Strategy of consistency
3. Strategy of sufficiency
4. Self-organization / self-responsibility

Source: Kreibich 2004

Mobility/Traffic

- **Mobility**
  is the possibility to move persons, goods or informations from point A to point B with the least necessary expenditure of material or energy resources. Mobility means potential and actual mobility in space and time with a high degree of practical effect at low effort.
- **Traffic**
  is every location- and time-dependent movement of persons, commodities and messages

- **Dimensional size for the traffic**

Passenger traffic	person x kilometers
Transport of goods	tons x kilometers
Information exchange	amount of information per unit of time (bit/sec)

Traffic

Negative consequences of traffic/generation of external costs

- raw material consumption
- energy consumption
- noxious emission
- noise emission
- loss of urbanity and quality of life
- refuse (plastic, engine oils, hazardous waste)
- environmental pollution (ecological systems, air, water, earth)
- landscape consumption
- fragmentation of landscapes
- damage to health
- accidents/consequences of accidents
- traffic congestion costs
- etc.

Source: Kreibich 2001

Traffic

New Cars in Germany 2003-2006

Mercedes-Benz	SLR McLaren	629 PS	334 km/h		€ 345.000
Mercedes-Benz	CLS-Coupé	195 kW	250 km/h	6,4 sec	
Maybach		485 PS	250 km/h		€ 400.000
Bugatti (VW)	Veyron	1001 PS	403 km/h		€ 1,5 Mio.
VW	Phaeton V12	420 PS	250 km/h	4,4 sec	
VW	ConceptR	260 PS		5,2 sec	
Audi	Le Mans	449 PS	345 km/h	4,3 sec	
Lamborghini (Audi)	Gallardo	500 PS	320 km/h		€ 175.000
Porsche	Carrera GT	612 PS			
Maserati	Quattroporte	400 PS			€ 115.000
Rolls-Royce (BMW)	Phantom	512 PS			€ 375.000

Traffic

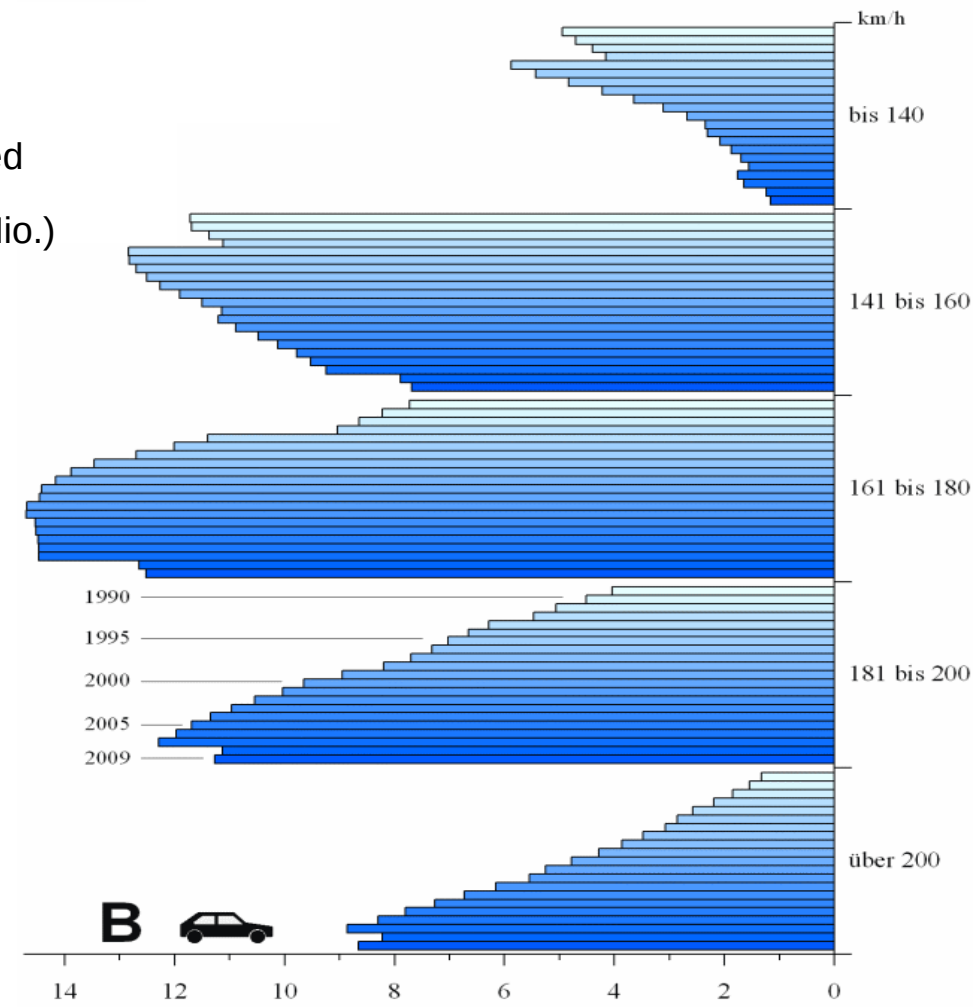
Car /Trailer

Combination

Store after maximum speed

Germany (Number in Mio.)

1990-2009



Source :
Verkehr in Zahlen 2009/2010

Traffic

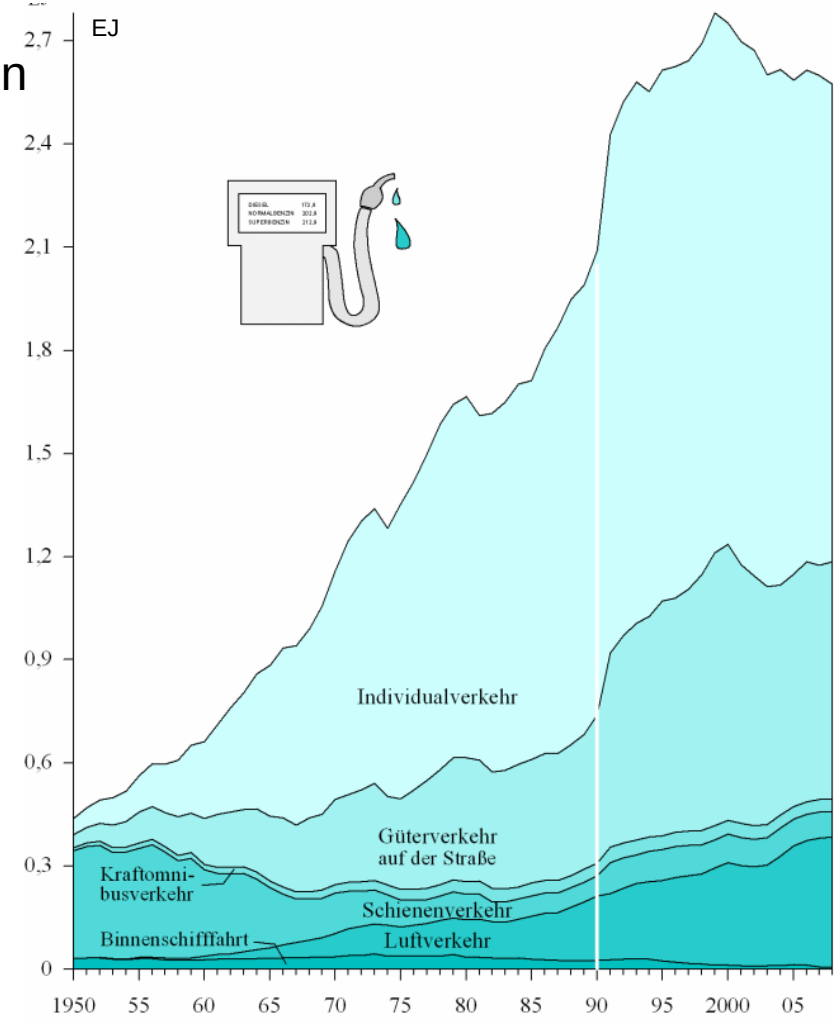
End-Energyconsumption traffic

Transport sector

Exajoule (EJ)

Germany

1950-2008



Source :

Verkehr in Zahlen 2009/2010

Traffic

Functions of private motorized transport

- means of locomotion
- transport
- bedroom (trucks and cars)
- living room on wheels
- rolling cooler (lorry)
- sports equipment
- Hi-fi box
- love nest on wheels
- prestige object
- status symbol
- movie place
- etc.

Source : Kreibich 1998

Development of World Trade
Growth of World Trade

Average growth rate of world trade

1990 - 1999: 5.8%

Doubled in 15 years

2000 - 2008: 12.4%

Doubled in 8 years

No. of Motor Cars per Inhabitant (2008)

Passenger cars per 1.000 people in:

• Germany	560	82	million inhabitants
• USA total	780	306	million inhabitants
California	1.130	37	million inhabitants
• China	21	1.300	million inhabitants
• India	9	1.100	million inhabitants

Source : OECD 2009

Resource Development in the Future

Pillars of a future-oriented strategy for energy and raw materials

- **Efficient technologies and efficient innovations**
  In all sectors of consumption: industry, households, services, transport
- **Consistent energy sources, renewable raw materials and circular flow economy**
  Renewable energy, renewable raw materials, ecologically and socially acceptable storage of heat and electricity, recovery of the recycable fraction on a high-quality level
- **Responsible, efficient and economical consumer and user behavior**
  Better quality of life through reduced consumption of energy and raw materials, reduced environmental pollution, lower costs and protection of health

Source : Kreibich 2008

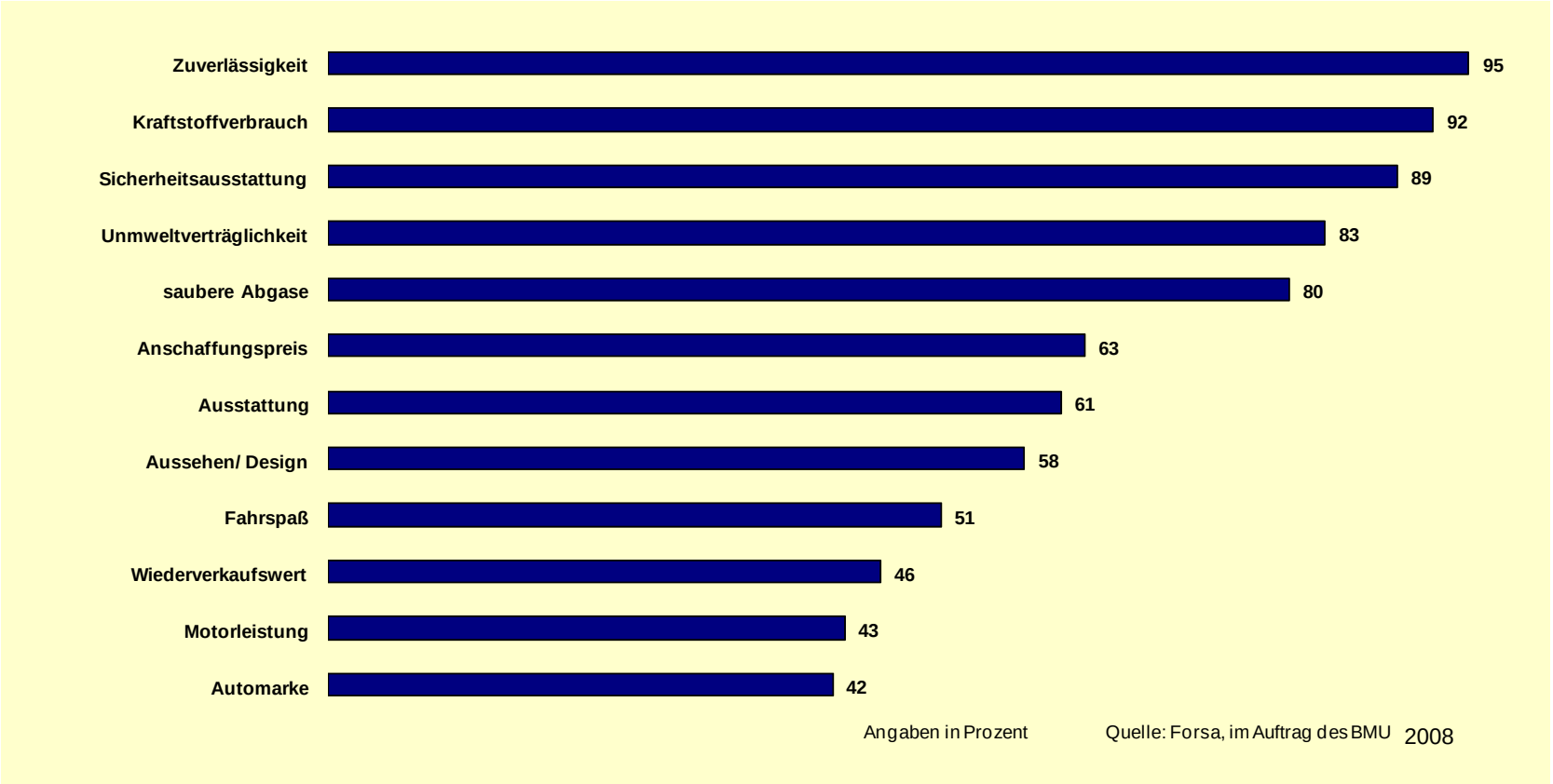
Solar Industry I

- Breakthrough in renewable energies and efficient technologies is a reality
- Solar industry is a prime example of a new ecological industrial policy and is a trend towards a new ecological mobility
- The solar industry is proof: economy and ecology are mutually dependant rather than opposed to each other in a world of limited resources and vulnerable ecosystems
- The basic presumption of the neo-liberal over-exploitation economy that companies should first make big profits to allow them to make good the gigantic consequential damages (consumption of fossil and nuclear resources and misuse of other raw material) has been refuted.

Source: Kreibich 2008

Traffic

1645 car drivers were asked about what they consider important when purchasing a car:



Sustainable Mobility

- Space and housing development for shorter distances
- Combining living, work, education, leisure, culture and shopping
- Drastic reduction in the use of fossil fuels and valuable raw materials
- Support for a new type of lifestyle with socially acceptable forms of locomotion (bicycle, foot traffic, public transport, etc.)
- Avoiding socially unacceptable and promoting socially acceptable transport concepts, transport technologies and transport systems
- Use of traffic-reducing as well as socially and ecologically acceptable information and communication approaches (efficient organization, logistics, interfaces between modes of transport)
- Promoting transport systems that are in line with the environment (e.g. wheel-rail-telematics technique)

Source : Kreibich 2004

Sustainable Mobility/Traffic

Fields of action for the reduction of traffic and resource consumption

- Reduction/avoidance of traffic
- Shifting traffic to environmentally friendly and socially acceptable transport systems
- Optimization of traffic flows
- Increase in efficiency of carriers and transport systems
- Regulatory and price policy

Source: Kreibich 2004

Traffic avoidance and traffic reduction

- “Short paths and “decentralized concentration“
- Avoiding overdevelopment and suburbanization
- Strengthening the regional economic cycle
- Revision of the European and national policy of subsidies with respect to traffic-generating effects (personal and commercial traffic)
- Separating economical growth from traffic

Source : Kreibich 2004

Sustainable Mobility/Traffic

Shifting transport modes to environmentally friendly and socially acceptable transport systems

- Consistent promotion of pedestrian and cyclist traffic at the cost of motorized individual traffic
- Consistent promotion of (local) public transport at the cost of motorized individual traffic and air traffic
- Improvement in the interfaces between transport system (pedestrian and bicycle traffic to (local) public transport; changeover from street to rail for trucks and cars; changeover pedestrian, bicycle, car, road traffic, inland waterway transport, rail traffic and air traffic)
- Car sharing
- Shifting goods traffic from road to rail and inland waterway transport
- Expansion of high-speed railways, fast goods transport on rails and regional traffic at the cost of MIV (trucks and cars) and air traffic

Source : Kreibich 2004

Optimisation of traffic flows

- Comprehensive coverage of public transport (ÖV) (city, environs, region, national level, Europe)
- Integrated network structure in local public transport with aircrafts and lighter-than-air technologies
- Telematic process control system for optimal traffic flow in public transport and motorized individual traffic (MIV)
- Fleet management
- Raising the load factor of personal and goods traffic
- Optimized logistic concepts

Source : Kreibich 2004

Efficiency increase of transport carriers

- Drastic increase in energy and raw material efficiency of trucks and cars of the entire fleet
- E-mobility
- Noise control on motor cycles, scooters, mopeds and trucks
- Lowering EU noise limits for tires
- Technical increase in efficiency for all motor vehicles
  (SMALL, intelligent, light, efficiency)
- Energy recovery in trains, busses and hybrid vehicles

Source : Kreibich 2004

Regulatory and price policy

- Maximum consumption limit for trucks and cars fleets
  Average consumption until 2020: 5 liters/100 km -equivalent
  until 2030: 4 liters/100 km -equivalent
- Max. speed limit in road traffic
  motorways 120 km/h
  federal highways 90 km/h
- Extension of low-traffic zones and local driving bans
- Encouraging better parking space management
- Finance reform to promote sustainable mobility
- Taxing aviation fuel (kerosene)
- Reducing value added tax exemption for air traffic
- Raising limits for pollutant emission and noise levels of aircrafts

Source : Kreibich 2004

Sustainable E-mobility

- **SMILE: Small – Intelligent – Light – Efficient**
- **Foundation: regenerative energy**
- Smart and powerful storage of electricity: expansion
  pumped storage plants; drastic improvement of storage battery technology (energy density, weight, raw materials, costs); accumulator systems; intelligent network (smart grids)
- Establishing a tank infrastructure that is ever available, intelligent, cost-effective, and powerful
- Development of a hydrogen storage device and automotive technology for fuel cells
- Car sharing

Source : Kreibich 2010

Vision of the future I

- Mobility-friendly city
  Portion of transport services based on public transport, pedestrians, bicycle and telematics > 70%
- "Pedestrian and bicycle-friendly city"
  Portion of transport services > 40%
- The two-liter-petrol or natural gas car and future electric car
  SMILE = small, Intelligent, light, efficient, using regenerative energies
- ZEV Zero emission vehicle
  - electrical vehicles,
  - solar hydrogen and fuel cells
- Car sharing on a massive scale

Source : Kreibich 2010

Sustainable Mobility/Traffic

Vision of the future II

- Reduction in land use based on traffic areas from less than 5 ha/day by 2020
- Substitution of 40% of physical traffic by telematics (information and communication traffic) by 2030
- 50% of goods transport by rail and inland shipping based on highly flexible transport chains by 2030; automatic loading equipment
- Use of solar batteries in lighter-than-air air transport systems
- Implementation of traffic-reducing, mobile lifestyle

Source : Kreibich 2010

Knowledge Society

RELEVANT KNOWLEDGE

Information pile **Information trash**

Expert knowledge
Reference knowledge
Selective knowledge
Networked knowledge
Practical knowledge
Key qualifications
Social competence
Cultural knowledge
Foreign language competence
Decision-making competence

Source : Kreibich 2007

Futures Studios and Shaping of the Future
Conclusion

You cannot predict the future -

but you can use scientific sources of knowledge in order to encompass possible, likely and desirable futurities and, in a participative-democratic process, work towards preventing negative developments and catastrophes, and realizing a desirable future. This applies particularly to the realization of an intelligent design of e-mobility on a massive scale.