11

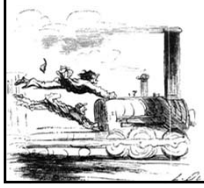
Resistance to Technology & Environmental Movements

Technikkritik und Umweltbewegung

Technological Scepticism

- Recurrent
- Some historical milestones:
  1825-1830: Captain Swing and King Ludd
  1865: W.S. Jevons „The Coal Question“
  1914-1918 WW I
  1968-1972: B. Commoner
  1973: Limits to Growth vs. Starr/Rudman
  >1970: Risk and Technology Assessment
  „NIMBY“, central „bans“

Auswirkungen eines mit 60 km/h fahrenden Zuges auf die Umgebung (1862)



Lok-Führer und Heizer auf einem mit 60 km/h fahrenden Zug (1862)

Innovation: Scepticism and Resistance in View of the Unknown

Speed kills..... 19th century sceptical German cartoons reflecting Science's (Prussian Academy of Sciences) verdict

"Weeping willow" Strategy:

Use constraints/ opposition as opportunity

Vienna waste incinerator bowing to "green" public perception

Environmental Concerns

- 13th Century: First air pollution complaints
- 18th Century: Fear of timber „famines"
- 1884: J. Ruskin „Storm Cloud of the 19th Century"
- 1896: S. Arrhenius on CO_2 and climate
- 1900: Conservation movement
- 1920s: Oil scarcity fears
- 1952: „Killer smog" in London
- 1962: R. Carson „Silent Spring"
- 1972: Limits to Growth

Recurring Perception of Scarcity

"…the data at hand in regard to the gas still available underground … make it probable that the annual output will never be very much more than it was during the period 1916 - 1920."

R.S. McBride and E.G. Sievers (USGS),
Mineral Resources of the United States, 1921, p.340.

US gas production:
22 Mtoe in 1920
100 Mtoe in 1995

"The stone age did not come to an end because of a lack of stones."

Sheikh Yamani

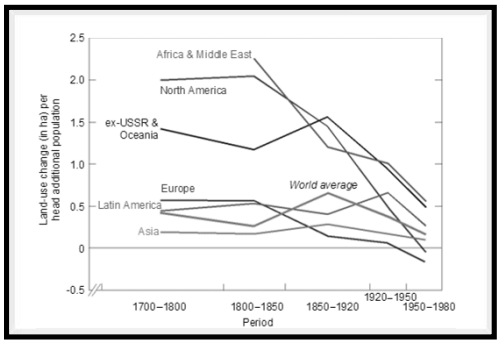
Technology – Environment Paradox

- Race between productivity/efficiency and output/consumption growth
- Solving one problem, but creating yet another one
- Scale of influence
- Uncertainty and suprise, genuine or „constructed" (attention management problem)

IPAT Identity for OECD 1900-2000 (**all #**'s rounded!)

	POP 10^6	GDP/POP $/cap	GDP 10^9 $	ENE/GDP kgoe/$	ENE Mtoe	C/ENE tC/toe	C MtC
1900	350	3000	1000	.7	700	.9	600
2000	900	21000	19000	.25	5000	.7	3300
Factor In-crease	2.6	7	19	.36	7	.74	5.5
aagr %/yr	1.0	2.0	3	-1.0	2.0	-0.3	1.7

Land-use Change per Head Additional Population (ha per person)



Technik & Umwelt **Arnulf Grübler**

Energy Efficiency (%) and Emissions (g/km) for Horses, and Early and Contemporary Automobiles

	Horses	Cars (ca. 1920)	Cars (1995)
Engine efficiency, %	4	10	20
Wastes			
Solid	400	–	–
Liquid	200	–	–
Gaseous, including			
Carbon (CO_2)[d]	170	120	70
Carbon (CO)	–	90	2
Nitrogen (NO_x)	–	4	0.2
Hydrocarbons	2[e]	15	0.2

d Total carbon content of fuel
e Methane

Technik & Umwelt **Arnulf Grübler**

Global Materials Mobilization

Billion tons per year. AD 2000

	Fossil energy	Metals	Industrial raw materials	Constr. materials	Earth moved	Food & fibers	**Total**
Mining/ harvesting	10	>5	2.5	~16	- -	>5	**>40**
Overburden, wastes	>20	>15?	<1	>1	>50	<5	**>100**

Source: Argawal (1991), Grübler (2001), Nötstaller (1998).

Technik & Umwelt **Arnulf Grübler**

Far away from the stone age, we used more crushed stone in 30 years than our ancestors in 30,000 years.

Dimensions of Global Change ca. AD 2000

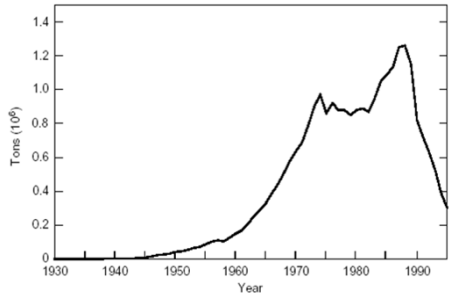
	Land use 10^6 km^2	**Water use** km^3	**Materials mobilized** 10^9 t	**Emissions** 10^6 t			
				Arsenic	CFCs*	Sulfur	Nitrogen#
Human	**47**	**3,000**	**>100**	**0.04**	**0.5**	**70**	**80**
Natural	**84**	**10,000**	**<25**	**<0.02**	**~0**	**<25**	**<50**
Human as % of Nature	**56%**	**30%**	**400%**	**200%**	**~∞**	**300%**	**200%**

*Peak in 1988: >1.1 Million tons.
#1990 data.

We "dematerialize" at ever higher levels of materials use.

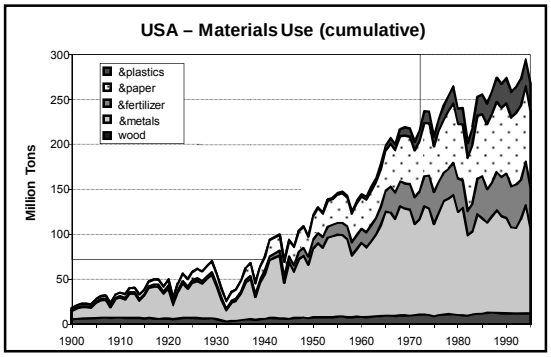
World – Emissions of CFCs

2 “surpises” (introduction AND phase-out)



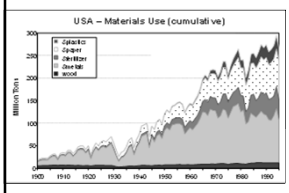
Technik & Umwelt **Arnulf Grübler**

USA – Materials Use (cumulative)

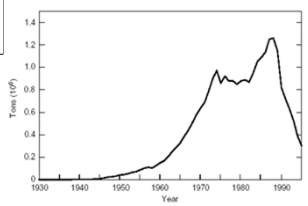


Technik & Umwelt Source: adapted from Wernick & Ausubel (1995). **Arnulf Grübler**

Dematerialization



Most cases only “relative”
(in OECD, not apparent in DCs)

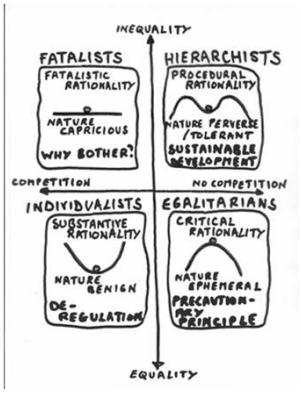


Few cases of “absolute” DM:
Via central policy bans and
technological obsolescence

Technik & Umwelt **Arnulf Grübler**

Decision Making Paradoxa

- Imperfect information: „disvovery by accident“ vs „precautionary principle“
- Difference between subjective and probabilistic risk perception
- Difference between individual vs central decision making (PC vs. Reactors)
- Diametrically opposing world views

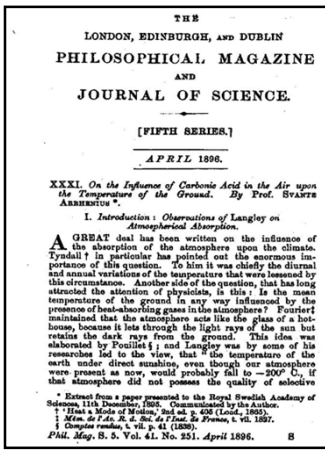


Typology of “Value-ists” Along 2 Dimensions of Social Relations & Associated Myths of Nature

(Source: Mike Thompson based on Timmermann, 1986)

Genuine and „constructed“ Uncertainties

- Ignorance (lack of „know-why“ and „know-how“
- Lack of technology (e.g. for measurement and modeling)
- Knowledge not available to right people
- „Attention management“ (get ear of decision maker)
- Biases and filters: „Discovery by accident“



THE
LONDON, EDINBURGH, AND DUBLIN
PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

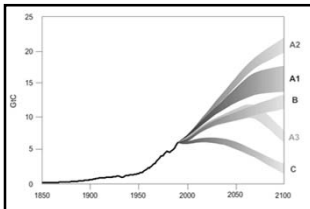
1. *Introduction: Observations of Langley on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet§; and Langley was by some of his researches led to the view, that if the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to −200° C., if that atmosphere did not possess the quality of selective

* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1895. Communicated by the Author.
† 'Heat a Mode of Motion,' 2nd ed. p. 408 (Lond., 1865).
‡ *Mém. de l'Ac. R. d. Sci. de l'Inst. de France*, t. vii. 1827.
§ *Comptes rendus*, t. vii. p. 41 (1838).
Phil. Mag. S. 5. Vol. 41. No. 251. *April* 1896. 8

Svante Arrhenius: *Climate change as attention management problem*

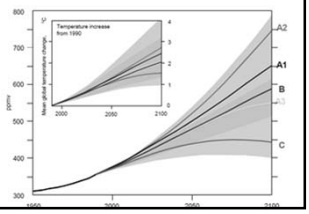
Arnulf Grübler



Global Change in IIASA-WEC Scenarios

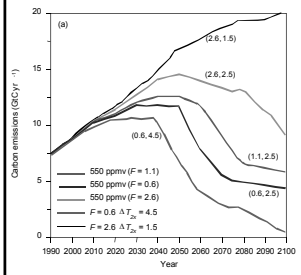
Cause - Effect

Development & policies
Emissions (GtC)
C-cycle
CO2 concentration (ppmv)
climate sensitivity
GMTC in °C

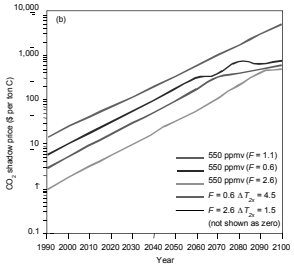


Uncertainties (F=carbon cycle; Δt_{2x}=climate sensitivity) in Stabilizing Climate Change at +2.5 ºC by 2100

Emissions

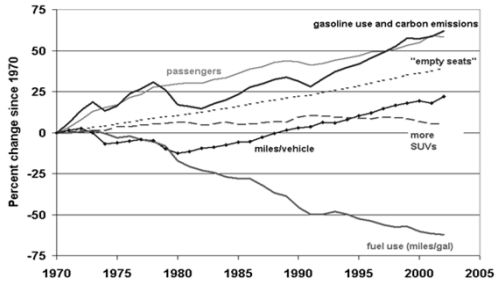


Shadow Prices

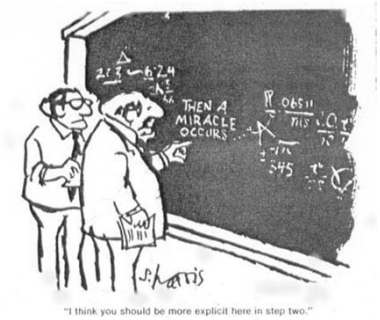


Value and Lifestyle (Preferences) Change

Percent Change since 1970 in US Automobile CO_2 Emissions and Driving Forces



"I think you should be more explicit here in step two"



4 Systems of Enquiry

„Truth“ is:

LEIBNITZ Gottfried Willhelm von	Analytic „get the right model“
LOCKE John	Empirical „get the right data“
KANT Immanuel	Synthetic „integrate theory and data“
HEGEL Georg Friedrich Wilhelm	Conflictual „synthesis out of dialectic discourse“