Establishing Green Industries

Examples from Europe

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Typhoid Mortality in Berlin 1854-1890

Typhus as a cause of mortality in %

1854 1856 1858 1860 1862 1864 1866 1868 1870 1872 1874 1876 1878 1880 1882 1884 1886 1888 1890

Source: Hösel 1987
The carrying capacity of the planet is limited
Climate change as a driver for new products

Electric Tesla Car

top speed: 200 km/h, acceleration: 0-100 km/h in 3.9 sec.
(relative) fuel consumption < 2 liter /100 km, range: 350 km
Resource conservation as a driver for new products

Plastic recycling -> Tiles made from plastic waste
Three directions for „Green“ Industries

1. Green manufacturing:
   • Pollution control
   • Waste prevention

2. Green products:
   • Vehicles
   • Energy
   • Materials
   • Buildings

3. Industrial symbiosis
Development of MSW incineration 1900 - 2000

1896

1970

1990
Reduction of MSW incineration emissions 1930 - 1995

changes since 1930 in %

- NO$_x$
- SO$_x$
- HCl
- Hg
- dioxins
- Cd
- Pb
- dust

1930 (=100 %) 1970 1995
Air pollution control systems are export hit for Austria

Quelle: SGP-VA
Green production results in very low waste (Ex. Zinc plating)

Source: W. Enöckl, 1994

Most waste is recycled
Products as major emission sources: Ex. Cadmium

production related Cd flows

Consumer related Cd flows

Quelle: Bergbäck, 1992
Three challenges for „Green“ Industries

1. Green manufacturing:
   • Pollution control
   • Waste prevention

2. Green products:
   • Vehicles
   • Energy
   • Materials
   • Buildings
   • Systems

3. Industrial symbiosis
Electric vehicles, the next revolution

Electric Tesla Car: twice as efficient as a Toyota Prius (5 x more expensive!)

![Well-to-Wheel Energy Efficiency Graph]
Energy from biomass

- solar energy
- electrons

<table>
<thead>
<tr>
<th>sun -&gt; electron</th>
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- biomass
- harvest transport
- pre-treatment
- incineration
- heat-exchange
- turbine
- generator
- grid
Solar energy utilization

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<tr>
<td>photovoltaic cells</td>
<td>80 m²/capita</td>
<td>0 kg/c.year</td>
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</table>

PV cell utilization
Utilization of waste derived fuels in cement kilns
Production of fuel from plastic wastes for cement kilns
Feeding wastes to cement kilns
Glas recycling in Switzerland 2000 -> new products!

System Boundary "Switzerland"
Buildings as the main consumers of energy and materials

- Transportation: 27%
- Industry: 25%
- Buildings: 48%
Green buildings = zero energy consumption buildings

Ijsselstein Housing
Beyond green buildings: „productive“ buildings
Buildings are resource stocks of the future
Huge potential for improvement in view of RM
Productive buildings provide space, energy, and food
Green facades to produce food and adjust temperature
Area needed to supply electricity and food to NYC
No-mix toilets to recycle nutrients
Wind turbines and PV cells on the 2020 Tower
The 2020 Tower, a sustainable building?
Vision of „Güssing“: energy and chemicals from biomass

Product
- Producer Gas (gas engine, gas turbine, fuel cell)
- Synthetic Natural Gas (SNG)
- FT-Fuels (FT-Diesel)
- Methanol
- Hydrogen
- Others

Experience
- 30,000 hours of operation on gas engine
- 1 MW SNG production under construction
- Laboratory scale FT unit in operation
- No ongoing project
- AER-gas concept, but no upgrading to pure hydrogen
Thank you