CO_2-Emissions of the Traffic Sector: Technical and Economical Conditions for Political Actions

The Board of Academic Advisers to the Federal Minister of Transport, Building and Housing

Prof. Dr. Volker Schindler (TU Berlin)

- In Europe traffic contributes about a quarter to total anthropogenic CO_2-emissions.
- Most prominent emitters are passenger cars.
- Growth is expected in **road haulage** and **air traffic**.
- Emissions from **seagoing vessels** also give cause for concerns.

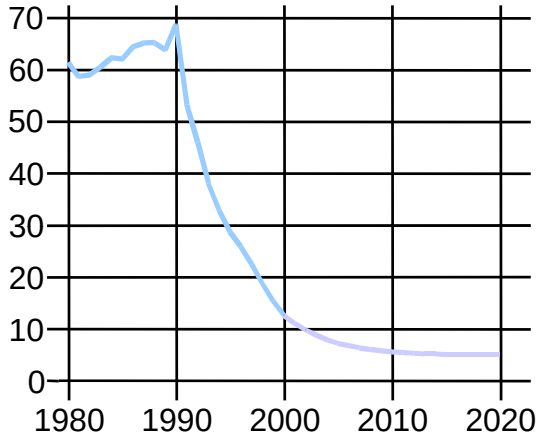
Energy use in road vehicles causes undesirable side effects:

- Local effects of emissions
  - CO, HC, NOx, SO_2, Pb, …
  - particles
  - (noise)
- Global effects of emission
- Finiteness of fossil resources
- Political disposability of fossil resources

Trends in tail pipe emissions in Germany

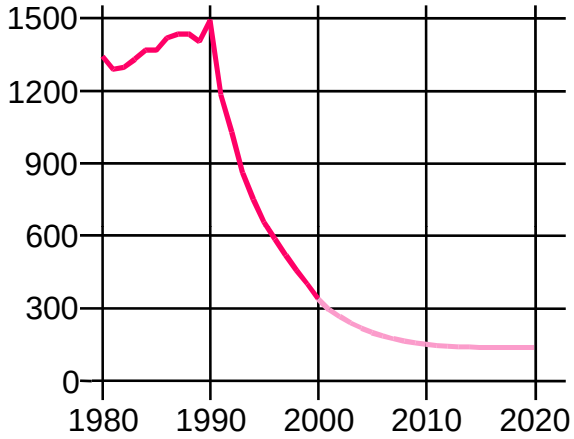
Benzol

Benzol-Emissionen [kt/a]



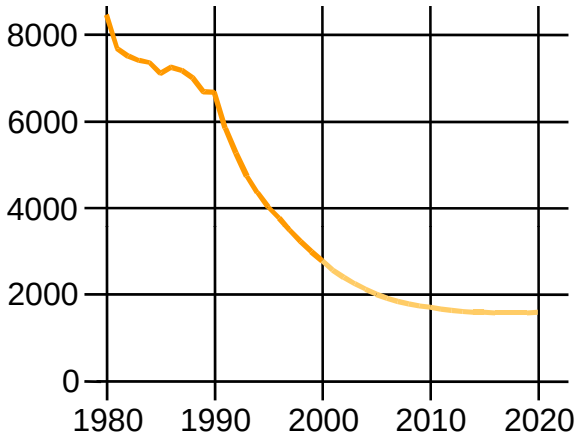
Kohlenwasserstoffe

Kohlenwasserstoff-Emissionen [kt/a]



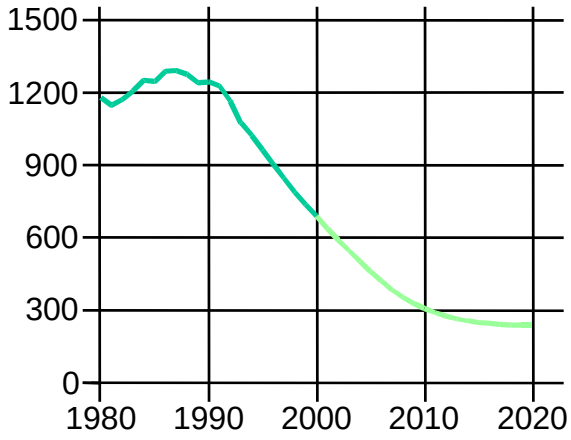
Kohlenmonoxid

Kohlenmonoxid-Emissionen [kt/a]



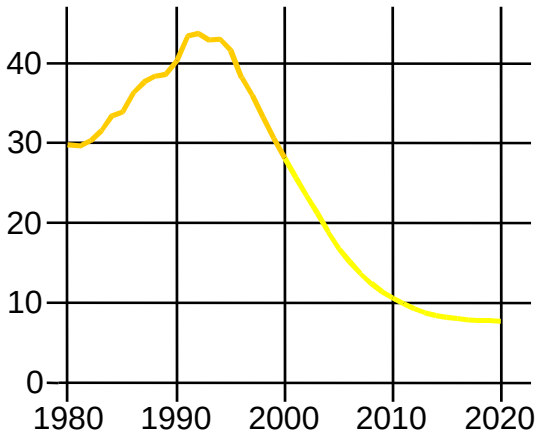
Stickoxide

Stickoxid-Emissionen [kt/a]



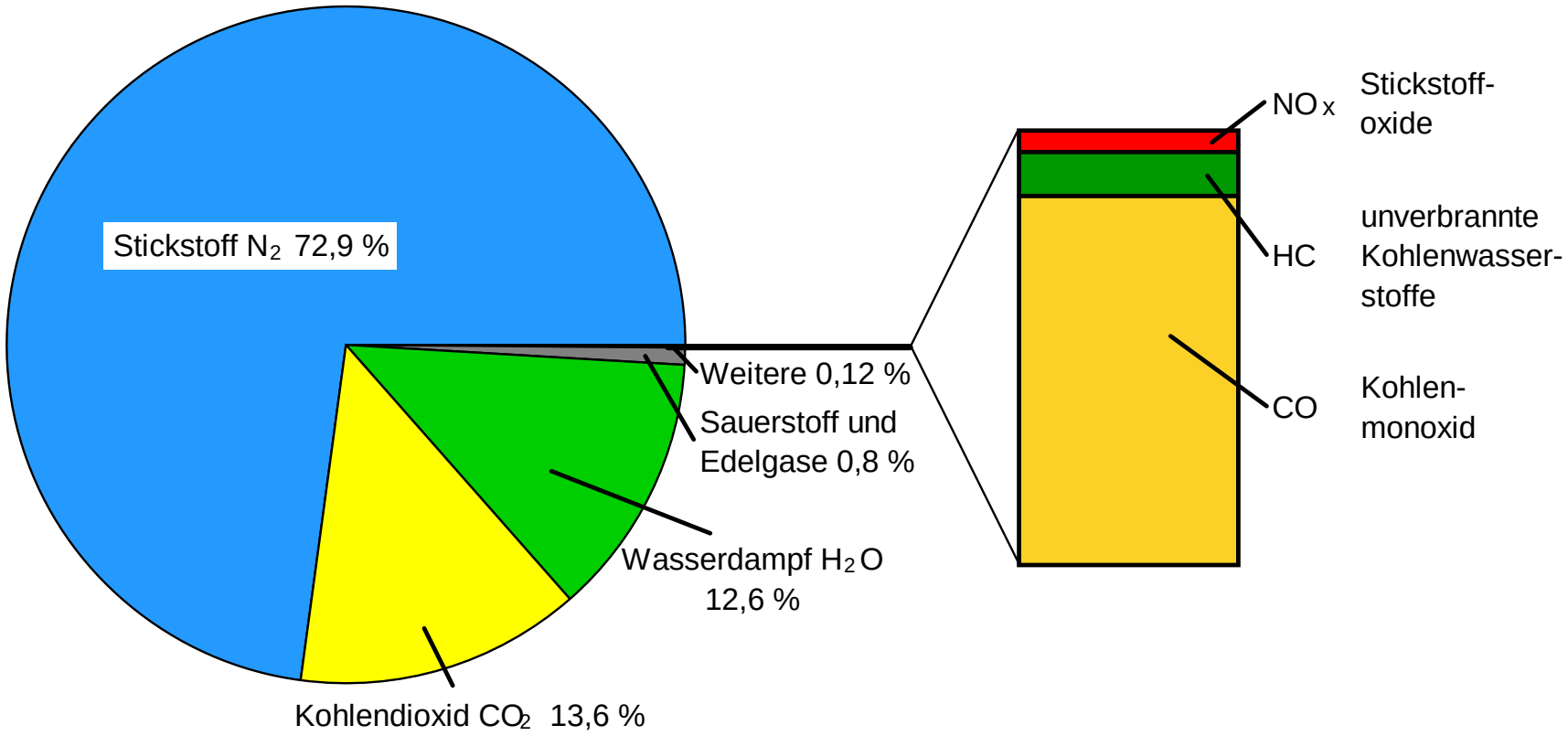
Dieselpartikel

Partikel-Emissionen [kt/a]



Quelle:
IFEU im Auftrag des UBA

Break down of emissions from the tail pipe of a gasoline car (Euro II)



5030801.1

What has been acchieved?

CO	✓	Combustion process, Exhaust gas after treatment
Pb - lead	✓	Abdication of Pb in fuels
SO_2	✓	Desulfurisation of fuels
NOx	✓	Gasoline engines with closed-loop 3-way catalys, Diesel engines with refined combustion process SCR in heavy commercial vehicles
Ozone-percursors	✓	Refinements in fuel composition, Exhaust gas after treatment
Benzene	✓	Partial abdication of benzene in fuels, Exhaust gas after treatment
CO_2		Reduction of specific and absolute fuel consumption Non-fossil fuels
Fine Particles	(✓)	Combustion process, Diesel particulate filter, improved fuels

What can be done?

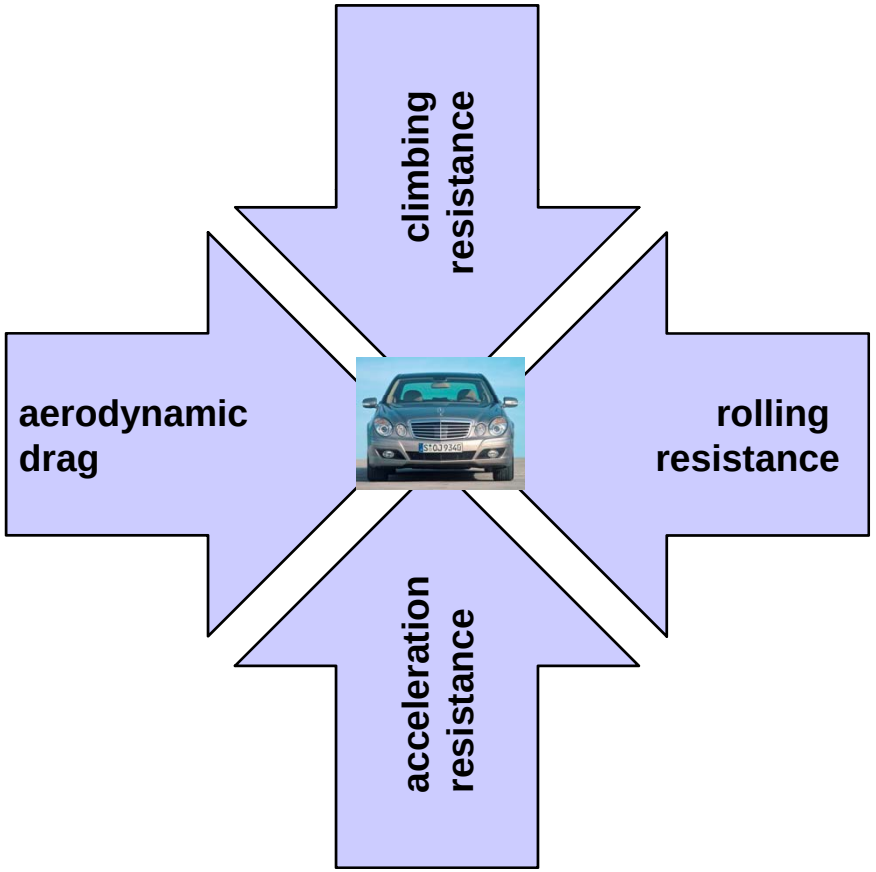
- Less road transport:
  - → life styles, land use and spatial structure, division of labour, logistics, …
- More efficient use of vehicles:
  - → driver training, driver assistance systems
- Use of more efficient vehicles:
  - → vehicle and drive train technologies, fuel technologies, …
- Usage of smaller and less consuming vehicles:
  - → live styles, vehicle and drive train technologies, safety in mixed traffic, industry, policies, …
- Fuels based on material and energy poor in fossil carbon:
  - → energy technologies and energy economy, agriculture, land use, vehicle and drive train technologies,
- Policy:
  - → Creation of an appropriate economic framework: taxes, road pricing, administrative rules were necessary: minimal standards, …. long term reliability

What can be done?

- Less road transport:
  - → life styles, land use and spatial structure, division of labour, logistics, …
- More efficient use of vehicles:
  - → driver training, driver assistance systems
- Use of more efficient vehicles:
  - → vehicle and drive train technologies, fuel technologies, …
- Usage of smaller and less consuming vehicles:
  - → live styles, vehicle and drive train technologies, safety in mixed traffic, industry, policies, …
- Fuels based on material and energy poor in fossil carbon:
  - → energy technologies and energy economy, agriculture, land use, vehicle and drive train technologies,
- Policy:
  - → Creation of an appropriate economic framework: taxes, road pricing, administrative rules were necessary: minimal standards, …. long term reliability

What determines mileage?

Vehicle physics



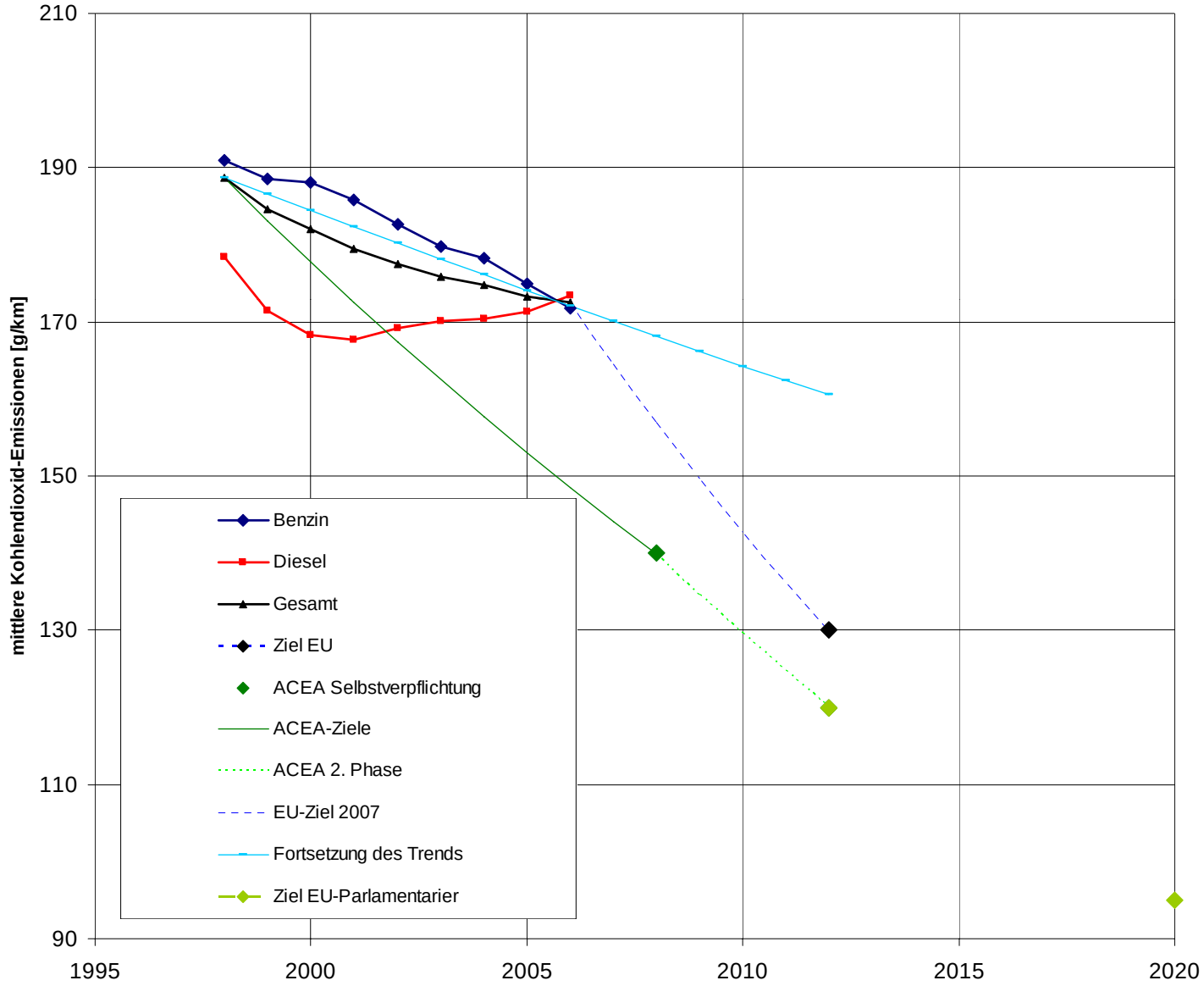
- Consumption of auxilliaries
- Efficiency of on-board energy conversion

- For a given technical means an increase in mileage is rarely more than a few percent.
- Costs become a serious issue: All low hanging fruits already have been reaped.

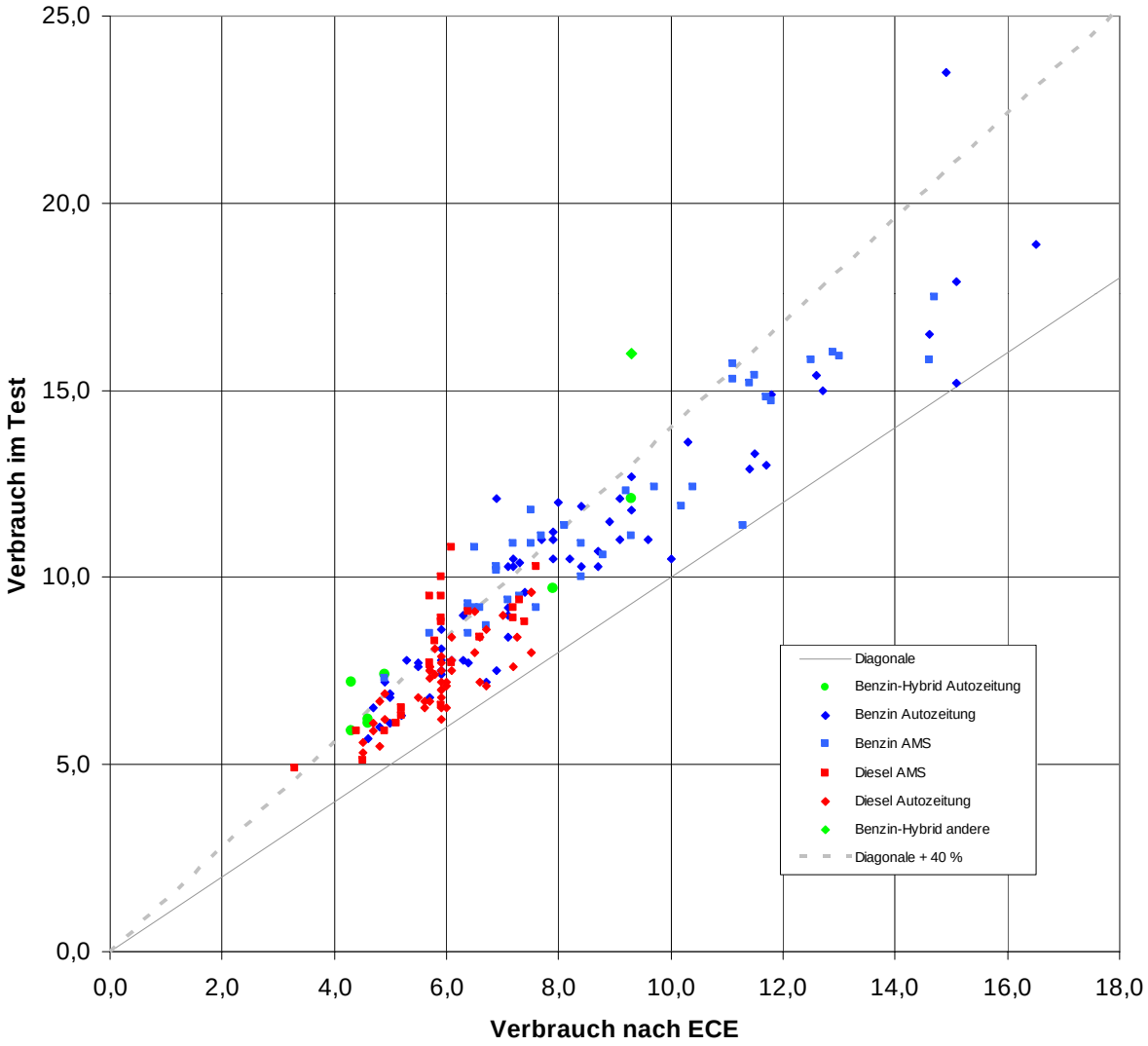
Where are the limits of mileage?

65 g/km

Specific CO_2-emission of the German new car fleet



What does ECE-fuel consumption say about real mileage ?



Ruling based on test procedures inevitably becomes an objective of engineering optimisation.

Real life effectiveness can very much be questioned.

Intermediate result:

- It is possible to increase mileage by a considerable amount.
- This requires quite expensive technologies
  and/or
  a switch to smaller cars.
- Timing has to be agreed realistically.

What else can be done?

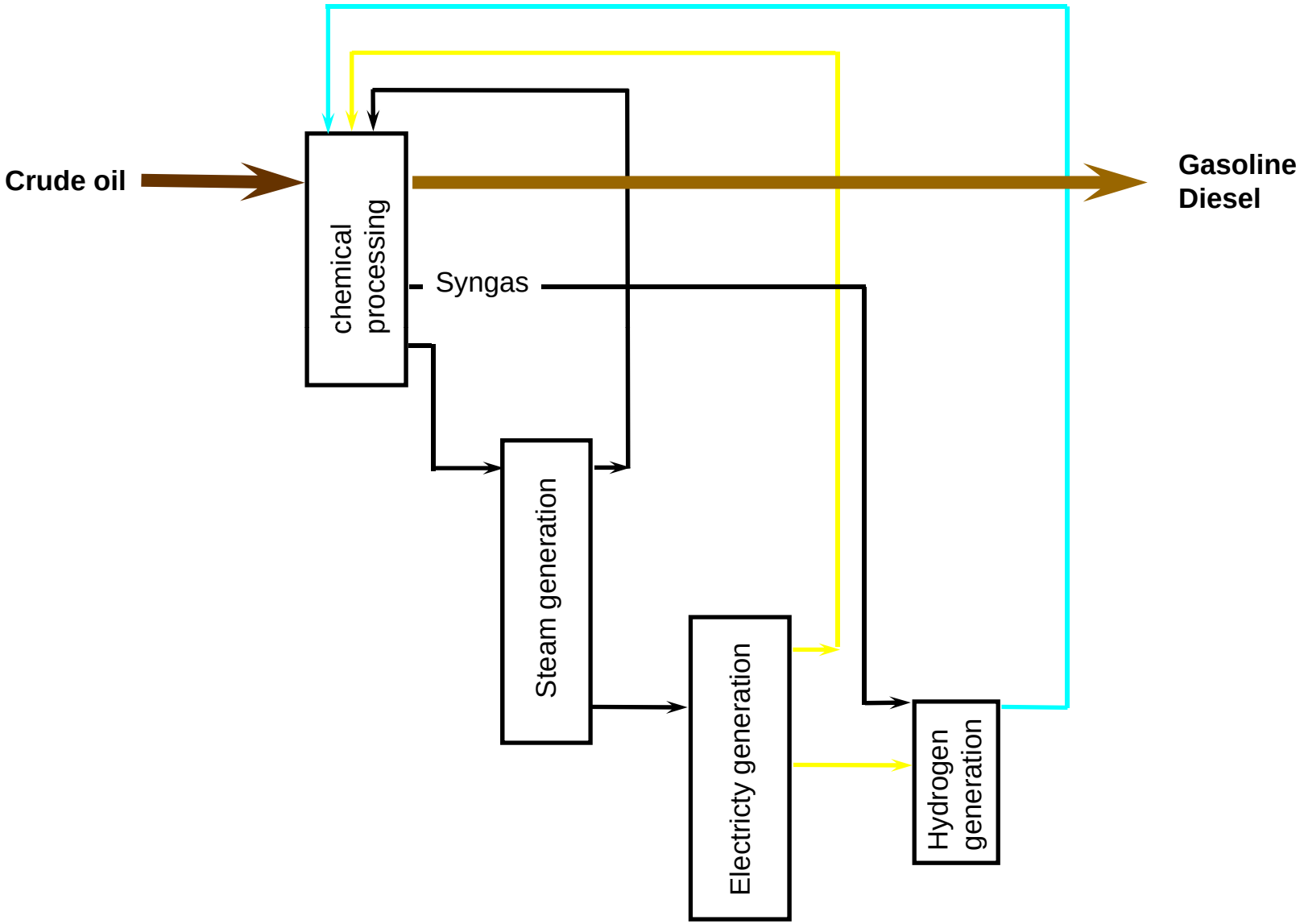
- Less road transport:
  → life styles, land use and spatial structure, division of labour, logistics, …
- More efficient use of vehicles:
  → driver training, driver assistance systems
- Use of more efficient vehicles:
  → vehicle and drive train technologies, fuel technologies, …
- Usage of smaller and less consuming vehicles:
  → live styles, vehicle and drive train technologies, safety in mixed traffic, industry, policies, …
- Fuels based on material and energy poor in fossil carbon:
  → energy technologies and energy economy, agriculture, land use, vehicle and drive train technologies,
- Policy:
  → Creation of an appropriate economic framework: taxes, road pricing, administrative rules were necessary: minimal standards, ….
  long term reliability

- Gasoline and diesel as fuels offer a very well balanced trade-off of properties.
- Remaining deficits:
  1. Ex-engine emissions of harmful substances makes aftertreatment systems necessary.
  2. Doubts concerning long term availability of crude
  3. Greenhouse gas emissions

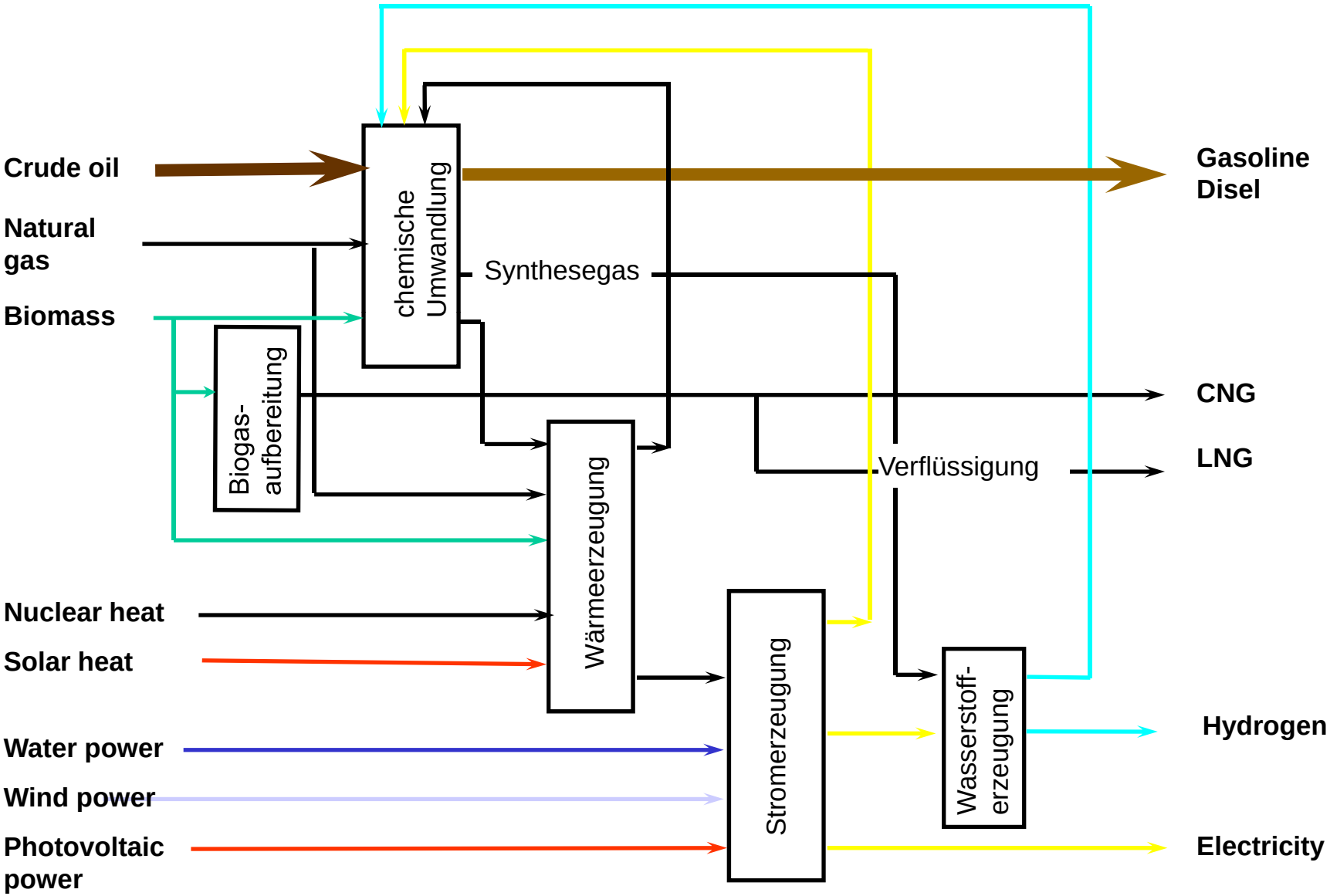
- Is it possible to retain their advantages and to avoid their problems?

Yes, in principle

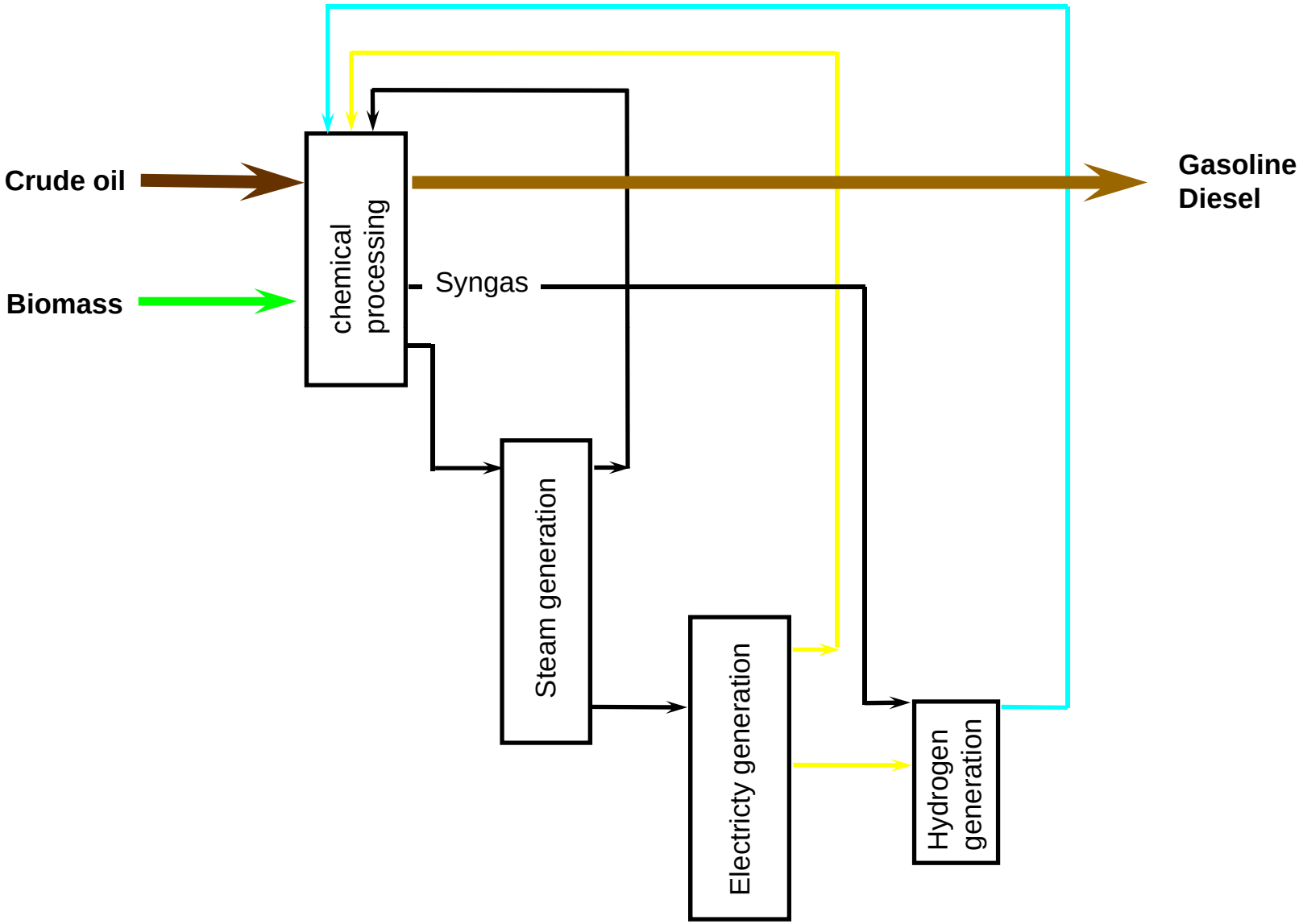
The refinery process in a nutshell



Fuel can be made from a lt of sources in principle …



A future refinery process ?



Intermediate result:

- A change to **another material and energy basis** for gasoline and diesel is possible in principle.

- An obvious choice is biomass.
- But:
  - It will become quite expensive.
  - We will have to restructure huge areas.
  - Adverse consequences to food production and to ecological objectives seem to be hardly avoidable.

What can be done?

- Less road transport:
  - → life styles, land use and spatial structure, division of labour, logistics, …
- More efficient use of vehicles:
  - → driver training, driver assistance systems
- Use of more efficient vehicles:
  - → vehicle and drive train technologies, fuel technologies, …
- Usage of smaller and less consuming vehicles:
  - → live styles, vehicle and drive train technologies, safety in mixed traffic, industry, policies, …
- Fuels based on material and energy poor in fossil carbon:
  - → energy technologies and energy economy, agriculture, land use, vehicle and drive train technologies,
- Policy:
  - → Creation of an appropriate economic framework: taxes, road pricing, administrative rules were necessary: minimal standards, ….
    long term reliability

What are we able to afford ?

Strecken-verbrauch	Kraftstoff	jährliche Fahrleistung	Gesamt-fahrleistung	Haltedauer	Gegenwartswert von 1l/100 km Minder-verbrauch
[l/100]		[km]	[km]	[a]	[€]
6	Benzin	11.000	121.000	11	1.457
8	Benzin	11.000	121.000	11	1.467
8	Diesel	11.000	121.000	11	1.334
10	Benzin	18.000	198.000	11	2.401
10	Diesel	18.000	198.000	11	2.182
12	Benzin	25.000	225.000	9	2.774
12	Diesel	25.000	225.000	9	2.522
20	Diesel	70.000	350.000	5	4.048
35	Diesel	125.000	750.000	6	8.623
35	Diesel	294.000	1.470.000	5	17.045

Should fuel taxes be increased further?

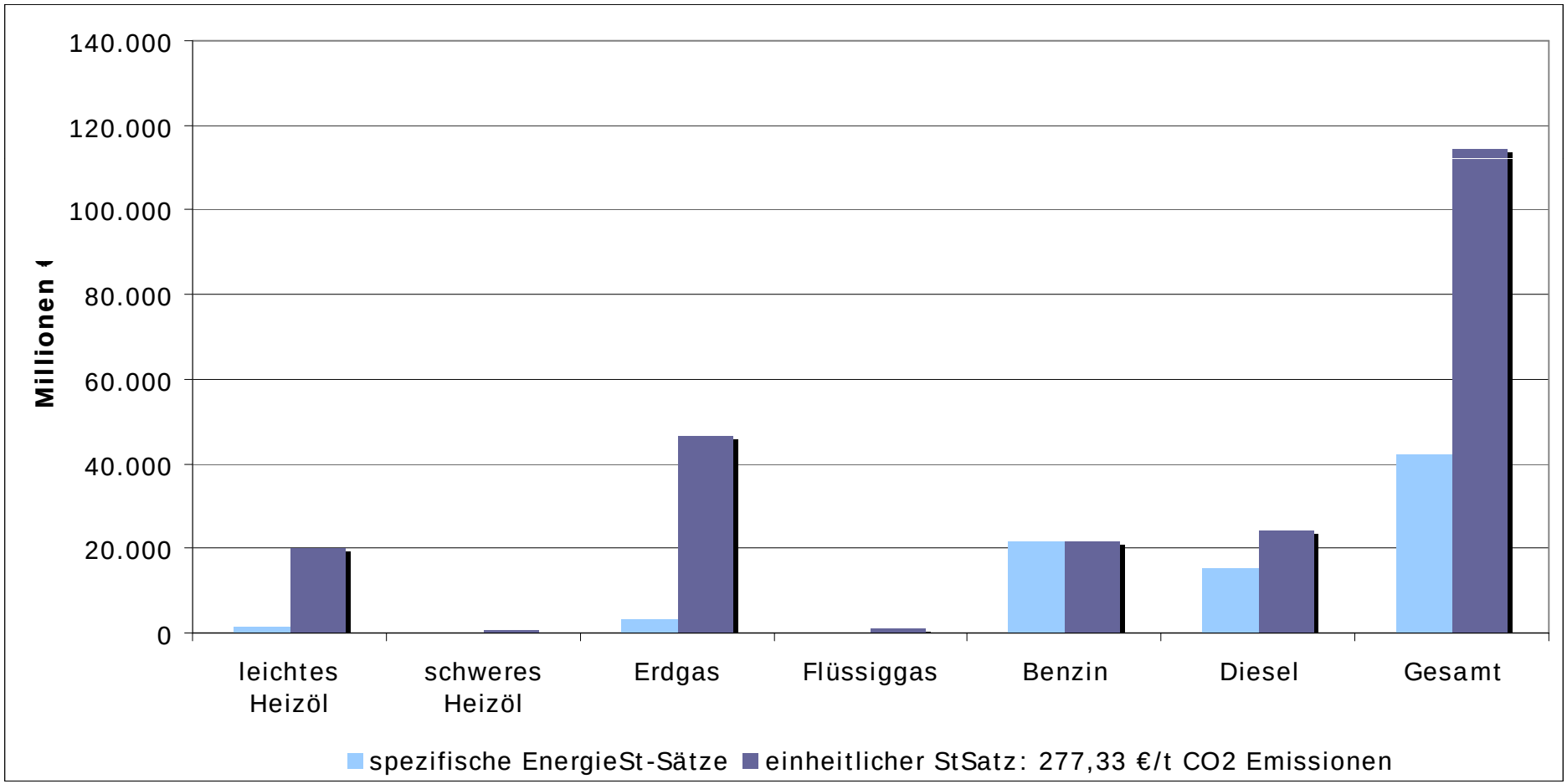
Yes, in principle.

But this would result in uneconomical usage of scarce resources!

Taxes on all usage of fossil carbon should be harmonised!

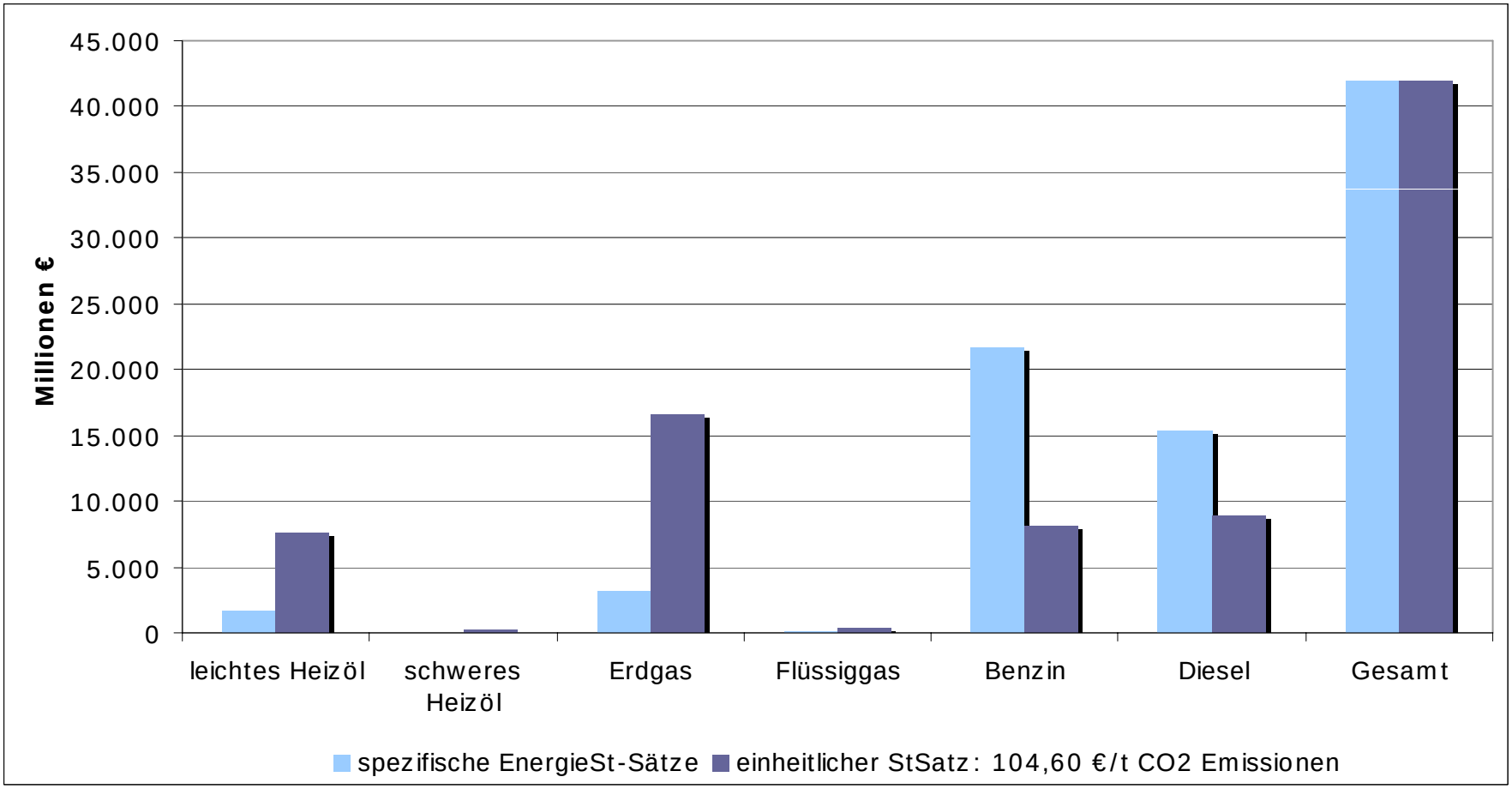
Intellectual Game:

All taxes on fuels at the current level for gasoline



Intellectual Game:

The sum of taxes on fuels unchanged, but adjusted to equal €/g CO_2



A rational policy should consider,

- to aim at an **equal level of taxation per used amount of fossil carbon** for all uses,
- to create a **coalition between car makers, car users , and policy** with the goal, to make energy users able and ready to invest in energy saving, but more expensive technology (e. g. cars) instead of paying high prices for fossil fuels.