Towards Sustainable Travel in Stockholm's Public Transport

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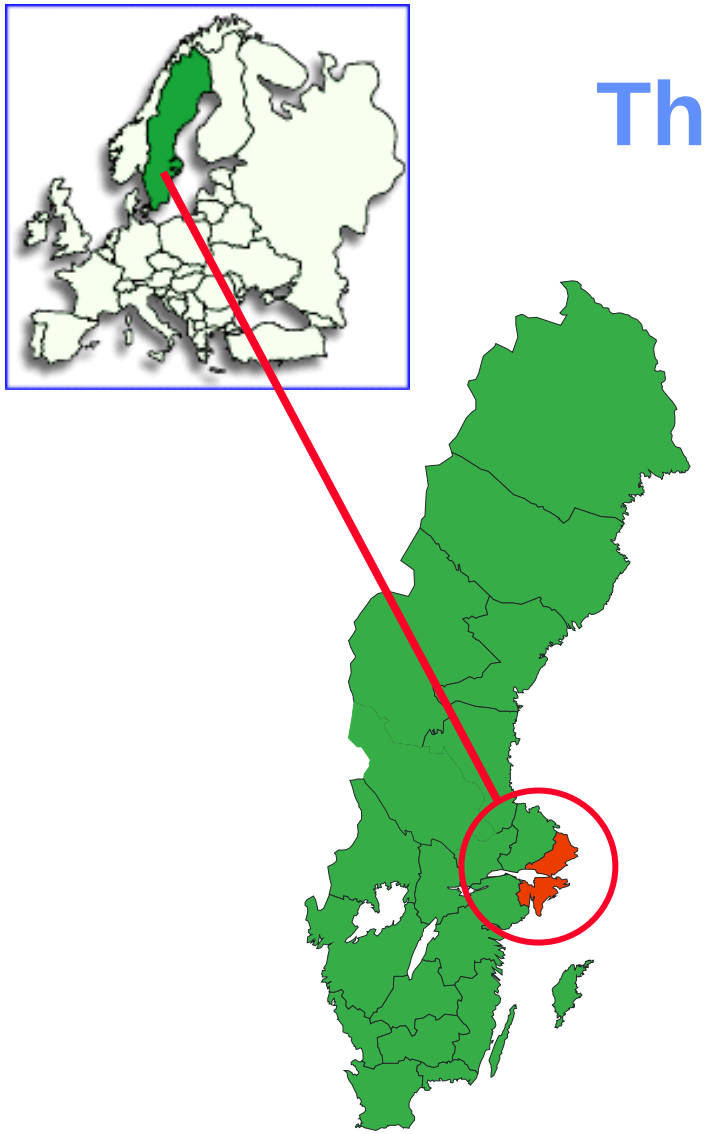
Today's menu

- Something about Stockholm and SL
- General Swedish policies and efforts regarding renewable fuels
- Why biofuels in Public Transport?
- 3 ways to tackle CO_2
- SL's work on renewable fuels
- Ethanol Bus Buyers' Consortium
- Questions and Discussion



The County of Stockholm

1.6 % of Sweden's total area

Population 1.9 million

Every fifth Swede lives here

Cars per thousand inhabitants

County of Stockholm: 402

Sweden: 459

Climate policies in EU/Sweden

- Kyoto: Industrialised countries should decrease emissions by on average 5 % until 2012 (of 1990 levels).
- EU members have agreed on an 8 % reduction until 2010.
- Division of emission burdens vary between countries – some are even allowed to increase emissions (e.g. Sweden)
- Sweden's national goal is a decrease with 4 % in 2012. (20 – 30 % 2020?)
- For transportation the EU directive (2003/30/EG) stipulates an increase in renewable fuels
  - 2 % 2005, 5.75 % in 2010, 10 % 2020.
  - Public transport specifically mentioned as an important forerunner

Tax Strategy for Alternative Fuels

CO_2-neutral fuels are exempt from both CO_2 tax and energy tax with effect from 2004 as part of a five-year programme.

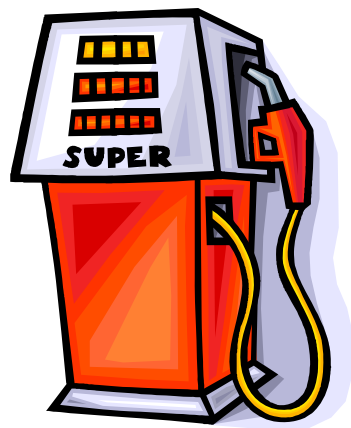
According to budget bill for 2006, biofuels will continue to have tax exemptions to ensure competetiveness.

Sticks…

According to legislation passed in December 2005, large filling stations will be obliged to market a biofuel alternative from April 1st 2006.

The obligation will be expanded to include all filling stations selling more than 1 000 m3 of conventional fuels by 2009.

An investment support for the filling station chosing to provide biogas will be made available.



…and carrots.

Reduced vehicle tax for green cars.

Reduction of benefit attributed to green cars for tax purposes to encourage the introduction of environment friendly company cars.

The environmental policy for government vehicles states that, from 2006, at least 75 procent of the cars bought by government agencies etc should be green cars. Cars with special requirements are exempted.

Taxi priority.

Free parking.

Congestion Charging…

Reduction of traffic to and from the city center by 20 to 25 percent

Times spent in traffic queues: Decrease by 30 to 50 percent

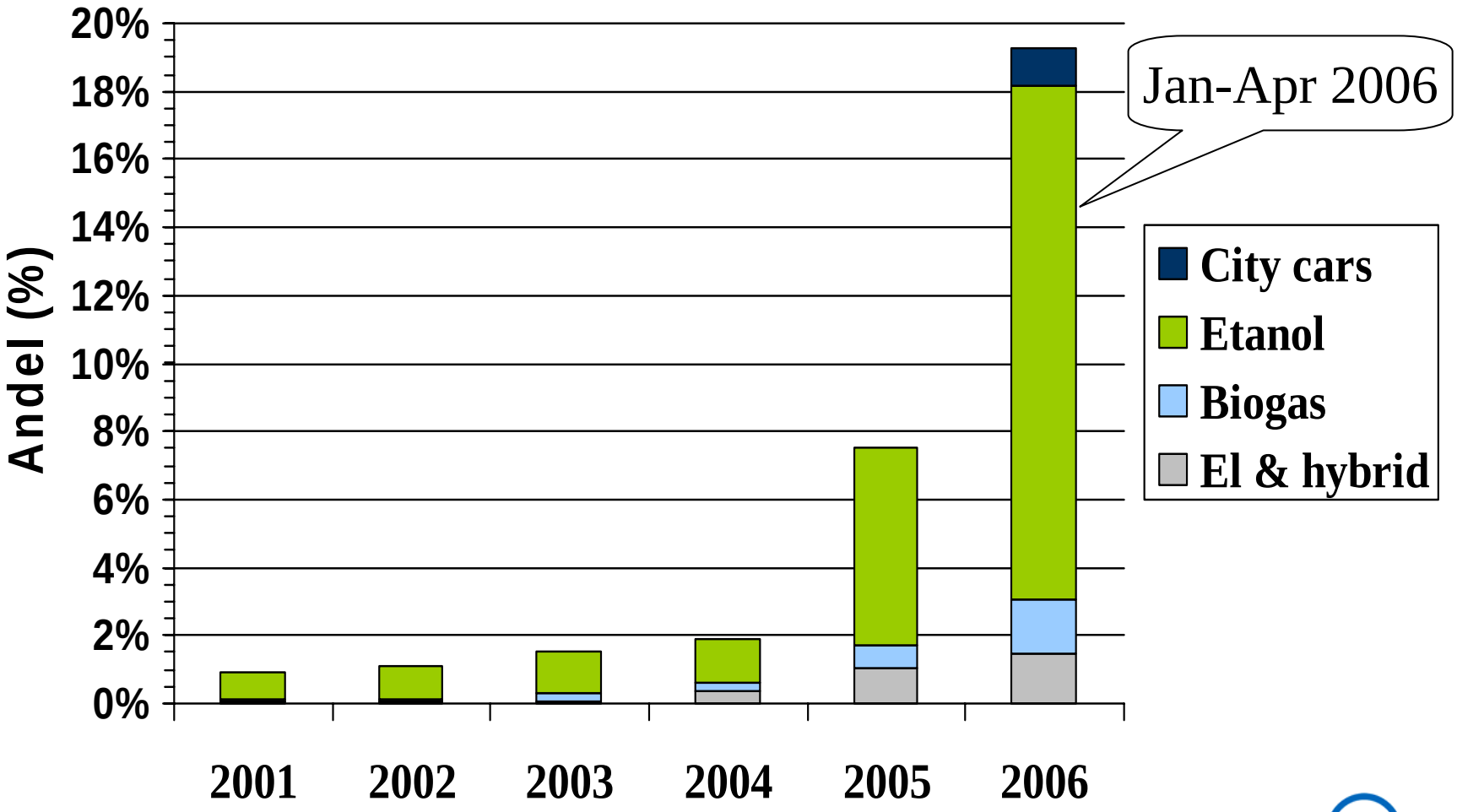
Emissions: Decrease by 14 percent in the city, and 2,5 percent in the county.

Green cars free of charge.

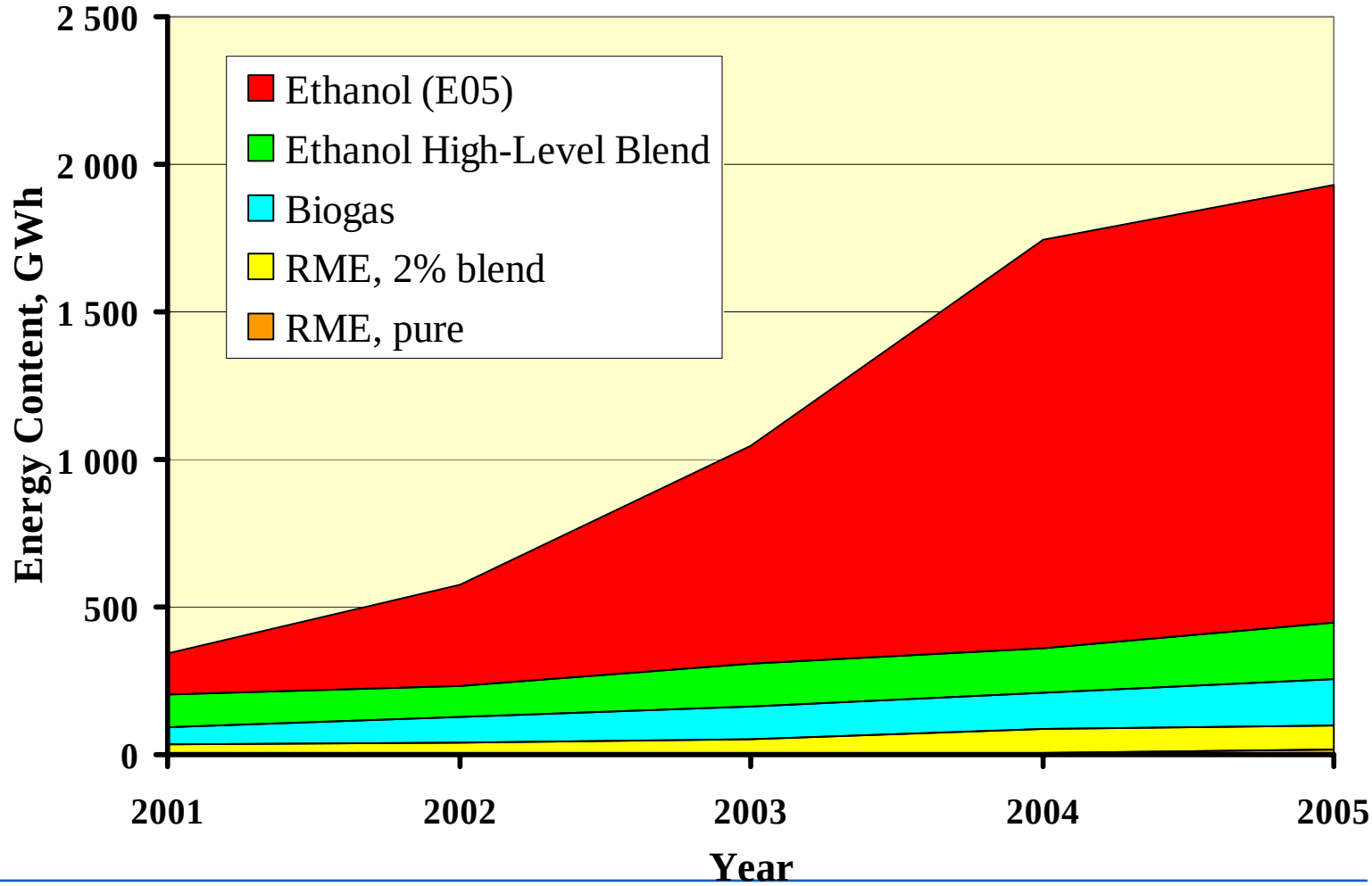
Increased travel with Public Transport

Higher fees during peak hours.

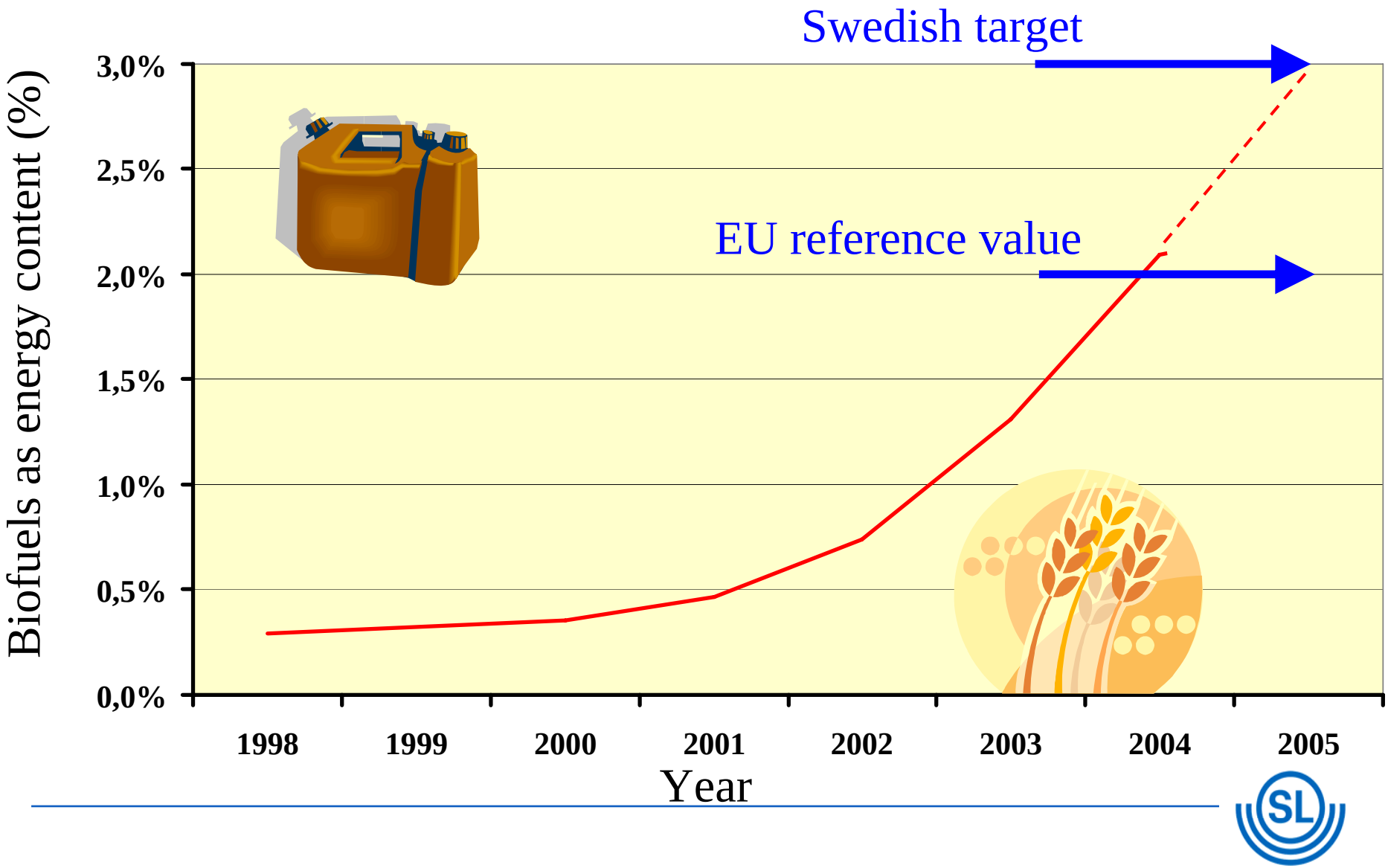
Sales of Clean vehicles in Stockholm 2001-2006



Biofuels per type …

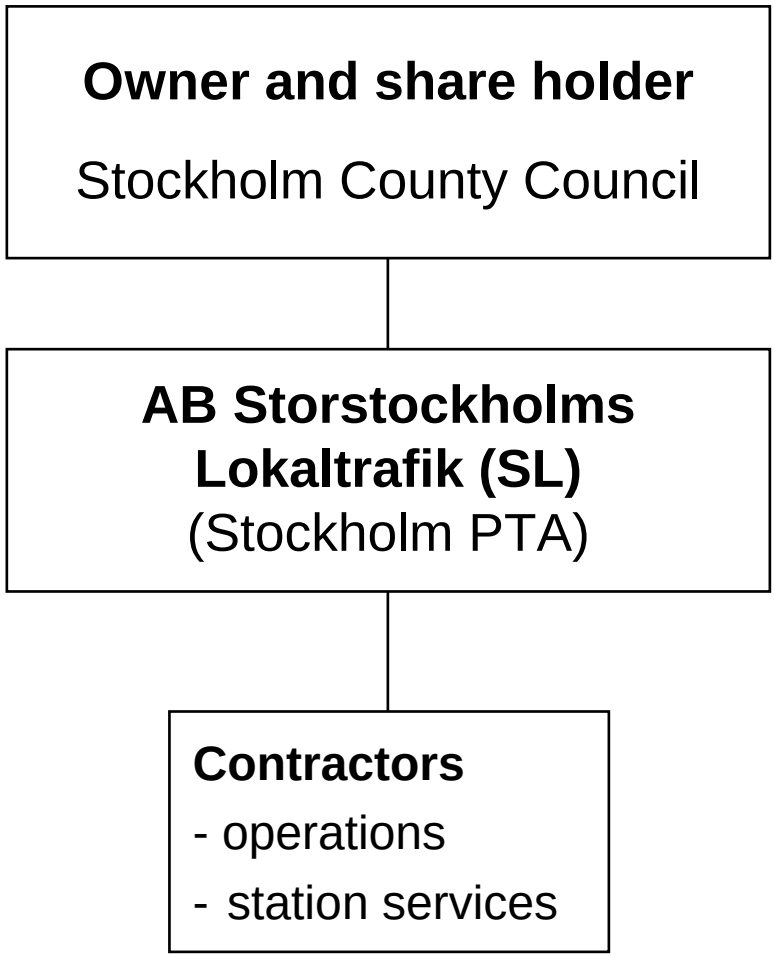


Share of Biofuels since 1998 …



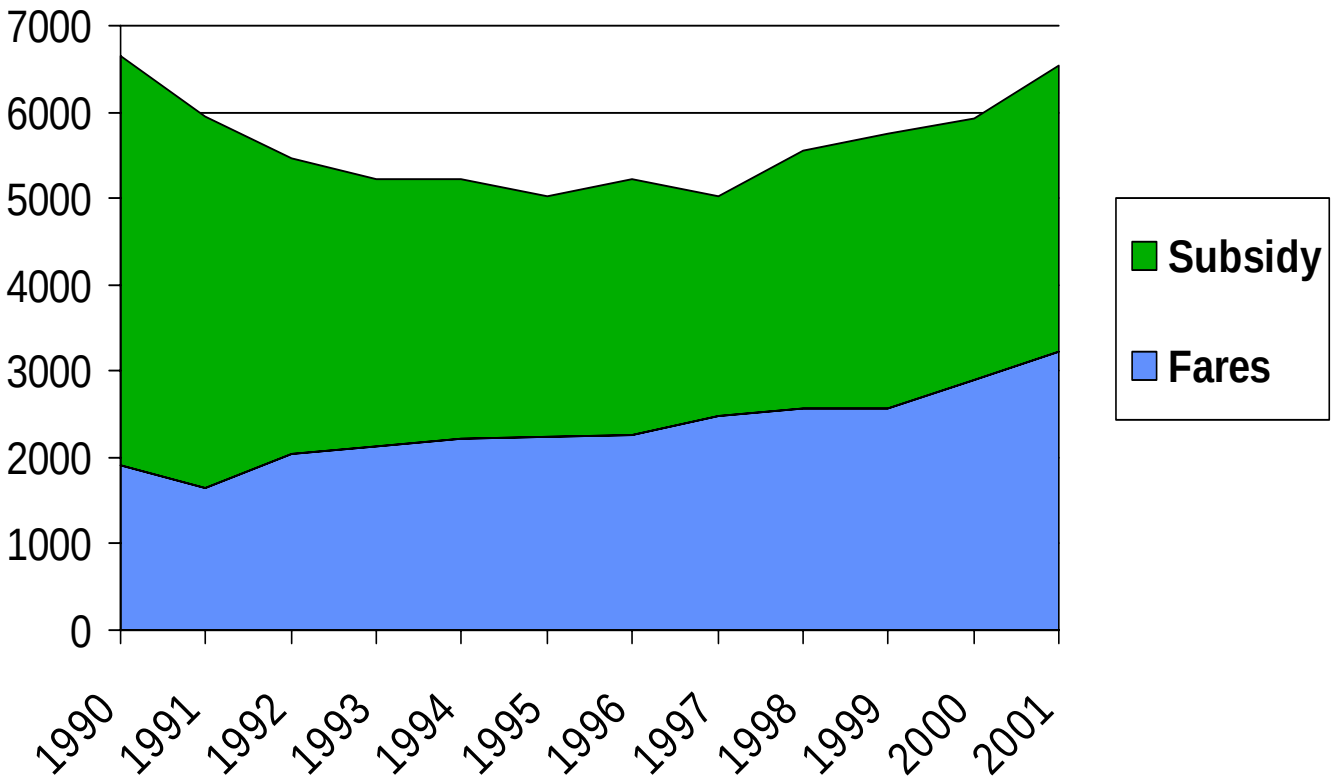
Stockholm Public Transport Authority (SL)

- ➔ Planning, Procurement and Follow-up of Public Transport in the County of Stockholm. Infrastructure management.
- ➔ Metro, Buses (2 000), Commuter trains, local trains, trams.
- ➔ 2,5 million trips/day, >70 % market share during peak hours.


Owner and share holder
Stockholm County Council
AB Storstockholms Lokaltrafik (SL)
(Stockholm PTA)
Contractors
- operations
- station services

Financing of public transport

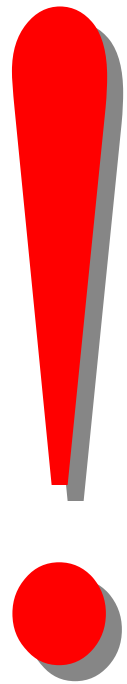
(MSEK, running prices)



Not only an Environmental problem!

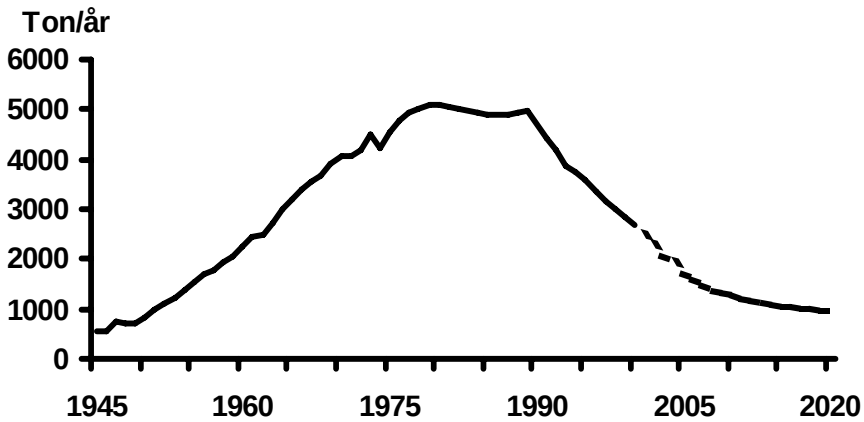
Oil dependency and CO_2 cause:

- ➔ **Environmental problems!**
- ➔ **Problems with security of supply!**
- ➔ **Financial problems!**

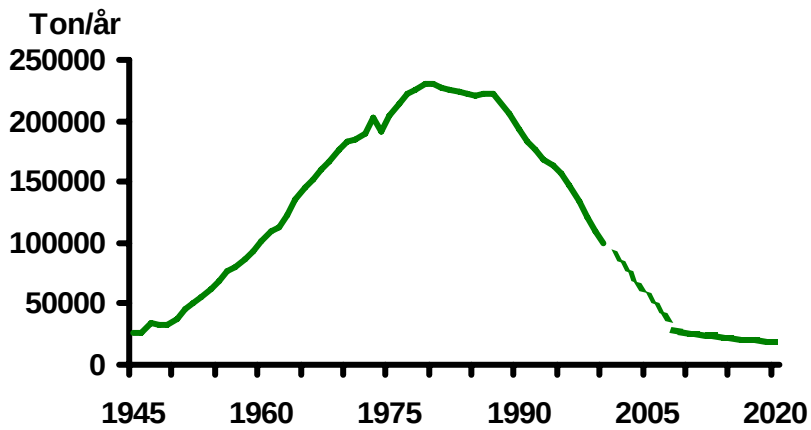


Local emissions - on the right track...

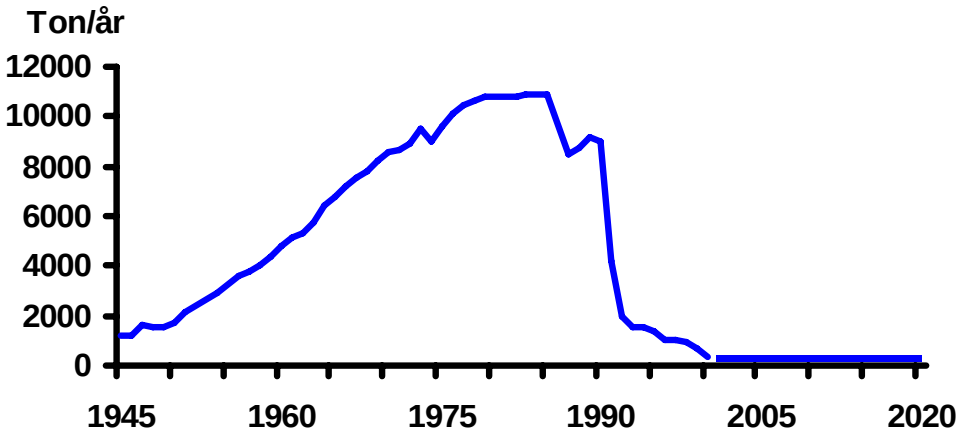
PM emissions from traffic, Sweden 1946-2020



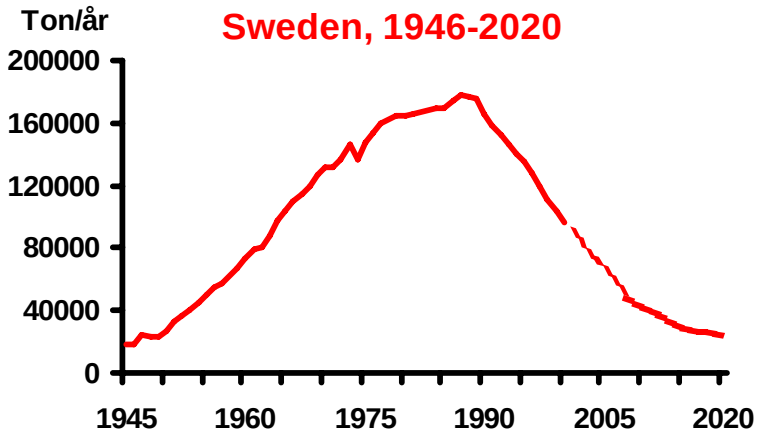
VOC-emissions from traffic, Sweden 1946-2020



SO_2-emissions from traffic, Sweden 1946-2020

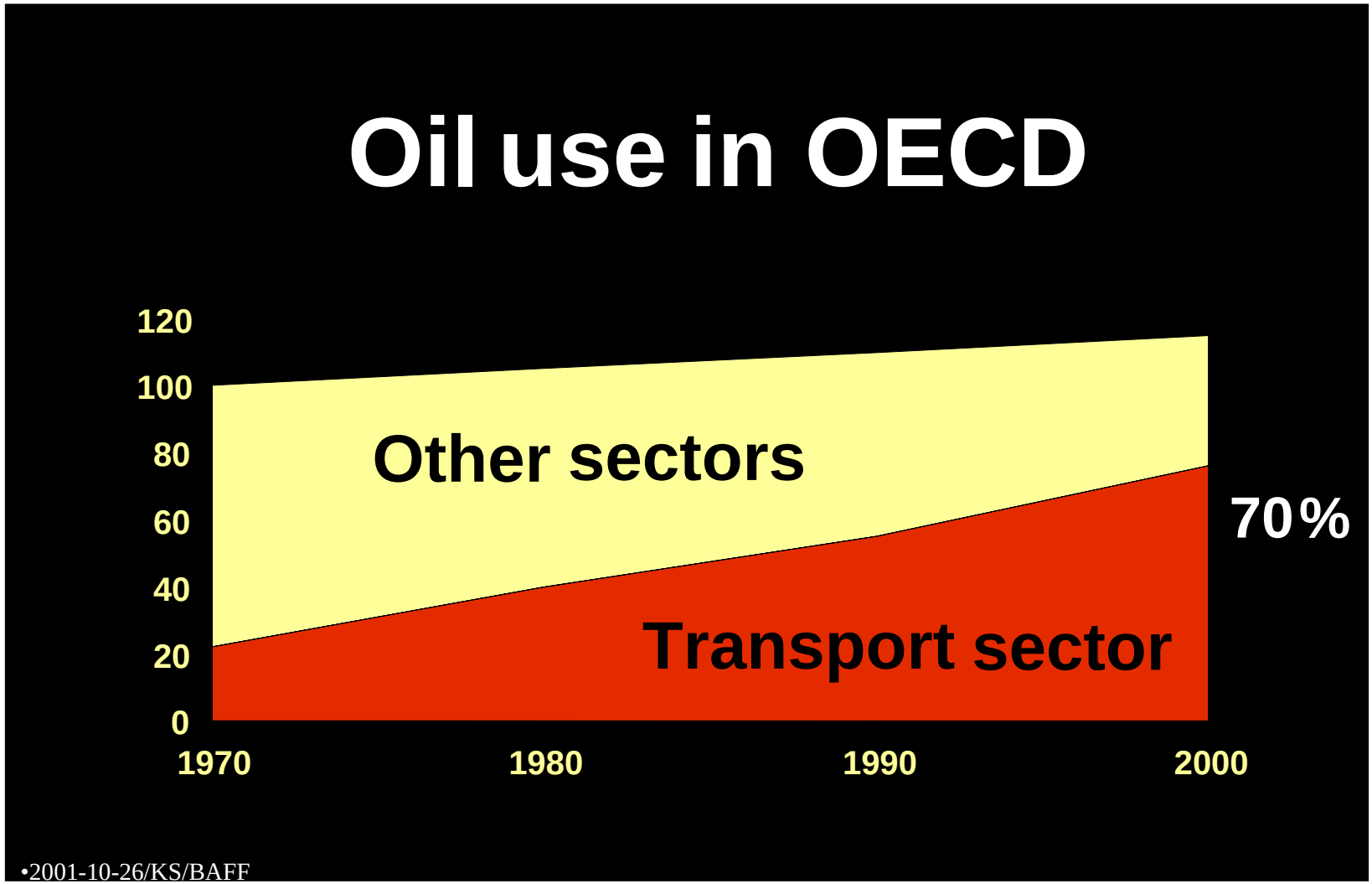


NO_x-emissions from traffic, Sweden, 1946-2020

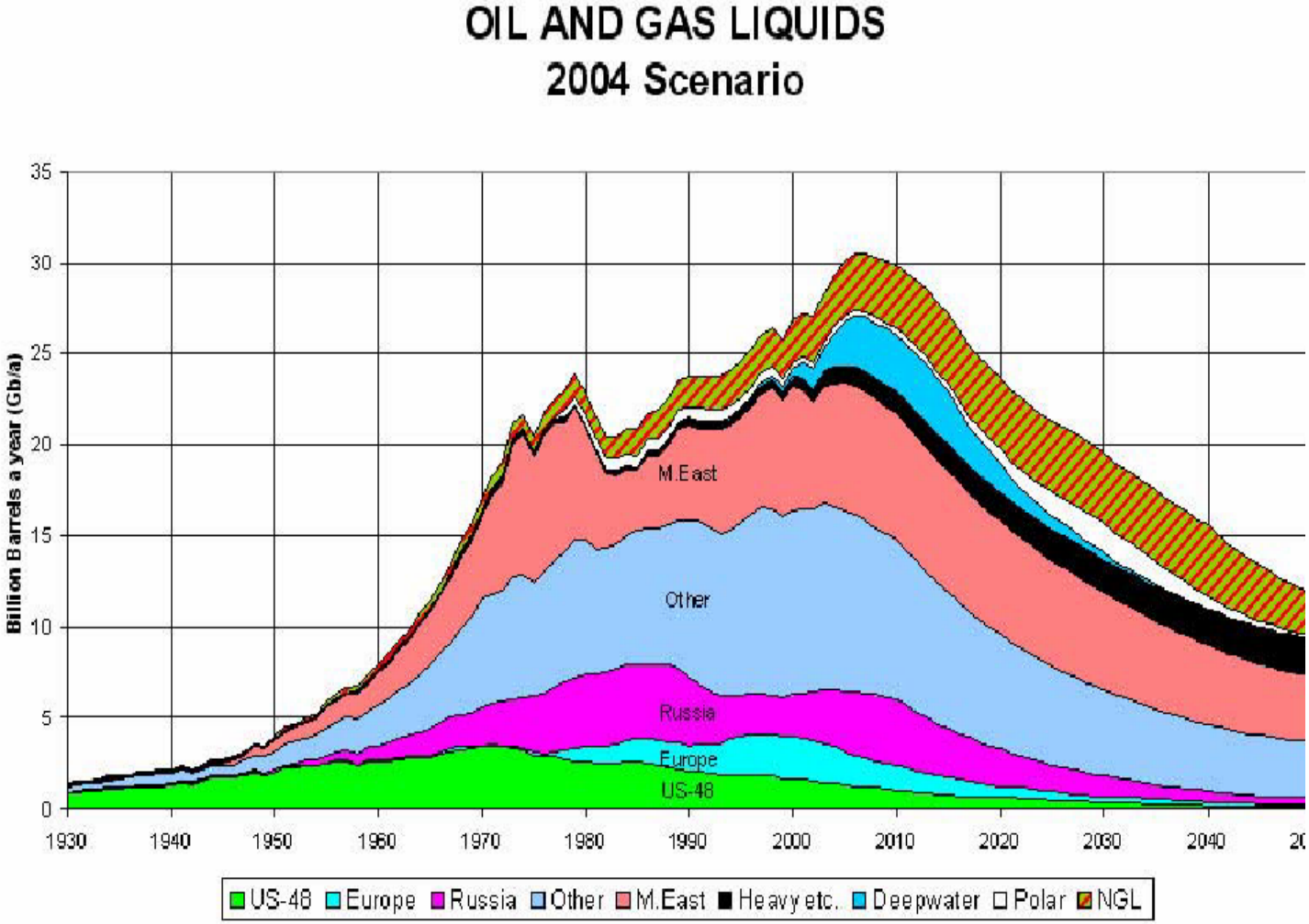


Källa: Vägverket och SPI
2000-03-16/UN1/BAFF

…but CO_2 is not!



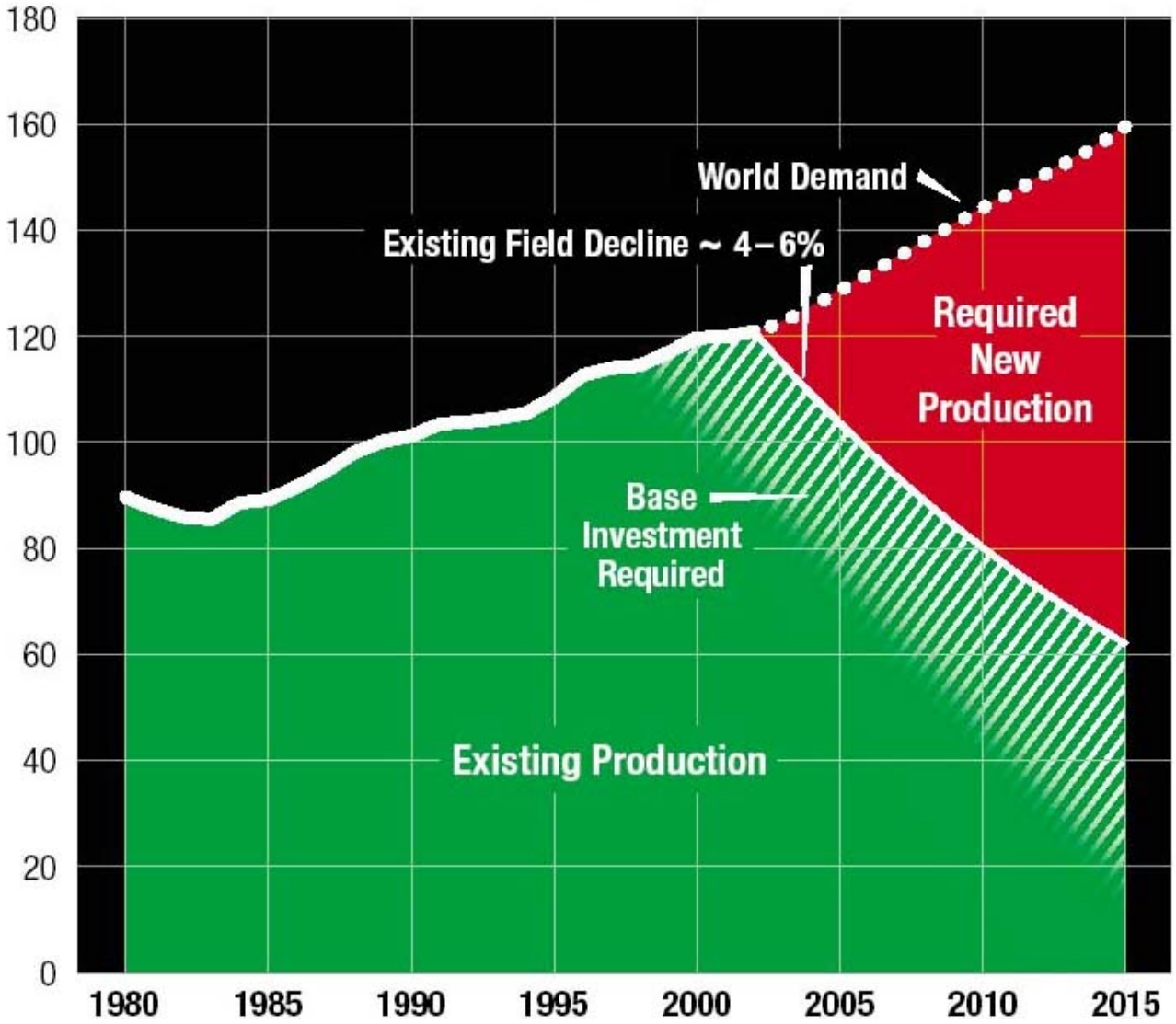
Oil and gas supply



ETHANOL BUS BUYERS´ CONSORTIUM

Supplying Oil and Gas Demand Will Require Major Investment

Millions of Barrels per Day of Oil Equivalent (MBDOE)

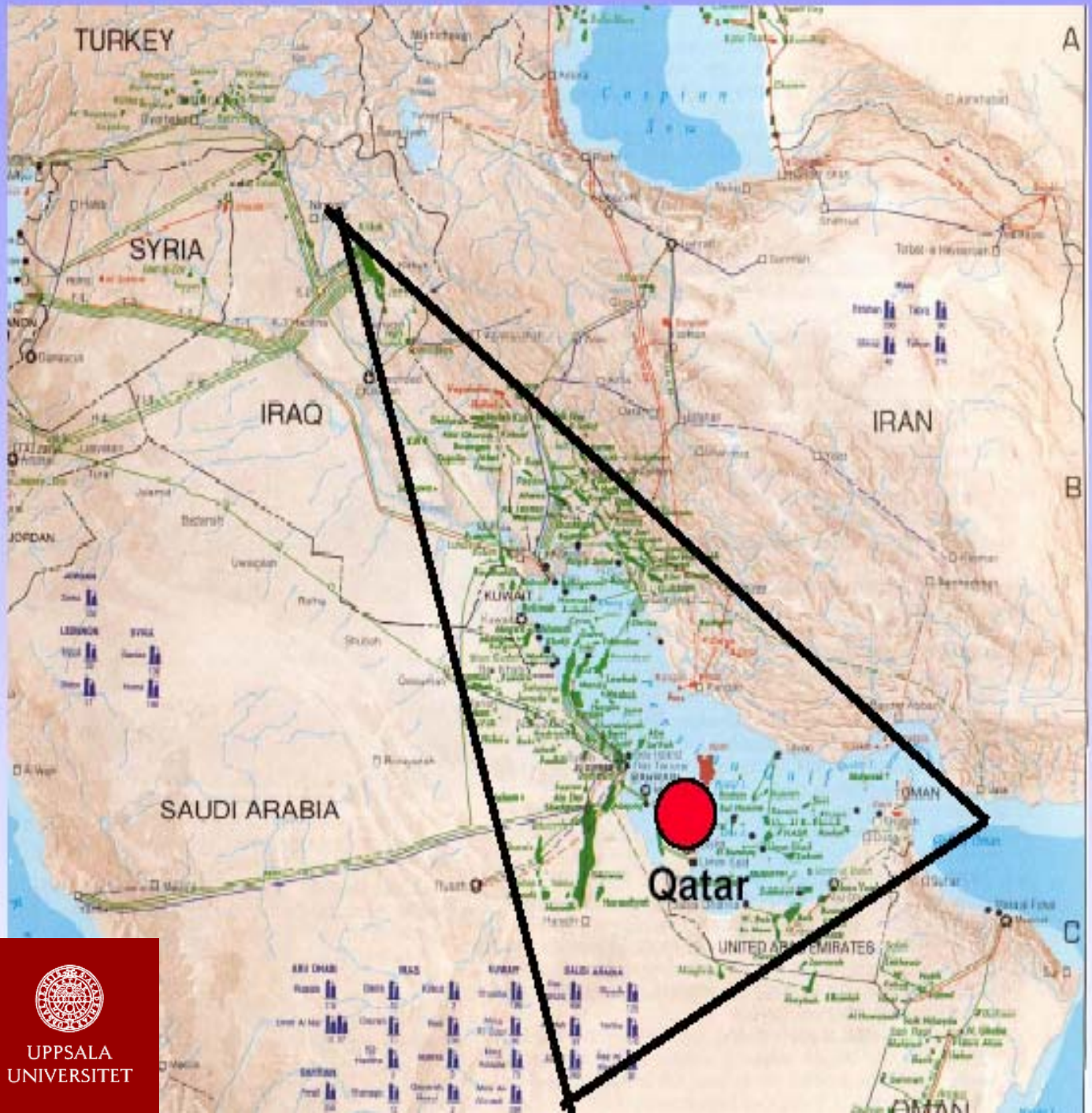


“The world needs new oil fields!”

ExxonMobil

“By 2025, we need to find, develop and produce a volume of “new” Oil & Gas that equals 8 out of every 10 barrels produced today.”

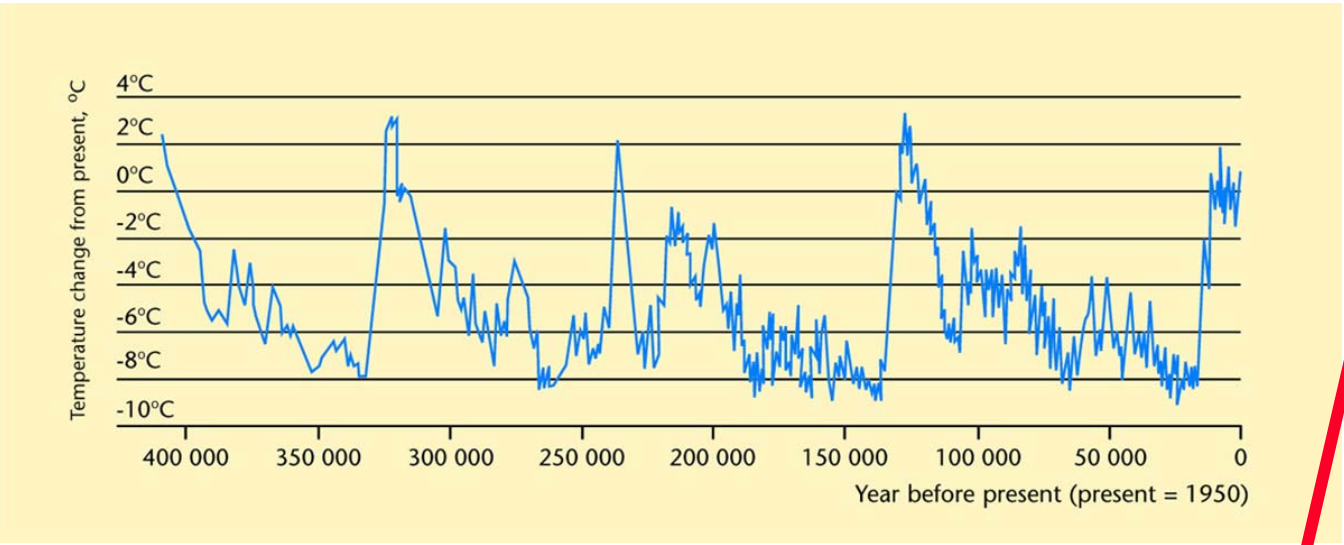
Source: Uppsala University 2004-06-16

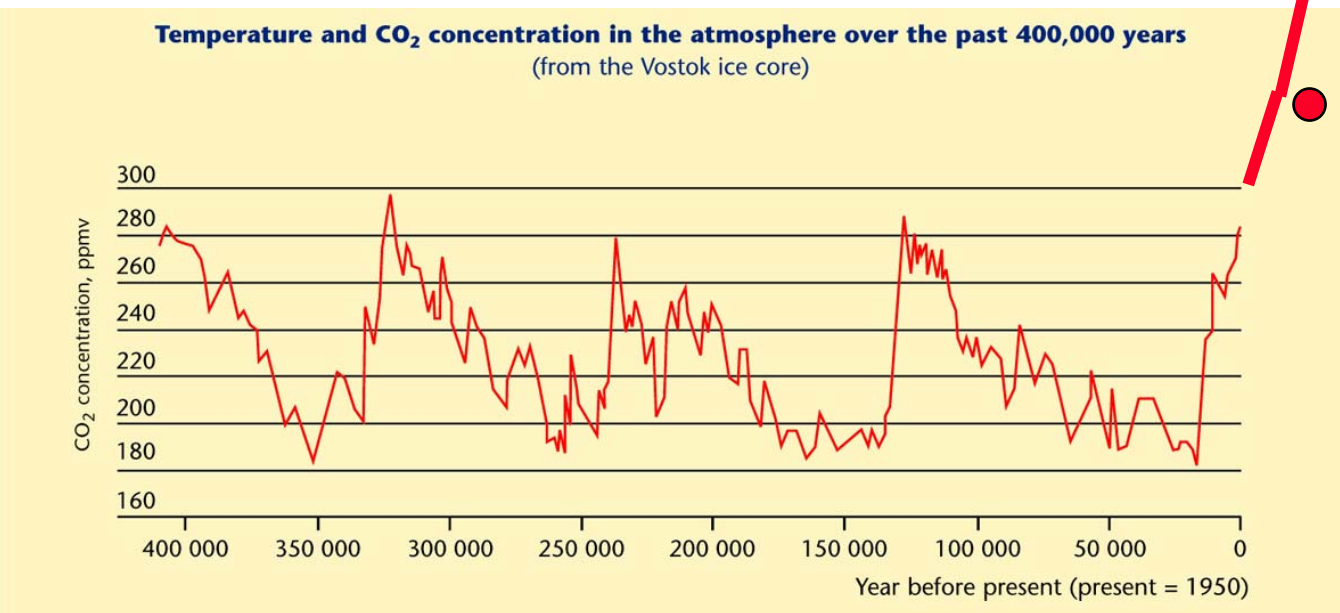


The Oil Triangle

Within the Oil Triangle you can find roughly 60 percent of the remaining oil reserves. The 2001 Cheney report says that in year 2020 around 54 to 67 percent of the world production of oil needs to come from the Oil Triangle. USA has moved their military head quarter from Riyadh to Qatar.

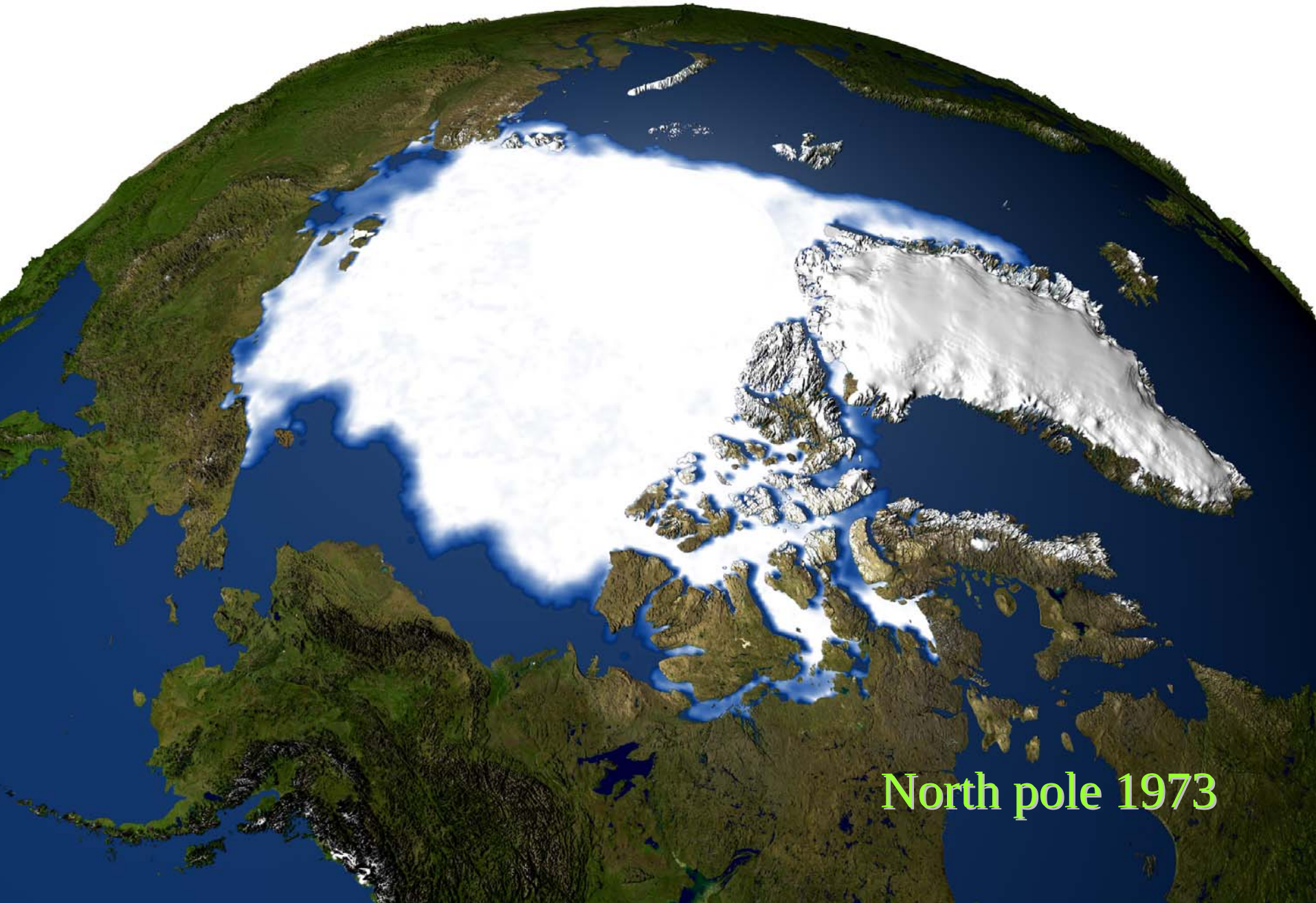
Interrelation of Atmospheric CO_2 - Temperature

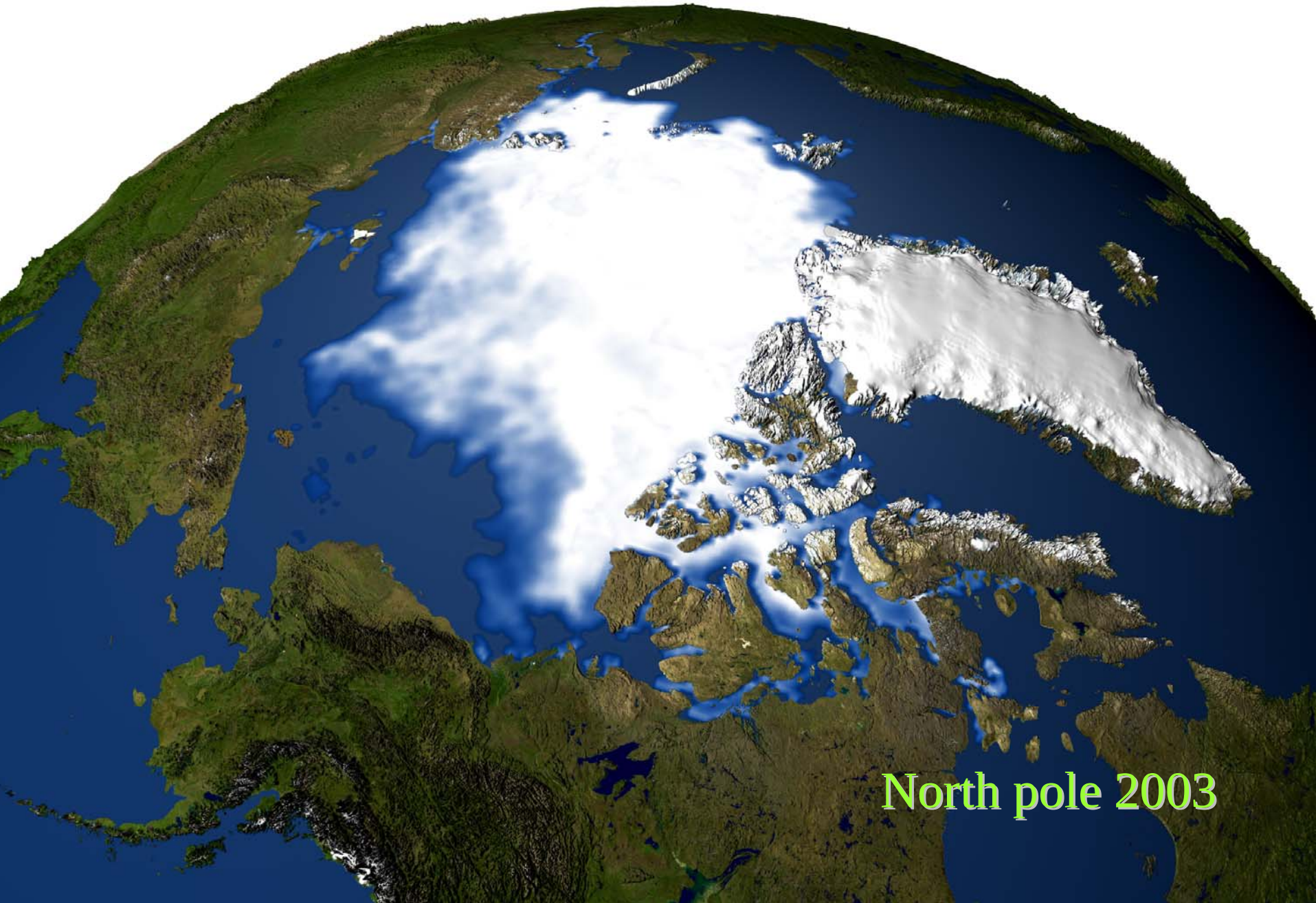




700 ppm (2100)

375 ppm (now)


North pole 1973


North pole 2003

Financial CO_2 problems

- Cost of emissions rights in industrial/energy sector is booming;
- Emission trading for transportation soon a fact.
- CO_2 taxes, km-taxes, etc;
- Scientists and oil industry agree that there will be a physical shortage of oil in the near future;
- Oil price likely to be sluggish and high;
- It will cost you to be oil addicted and to cause fossil CO_2 emissions!

Strategic long term conclusion

➔ Strategically and financially very important for everyone dependent on fuels to secure the supply of renewable fuel!

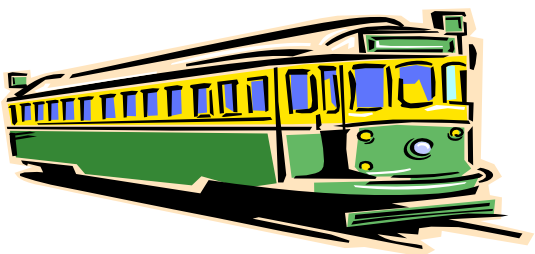
Only 3 ways to reduce oil dependency and fossil CO_2 from transportation!

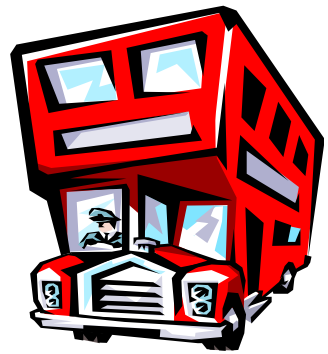
- Curb the uncontrolled growth of transport
- Increase energy efficiency
- Increase the use of biofuels

SL's goals

Rail Traffic

SL only uses electricity made from renewable sources
(wind, water, biomass)





Bus Traffic

- ➔ 25 % 2006
- ➔ 50 % 2011
- ➔ 100 % 2025

I.

Apply today's environmentally friendly standard solutions on a large scale! (Ethanol and biogas, etc.)

How to get there - Sustainability Philosophy

Support what you believe to be future solutions for a sustainable transport system! (Fuel Cells, Intermodality, etc)

II.

How to get there

SL - World Leadership on Renewable Fuels

➔ The future has always been just around the corner – at least since the 1970s…?

Battery Bus 1984

Electric Hybrid 1996-00

Flywheel 1984

Multiflex 1993

Gas 1984

Biogas 2003-

Accumulator 1989

Fuel Cell 2004-05

Ethanol, 1990-

How to get there

SL - World Leadership on Renewable Fuels

➔ CUTE - Test of 3 hydrogen Fuel Cell buses 2004-2005

- *27 buses in 9 EU cities*
- *Only water as exhaust*
- *FCs not commercial yet*
- *2 years in standard traffic with very high availability*
- *FCs + renewable fuels + hybridisation = An "optimal" vehicle in the future??*

Availability / Technical problems

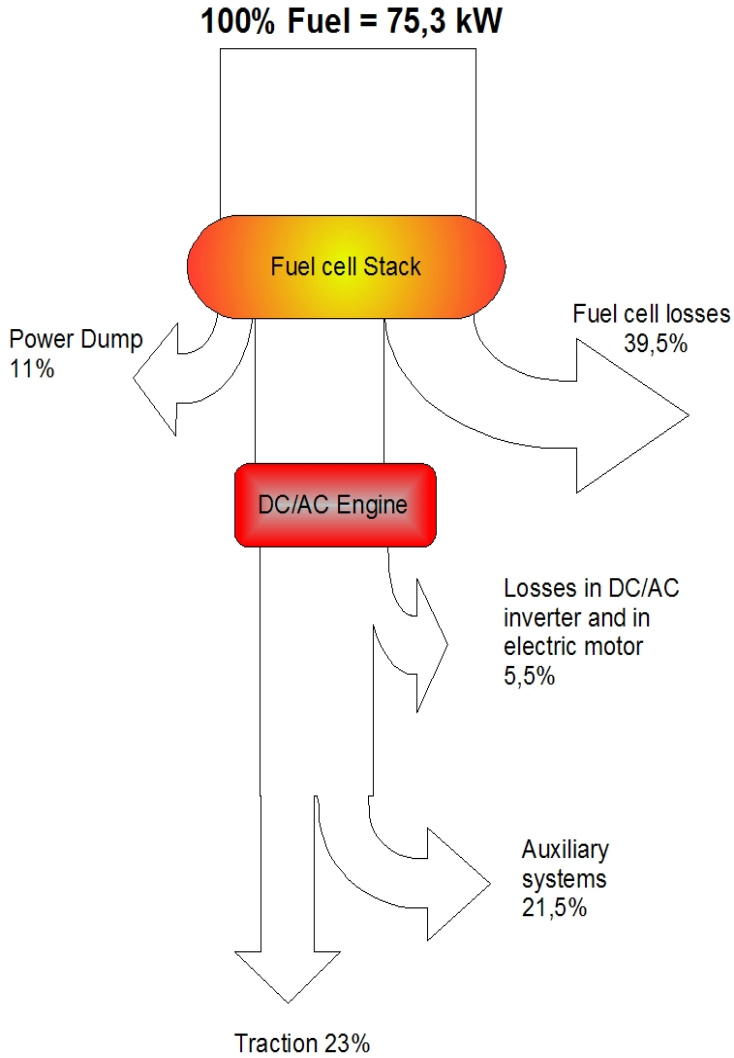
- Very high availability!
- Bus problems few and not related to FC but to auxillary systems, e.g. sensors, valves, electric components (inverter), pressure regulator, water tanks.
- Lack of spare parts
- High fuel consumption; 2.2-2.5 kg H_2/10 km (equals approx 7.5-8.5 l diesel/10 km)
- A proper ”FC-design” could increase energy efficiency dramatically
- Driving style important

Sankey diagram

Energy flow in the buses, average from test

Water route, July 2004

- Flat route in downtown traffic
- Low average speed: 10 km/h
- The fuel cell is regulated to not operate below a certain voltage. In times when this voltages is not needed for keeping the engine running the electricity produced is dumped.



Possible improvements

- Optimize control systems to avoid “power dumps” (14 %)
- Adapt auxiliary systems to Electric driveline (heating, gearbox, AC, generators, door openers…) (5 %)
- Regenerative breaking (20 %)
- Hybridization (20 %)

- Not cumulative, but a proper FC-design would save approximately 40 % of energy.

- ”Heavy-duty” quality and lifetime for components

- H2 infrastructure!
- Price – mass production
- Administration of hydrogen issues

How to get there

SL - World Leadership on Renewable Fuels

➔ One of Europe's largest Biogas Bus Fleets to be built up from 2004 and onwards

- *51 buses 2006 - 130 buses in 2009*
- *Secure, clean and long term (20-year contract with Stockholm Water Ltd Waste water/Sewage)*
- *Volumes only enough for small part of the bus fleet*
- *Very suitable for fleets of heavy vehicles*

How to get there

SL - World Leadership on Renewable Fuels

➔ The World's largest fleet of ethanol buses.

- *Since 1989*
- *256 buses 2005*
- *390 buses 2006*
- *Most cost efficient way to reduce both local and global emissions*
- *Liquid fuel simplifies infrastructure*
- *Only way to reach 50 % goal*

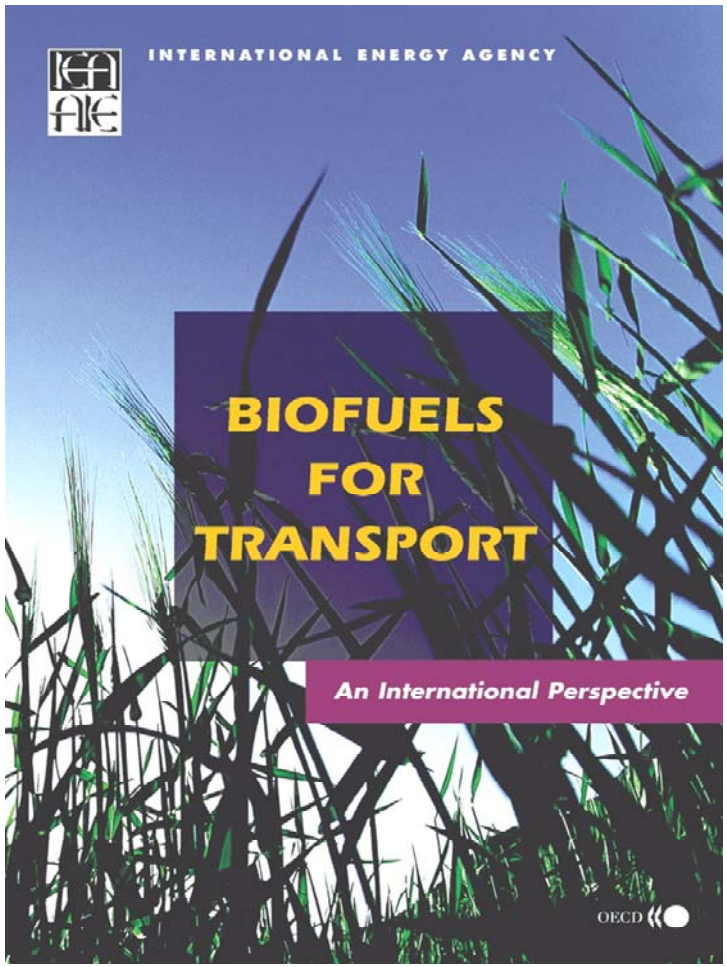
Ethanol - the Stockholm story

- Co-op SL – Scania
- Tax exemption granted for ”pilot projects”
- 30 buses tested in city traffic 1990
- Minor technical problems were solved
- Continuous introduction
- Inner city first (250 buses in 2000)
- Suburban traffic next (390 buses 2006)
- 25 % of all bus traffic runs on renwable fuel (2006)
- Goal is 50 % 2011

Net gain in Stockholm with ethanol and biogas buses

- ➔ 390 ethanol buses and 51 biogas buses (2006):
- ➔ Reduce diesel use with 16 million litres of diesel/year
- ➔ Reduce fossil CO_2 by approx. 41 000 tonnes/year
- ➔ Reduce particulates by approx. 4 tonnes/year

Few “neutral” views and reports on fuels around...

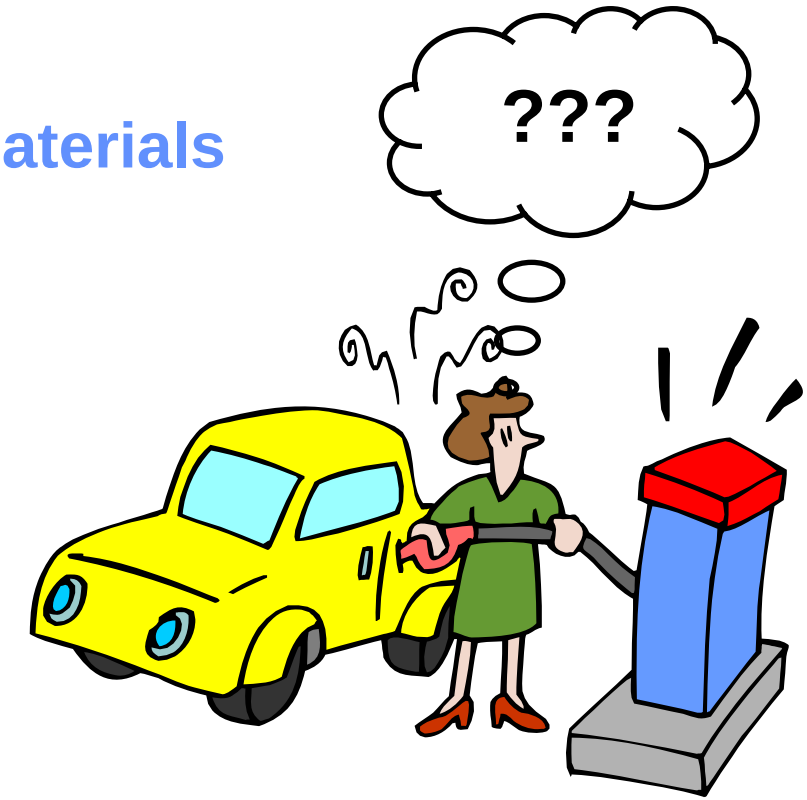


OECD
&
International Energy Agency (IEA)

www.iea.org/books

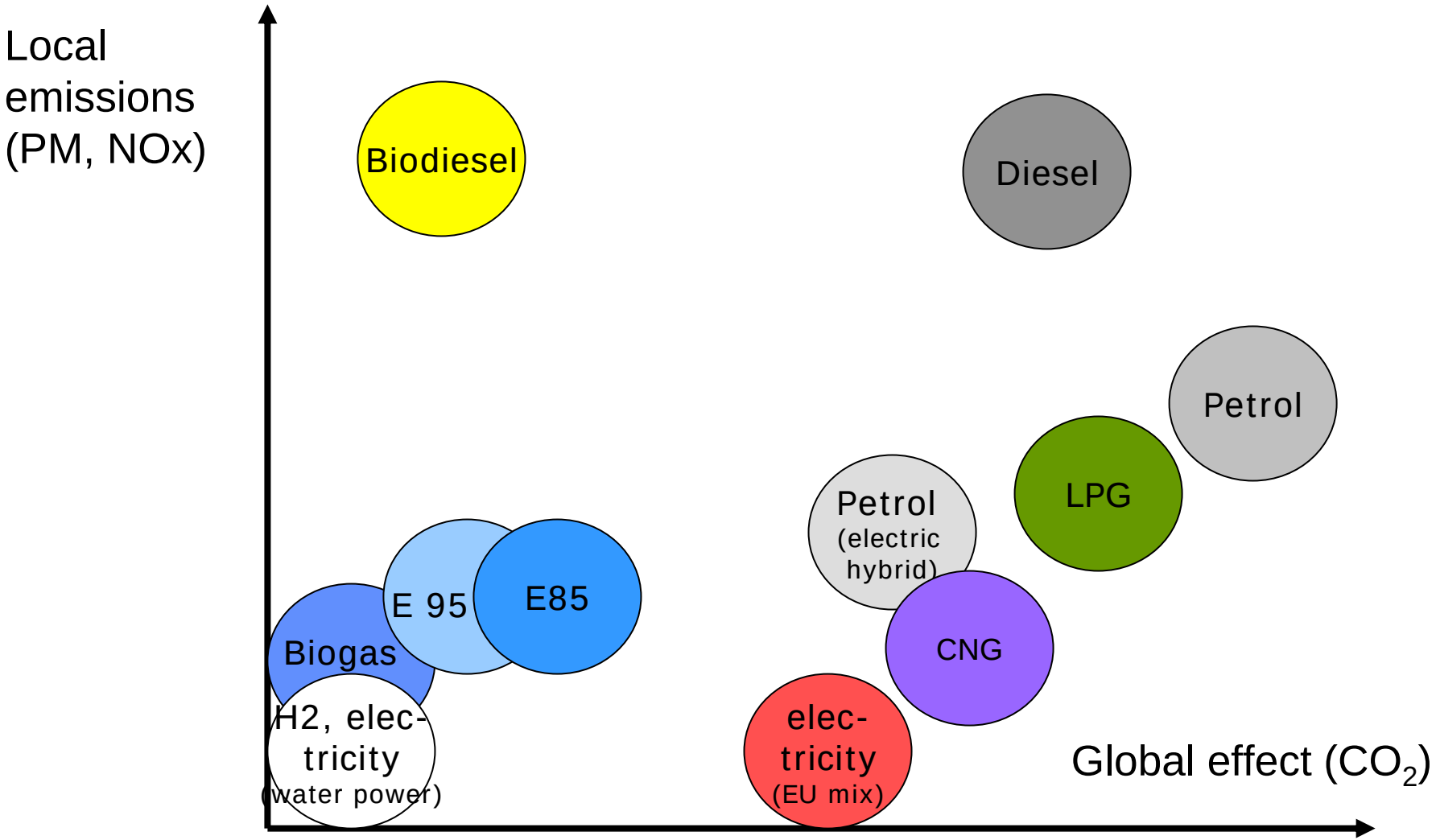
Fuels of the future…?

- **Ethanol from Sugar Cane**
- **Ethanol from Cellulosic Raw Materials**
- **Biogas**
- **Hybrids (any fuel)**
- **Fischer-Tropsch Biofuels**
- ***DME – DiMethylEther***
- ***Methanol, Hydrogen,***
- **…**



Must a product be perfect from every aspect to sell?

- ➔ There is always a better solution “just around the corner”…
- ➔ Optimal technology is not necessary…
- ➔ …it will sell anyway - if it is good enough and the timing is right!
- ➔ Transportation does not need another test project…
- ➔ …we need a functional, cost- and CO2-efficient product.



Summary of swedish studys on renewable fuels 2006, Inregia

Ethanol Bus Buyers' Consortium

An International Consortium for procurement of ethanol buses

- Kick-start the market for ethanol buses
- Transfer of 20 years of ethanol knowledge
- A test period with a small number of buses (5-30) for 1-2 years in pilot cities.
- If the test period is satisfactory, an introduction in a larger scale and in other cities, by the means of an International Buyers Consortium;
- **www.ETHANOLBUS.com**

ETHANOL BUS BUYERS´ CONSORTIUM

The BEST Proposal
EU-call on ”Biofuels in Cities”

BEST

– Bioethanol for Sustainable Transport

Ethanol cars	Ethanol buses	Low blends in petrol and diesel	Distribution	Incentives

Transfer of knowledge	Dissemination and Communication	Evaluation	Coordination

BEST BioEthanol for Sustainable Transport

Proposal to 6th Framework, Sustainable Energy Systems/Alternative Motor Fuels: BioFuel Cities

➔ Partners participating with buses:

- Stockholm
- Madrid
- Rotterdam
- Nanyang
- Sao Paolo
- Luxembourg
- La Spezia
- Slupsk
- BioFuel Region

ETHANOL BUS BUYERS´ CONSORTIUM

BEST

- **Transfer of knowledge**
  - Infrastructure
  - Political incentives
  - Campaigns, media work etc
- **European marketing**
  - Web sites, work shops, seminars, study tours, site visits
- **BEST friends** = close followers who can take advantage of the transfer of knowledge, etc.

The ethanol buses

The ethanol buses are standard Scania Omni buses with a 9 litres Scania diesel compression-ignition engine, slightly modified to operate on bioethanol bus fuel (E95).

ETHANOL BUS BUYERS´ CONSORTIUM

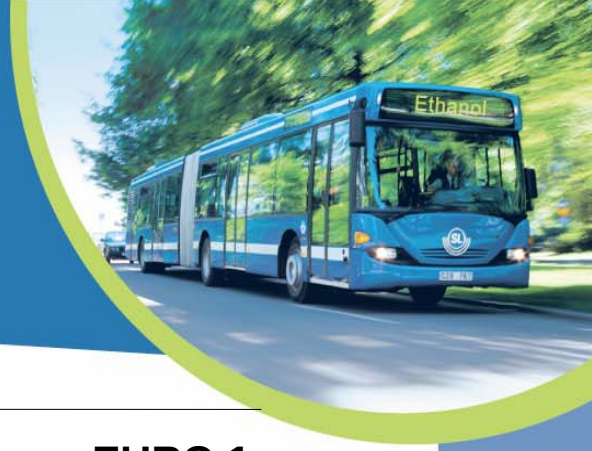
The fuel

- The ethanol fuel is developed for heavy-duty, ethanol compression-ignition engines.
- 95 % ethanol, 5 % ignition improver
- It fulfils the ethanol fuel standard given by Scania.
- Originates from renewable sources only.
- The fuel is produced and delivered by SEKAB located in Sweden.

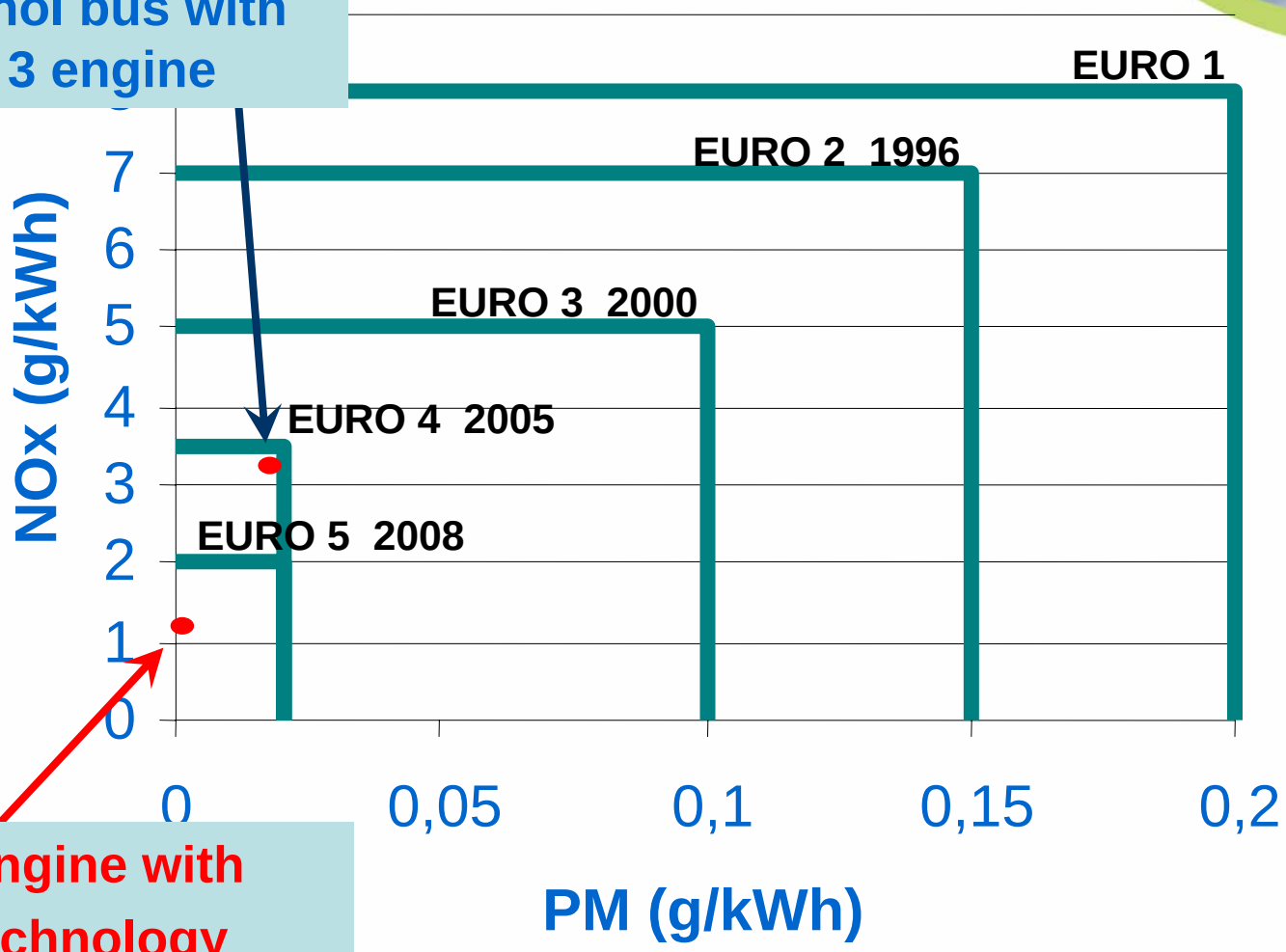
Refuelling bioethanol

- The bus driver will not observe any considerable differences. Refuelling ethanol is not different from refuelling diesel.
- For safety reason the fuel tank installation must be a dedicated tank for ethanol use.
- The fuel tank can be rented, leased or purchased from a number of companies that manufacture such installations.

Fulfils EURO 5 standard



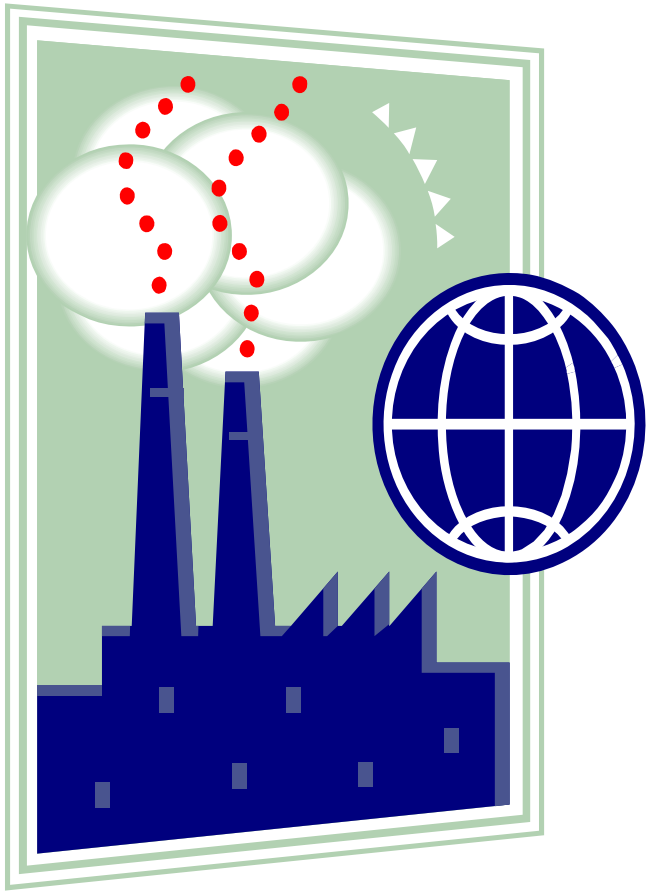
Ethanol bus with Euro 3 engine



Ethanol engine with today's technology

ETHANOL BUS BUYERS´ CONSORTIUM

Energy use worldwide

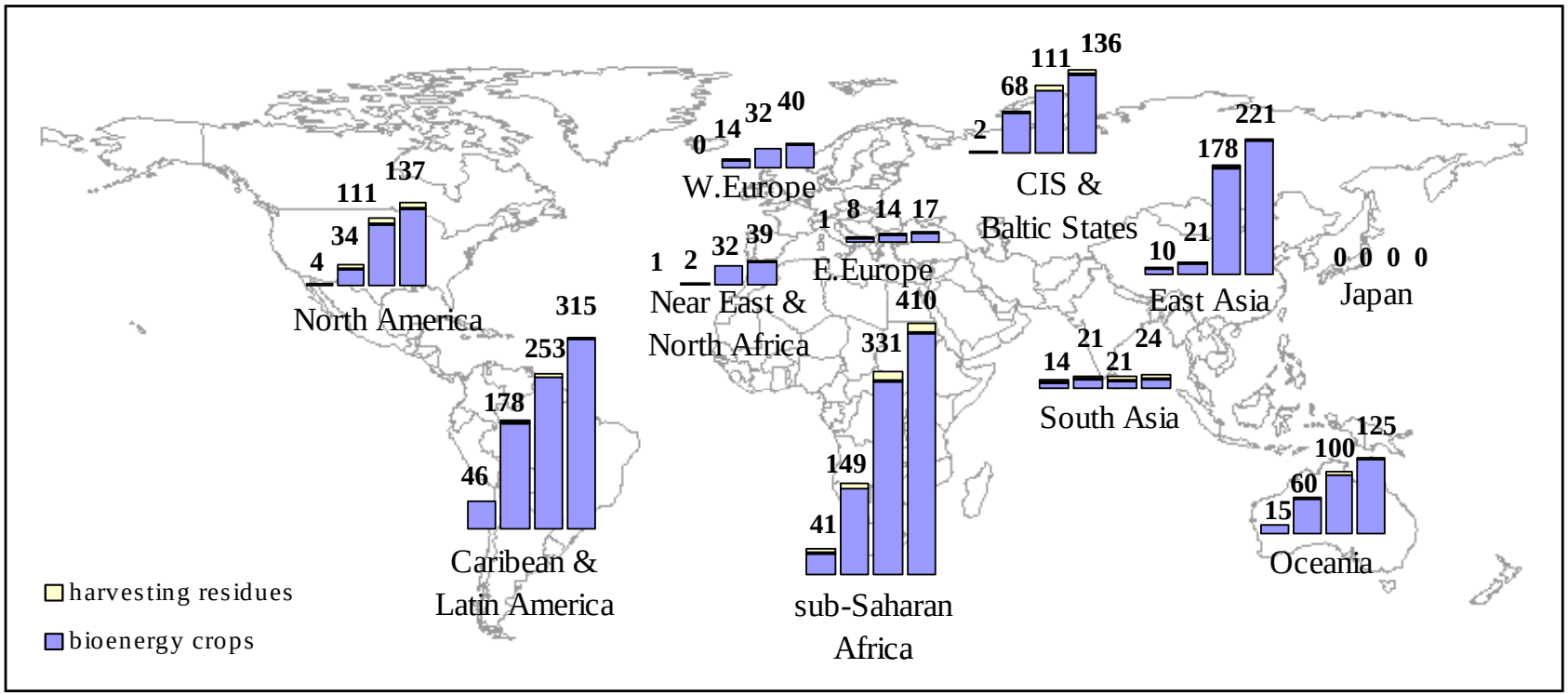


- Global Energy Demand:
  ~ 420 ExaJoule

- Transports:
  ~ 120 ExaJoule

Volumes of sustainable fuels

Bioenergy production potential in 2050 for different scenario's



Source: Smeets, Faaij 2004

Ethanol from sugar cane

J. Goldemberg et al. / Biomass and Bioenergy 26 (2004) 301–304

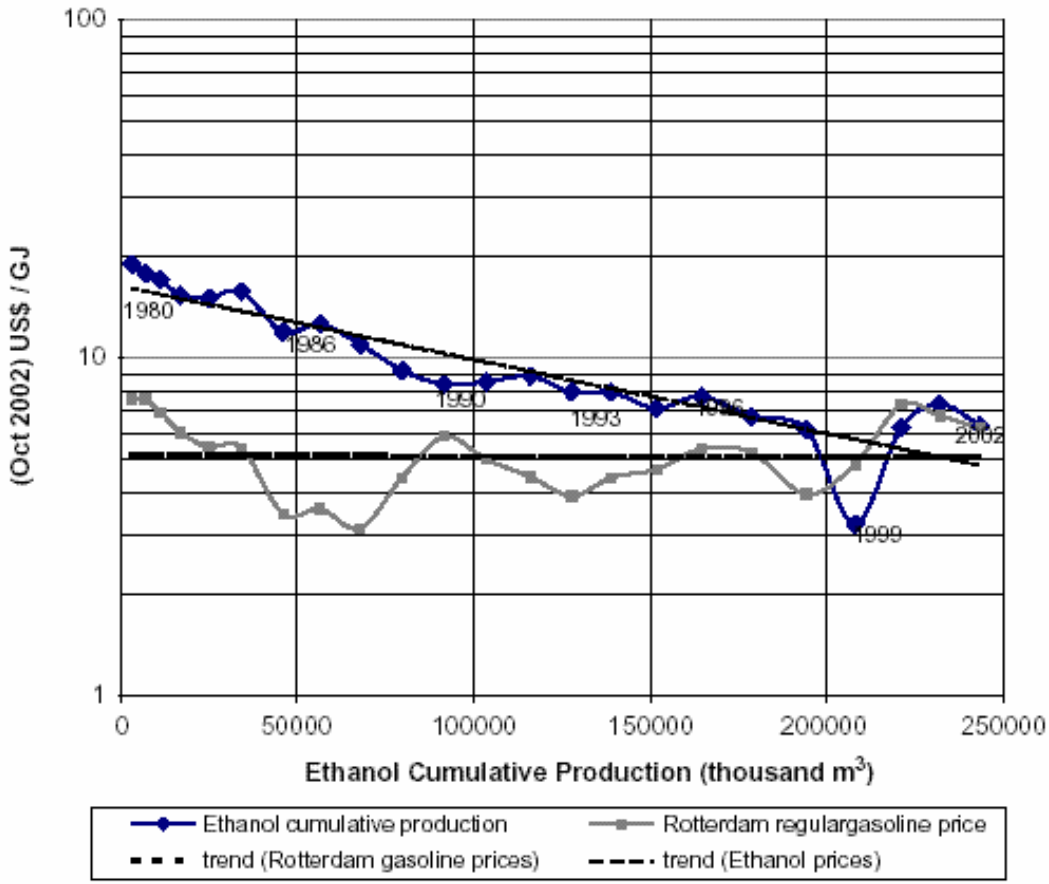
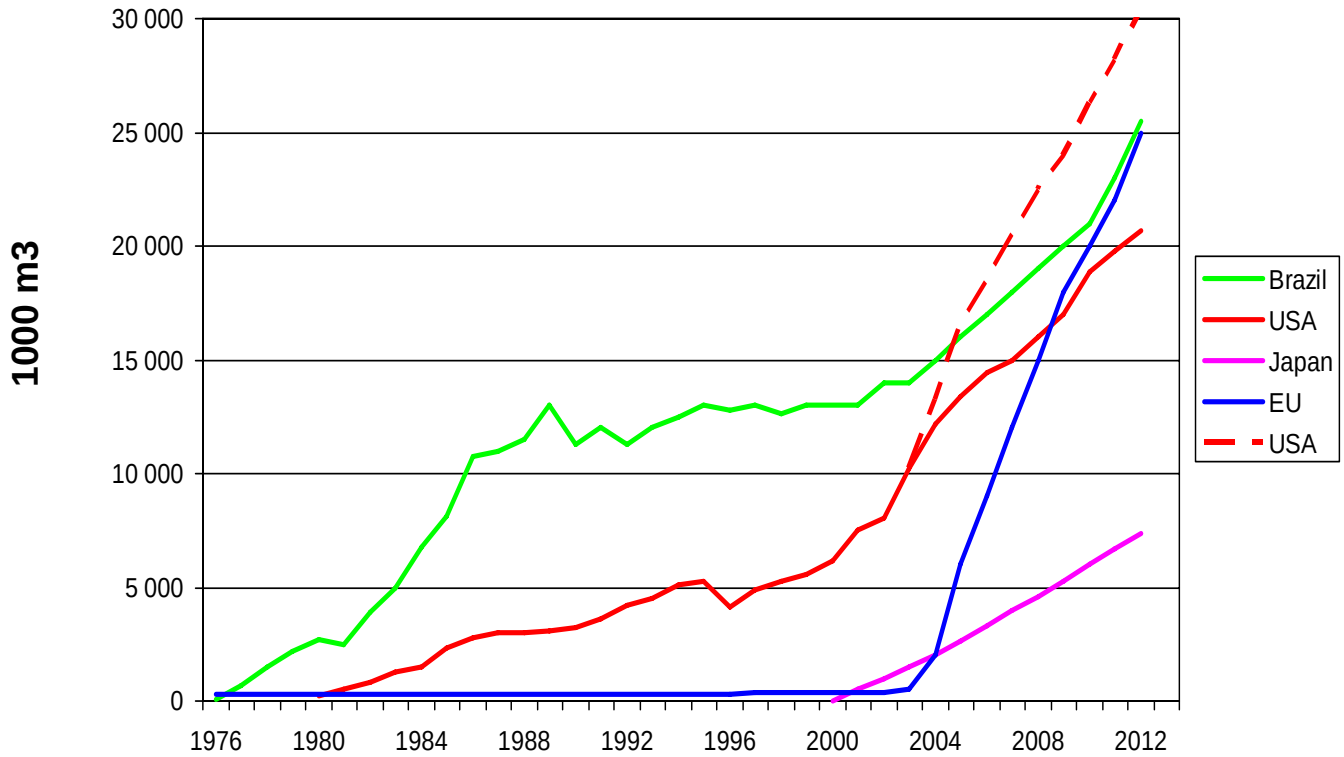


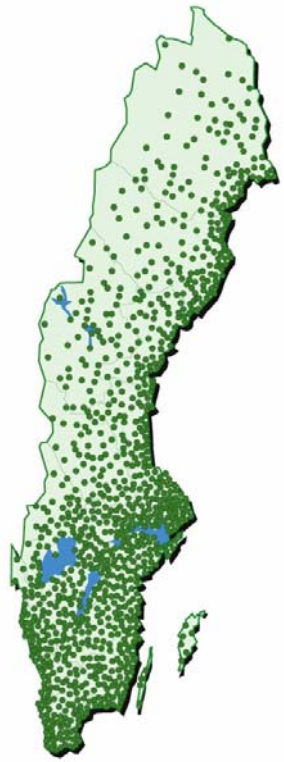
Fig. 2. Ethanol and gasoline prices.

Ethanol markets develops rapidly



Car industry has decided…

- E85 is the fuel that will be used to reach environmental goals
- 2000 pumps in 2008
- All major brands sell ethanol cars in South America
- Ethanol is the biggest fuel worldwide



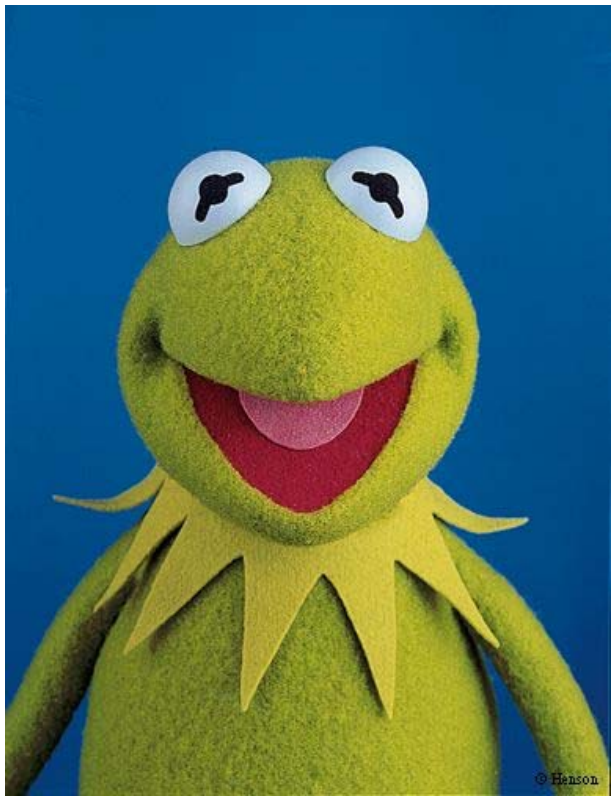
SL's conclusions

- Necessary to secure the supply of (renewable) fuel.
- Biogas and ethanol only functional and renewable fuels in the near future.
- Ethanol is the only renewable fuel with a large volume potential in the near future
- Ethanol is the financially most viable way to handle both global and local emissions
- Why wait? Sustainable Public Transport is already here. CO_2-neutral EEV standard with today's technology. Join the Ethanol Bus Buyers' Consortium.

”It’s ~~hard~~ to be green!” *

(*Kermit the Frog)

EASY



- Buses
  - Biogas and ethanol buses = available standard buses.
  - Dramatically reduces both global and local emissions.
  - Economy/km now equal (ethanol) or close (biogas) to diesel
- Infrastructure
  - Biogas and ethanol has a standard infrastructure.
  - Leasing of a fuelling station possible.
- Fuel
  - All cities can produce biogas.
  - Ethanol is the World’s biggest renewable fuel.
  - Available in large volumes in many countries.
  - Fully taxed ethanol in Brazil is cheaper than petrol.
  - The future potential of sustainable fuel from biomass is higher than today’s consumption.

End of Presentation

Thank You!

www.SL.se (om SL – Miljö)
www.ETHANOLBUS.com
www.fuel-cell-bus-club.com

Service object	Ethanol	Diesel
Number of Services	6	6
Fuel pipe change	1	
Fuel filter change	6	1
Oil and filter change	6	3
Injector change	3	

Service compared to a diesel bus

- Articulated bus 60 000 km/year in city traffic;
- For the next generation of Ethanol buses, service level is expected to be the same as for diesel buses.